



Inspiring the Educators:

Summary of feedback relating to the
teacher training workshops delivered
by individual partners and nodes

Karen Bultitude

UCL

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“Children need inspiration. This is a wonderful way!”

(Primary school teacher, Bulgaria)

Executive Summary

Guidelines for running bespoke face-to-face teacher training workshops were developed as part of the Space Awareness project. These training sessions were designed for primary and secondary teachers from any discipline. Workshops included hands-on activities and theoretical sections, and were designed for approximately 3-hours' total duration, though allowing for reduction, extension and combination as best suited the delivery node partners. Between September 2016 and June 2017 **34 teacher training courses were delivered within the Space Awareness project, reaching over 480 educators across 15 countries.** In total, **at least 22,152 students** were reported to receive a direct influence from Space Awareness due to their teachers' participation in the training workshops.

Teachers from across the different school levels were involved, **from pre-school (kindergarten) through to secondary school level**, with the majority (59%) being secondary school teachers, and a further quarter (27%) from primary level. Of those who specified a subject specialism, just over two-thirds of respondents currently taught STEM-related subjects (science, technology, engineering or mathematics). However, the project did also have some success in reaching beyond the traditional sciences, with **over 10% of respondents specialising in subjects outside STEM** – in particular geography¹ (7%) but also music, economics and other (mainly humanities) topics.

Standardised pre-/post- teacher surveys combined with feedback from workshop organisers were used to evaluate the impacts of the teacher training workshops delivered. Overall they were perceived to be of very high quality: **over 99% of participants rated the workshop they attended as at least "Good"**, with **at least 50% in every country giving the highest rating of "Very good"**. Compared to their wider cohorts, the courses were **particularly well received by geography teachers and females**, with at least 80% in each case giving a rating of "Very good", suggesting that the project succeeded well in targeting these groups. Pre-school (kindergarten) teachers were slightly less positive than teachers at other levels. Overall, **98% of respondents would both recommend the course** to a colleague or friend, and also be interested in participating in a similar course again. Participants were **particularly supportive of the relevance of the training workshops to teachers outside traditional STEM subjects.**

Perceived strengths focused on **the practical nature of the activities**, and the **quality and specific content of the tools and resources provided**. Teachers also spontaneously reported other key aims of the workshops as important success factors, for example enhancing teachers' ICT and inquiry skills, raising their awareness of the cross-disciplinary relevance of space science, or providing an opportunity to share ideas (especially with other teachers). Courses that were 90-minutes or shorter tended to leave participants feeling that they hadn't been able to fully engage with the content (especially the practical activities). Teachers also reported **wanting more explicit links between the activities and their local curriculum**, as well as **more activities for younger or lower ability students**. In certain countries the **lack of availability of resources in the local language** was a frustration to teachers and workshop organisers alike.

¹ Some countries include geography within the overall STEM umbrella, whilst others do not; for clarity we have considered it separately here.

Theme	Priority intended learning outcome				Rating
Feel	i. Feel inspired by space science				Strong evidence this outcome was achieved
	ii. Feel positive about space science				
Value	iii. Value the diverse contributions of many different cultures to space science				Strong evidence this outcome was achieved
	iv. Appreciate that school science is relevant to space science				
	v. Appreciate that people who work in space science are real people				
Understand	vi. Space science can be used for teaching in many disciplines including cross-disciplinary contexts and non-science subjects				Strong evidence this outcome was achieved
	vii. Understand space science career opportunities are diverse, rewarding and highly accessible (particularly to girls and ethnic minorities)				
	viii. Space science is a global/European endeavour				
	ix. Career opportunities in space science and technology at all levels				
Do	x. Access and use Space Awareness activities confidently				Strong evidence this outcome was achieved
Skills	xi. Develop inquiry-base skills for teaching/learning about space science				Strong evidence this outcome was achieved
	xii. Learn how to use IT to teach/learn about space science				
	xiii. Learn how to be more inclusive while teaching, particularly for girls and minorities				
Strong evidence this outcome was achieved	Strong but sporadic evidence this was achieved	Some evidence this outcome was achieved	Evidence this outcome was NOT achieved	No evidence either way	

There was **strong evidence that all 13 priority learning outcomes were achieved** within the Space Awareness teacher training workshops. These are outlined in detail in section 4. In brief: it is clear that participating teachers (and their students) felt inspired by space science, and gained a greater appreciation of the relevance of school science. Teachers (and students) demonstrated strong abilities to access and use the Space Awareness activities, and were confident in doing so. Teachers also reported better understanding of both space science as a global/European endeavour, and the associated career opportunities. Through both quantitative and qualitative feedback it was clear that the inquiry-based approach was highly successful and valued by the participating teachers, and that they gained a better appreciation of and value for space science as relevant across many disciplines. This last point is perhaps particularly interesting as **multiple workshop organisers expressed overt enthusiasm and even surprise at how successful they were in engaging and involving teachers from disciplines outside science**. The fact that this outcome was achieved not only within the teacher cohort, but also for the workshop organisers suggests that it may have wider knock-on effects for future training programmes run by those individuals.

Both quantitative and qualitative feedback from participants indicated **that the courses had impacted on them (and/or their students) across a range of emotional, attitudinal, behavioural, intellectual and skills-based domains**. Despite fairly high levels of reported confidence prior to the course, there were **notable increase in participants' familiarity and/or confidence with space science careers, inquiry-based teaching approaches and strategies for managing diversity in the classroom**. Even

those who were already familiar with such strategies reported a greater depth was added to their existing knowledge, for example:

"I have learned about inquiry in the past and the idea is much more clear for me now [after this workshop]." (Secondary school teacher, Portugal)

Overall these results suggest that even for participants to whom some of the key content was familiar, the training workshops were successful in strengthening their existing skills and strategies in a positive way.

Some teachers specifically highlighted **noticeable impacts on individual students**, relating to a variety of outcomes including **inspiration, progression, sharing their knowledge and enthusiasm with others, as well as improving individuals' self-esteem**.

"One student who had more or less been asleep all year came alive when she heard of the big bang theory - and was really mad that my answer was 'I don't know, they don't know!' Mad enough to go home and read more, and have more questions the following day. This student isn't experiencing much academic success in other areas of school, but in Science participates and is developing some good physics skills. Regardless of whether she pursues any career in Science, the inspiration has kept her engaged and been really great for her self-esteem in particular with regards to Science."
(Secondary school teacher, Ireland)

Building on the findings reported here, ten **recommendations** have been developed to help inform future similar programmes. These are outlined separately in section 4.1. To summarise: Certain aspects of the workshop materials, and the resources and activities provided, were identified as being particularly **successful and worth replicating again in future similar projects**. These included the high quality of the training materials themselves; the flexible model of delivery (which allowed for local variation to the course content, focus and duration); the practical nature of the activities and resources; and the success in targeting teachers from outside traditional STEM subjects (particularly geography but also wider humanities subjects). Likewise, certain **specific improvements** were noted, including: improving the uptake of certain course contents; further adapting the courses and activities to suit pre-school (kindergarten) ages or lower ability students; more overt links to local school topics or curricula; and reducing the level of background mathematics (for the students) or wider knowledge (for the teachers) required to complete some of the activities. Finally, there were some **logistical factors** noted, for example workshop timings affecting uptake, and the difficulties in collecting 'sensitive' data regarding student cohorts (especially minority status but also gender) in many countries.

Overall these results are extremely positive. There is evidence that all of the intended priority outcomes were achieved within the teacher training workshops, and that they are likely to have encouraged a shift in the everyday practice of teachers across Europe (and beyond). There is already evidence of subsequent impacts on learners' individual experiences which will be beneficial far beyond the life of the project.

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1 Introduction

Guidelines for running bespoke face-to-face teacher training workshops were developed as part of the Space Awareness project. These training sessions were designed for primary and secondary teachers from any discipline. Workshops included hands-on activities and theoretical sections, and were designed for approximately 3-hours' total duration, though allowing for reduction, extension and combination as best suited the delivery node partners.

The training courses developed were²:

- A: Space Awareness by topic:
 - A1 - Our Fragile Planet
 - A2 - Navigation through the Ages
 - A3 - Our Wonderful Universe
- A (additional option): developing ICT skills with space
- B: Introducing space sciences and careers in education
- C: Space for global citizenship

Each workshop was delivered by a Space Awareness delivery node or partner. The Space Awareness dissemination nodes are national organizations ideally positioned to increase the project's outreach and to provide valuable input into the Space Awareness activities. They are an integral part of the exchange of expertise and material between educators in EU member states and throughout the world. Since the beginning of the project, the network of dissemination nodes continued to evolve and attract new members committed to the popularisation of space science and space careers. In October 2017, the Space Awareness network counted 14 national organisations acting as "formal" dissemination nodes, 6 national organisations acting as informal nodes and supporting the project on a volunteering basis, as well as 4 node organisations which are also project partners.

The dissemination nodes chose the training format and scope to suit their local, regional and/or national needs, building on the guidelines provided and using local specialist knowledge to best ensure the courses were suitable for the teachers attending. The courses were designed to be followed up by an activity to be implemented by the teacher/educator with children and an exchange with the workshop organiser regarding the implementation experience. All trainings were complemented or combined with the use of the free online Space Awareness resources, including further online course materials. The intention was that pre- and post- workshop activities (such as an online needs and priorities analysis and a follow-up discussion between the workshop organiser and participating teachers) would assist to ensure that the workshop learning was embedded within the teachers' everyday practice. The evaluation mechanisms described in section 2.1 formed a specific component of the workshop guidelines (see Annexe 9), and

² Nodes were also offered the option to incorporate Space Awareness elements within their own existing space education training (described as type "Workshop D") rather than run a separate dedicated course. In this situation they were not expected to use the evaluation tools reported here.

as such were distributed directly with the workshop contents and instructions. The nodes themselves were thus responsible for managing the evaluation data collection with their participating teachers. Where possible the evaluation forms were provided electronically for ease of amendment, completion and submission, though some individual nodes did elect to distribute them in hardcopy where that was more suitable for local use.

Formal dissemination nodes from 11 countries were each expected to run at least one workshop for around 20 teachers as part of their involvement in Space Awareness. Ten formal dissemination nodes organised their activities before October 2017 and thus have been included in this report³. In addition to those workshops, Space Awareness training sessions were also carried out by informal nodes in Turkey and Nigeria, as well as by the Space Awareness project partners in Germany, Greece and Portugal. Dissemination nodes in Latvia and Spain are expected to deliver further teacher training workshops before February 2018, however their data are not included in the present analysis.

Each workshop had clearly defined (though different) learning objectives for participants, based on the Space Awareness intended outcomes. Table 1 provides a map regarding which workshops targeted which particular intended outcomes.

Face-to-face training workshop learning objectives mapped to the Space Awareness Intended Outcomes	A1 – Our Wonderful Universe	A2 – Navigation through the Ages	A3 - Our Fragile Planet	A (extension) - Developing ICT skills with space	B - Introducing Space Sciences and Careers in Education	C - Space for Global Citizenship	Overall (total from all workshops)
<i>Green outcomes were highest priority; Grey indicates additional outcomes of slightly lower importance than the rest</i>							
Feel <i>Enjoyment, inspiration and creativity = MAJOR PRIORITY CATEGORY</i>							
Find Space Awareness activities interesting	X	X	X	X	X	X	X
Enjoy learning about space	X	X	X	X	X	X	X
Feel inspired by space science	X	X	X	X	X	X	X
Feel positive about space science	X	X	X	X	X	X	X
Aspire to space science careers							
Value <i>Values and attitudes = MAJOR PRIORITY CATEGORY</i>							
Value the diverse contributions of many different cultures to space science					X	X	X
Value the contributions made by both women and men to space science					X	X	X
Value trans-national European and Global citizenship	X		X			X	X
Appreciate that space science contributes to everyday life	X	X	X				X
Appreciate that school science is relevant to space science	X	X	X	X	X	X	X
Appreciate that people who work in space science are real people					X		X

³ Space Awareness dissemination nodes from the following countries organised their training before October 2017: Belgium, Bulgaria, Czech Republic, France, Ireland, Italy, Poland, Spain, Romania and the United Kingdom (Wales).

Face-to-face training workshop learning objectives mapped to the Space Awareness Intended Outcomes	A1 – Our Wonderful Universe	A2 – Navigation through the Ages	A3 - Our Fragile Planet	A (extension) - Developing ICT skills with space	B - Introducing Space Sciences and Careers in Education	C - Space for Global Citizenship	Overall (total from all workshops)
<i>Green outcomes were highest priority; Grey indicates additional outcomes of slightly lower importance than the rest</i>							
Understand <i>Knowledge and understanding</i>							
Highlights of space science (Our Wonderful Universe, Our Fragile Planet and Navigation through the Ages)	X	X	X	X	X	X	X
Space science can be used for teaching in many disciplines including cross-disciplinary contexts and non-science subjects	X	X	X	X	X	X	X
Understand space science career opportunities are diverse, rewarding and highly accessible (particularly to girls and ethnic minorities)					X		X
Space science needs an interdisciplinary approach	X	X	X	X	X	X	X
Space science is a global/European endeavour	X	X	X	X	X	X	X
Career opportunities in space science and technology at all levels					X		X
Relevant pathways to these career opportunities					X		X
Do <i>Action, behaviour and progression</i>							
Access and use Space Awareness activities confidently	X	X	X	X	X	X	X
Want to learn more about space science	X	X	X	X	X	X	X
Choose or consider choosing, or encourage others, to study and pursue careers in space science and engineering or science and engineering more widely, especially girls and ethnic minorities					X		X
Share their understanding of space science and technology with learners, peers, family and/or their community							
Skills							
Learn how to carry out scientific or technical activities themselves	X	X	X				X
Develop inquiry-based skills for teaching/learning about space science	X	X	X				X
Learn how to use ICT to teach/learn about space science				X			X
Learn how to be more inclusive while teaching, particularly for girls and minorities					X	X	X

Table 1 - Map of intended outcomes for each training workshop

2 Data collection and analysis

Accompanying the workshop delivery materials was a suite of evaluation tools for nodes and partners to use, available both online and as documents to be printed locally in hardcopy. There were no contractual obligations regarding the number of feedback forms returned, however nodes were asked to ensure that wherever possible forms were completed by all teachers involved (aiming for at least 20 per node). Section 2.1 describes the evaluation protocols and tools that were developed relating to the teacher training workshops, whilst section 2.2 provides an overview of the data analysis procedures undertaken.

2.1 Evaluation tools and protocols

The face-to-face workshop evaluation deliberately incorporates both temporal and participant triangulation; participants are asked to provide their views at different stages of their involvement, and inputs are sought from both the teachers themselves, as well as the workshop organisers. Wherever possible the evaluation approaches have been designed to tie in with existing activities associated with the workshops in order to simplify the processes involved and make the evaluation a meaningful reflective element of the workshops themselves.

Evaluation data for the face-to-face training workshops was collected centrally from the nodes using the following online forms⁴:

1) Teacher feedback⁵:

- a. *Teacher training - pre course* form [Annexe 1, n=112]: An initial short survey was distributed directly to teachers prior to the course running to provide a baseline indication of teacher experience and perspectives. Basic (anonymised) demographic information collected at this stage also assisted in providing context for the teachers' subsequent responses.
- b. *Teacher training - post course* form [Annexe 2, n=124]: An online survey was also distributed directly to teachers after the course (sometimes within the course itself to encourage greater uptake of response). This survey incorporated both their reactions to the course itself as well as reflections on any changes to their own perspectives or likely future behaviours. Specific feedback regarding the course itself included the opportunity to rate the course overall, which aspects they did or didn't enjoy, and what improvements they might suggest in future.

⁴ The survey package [Opinio](#) was used to implement all the online surveys described here. Where appropriate the survey text was translated into local languages to encourage greater uptake.

⁵ Where pre/post course surveys were distributed electronically a unique identifier number was used to link the responses together; not every participant completed both elements hence the numbers across the two surveys differed. 225 responses were able to be tracked across both surveys, with 280 responses to the pre-course survey, and 293 responses to the post-course survey.

Additionally, teachers were asked to rate simple statements⁶ relating to the Space Awareness intended outcomes (see Table 1). These statements helped ascertain to what extent the teachers felt the workshop objectives were met. The statements differed depending on which workshop the teacher attended, however some of the statements targeted by other courses were also included in order to provide control indicators. This approach was designed to enable robust comparison regarding whether different courses effectively achieved their stated objectives (e.g. did courses that focused on careers elements achieve higher 'agree' results for those questions than other courses with no careers component).

- c. *Teacher training - data entry for nodes* [Annexe 3, n=169]: In some cases, nodes preferred to distribute hardcopy versions of the above forms⁷. In this case nodes then provided the data for central analysis electronically via a bespoke online survey designed specifically for that purpose. Where responses were originally provided in the local language the nodes took responsibility for translating them into English.

2) Workshop organiser feedback:

- a. *Workshop feedback form - course organisers* [Annexe 4, n=12, representing 6 countries: Bulgaria x2, Ireland x1, Italy x1, Poland x2, Portugal x2, Spain x4] – An electronic questionnaire allowed workshop organisers to feed back on the course itself from their perspective (covering similar aspects to the teachers' form described above). There were opportunities to report back on how many teachers attended, (approximately) what their backgrounds were, and any specific successes or challenges they encountered. Workshop organisers were also asked to indicate to what extent they felt their course met each of the Space Awareness intended outcomes. This element was included in order to provide local insights into priorities and content, and to provide further context for the teachers' responses in this regard. This form also captured any additional anecdotal comments or reflections from the teachers that may have arisen during the workshop. Workshop organisers completed this element as soon as possible after the training.
- b. *Follow up feedback form - course organisers* [Annexe 5, n=4, representing 4 countries: Bulgaria, Ireland, Poland and Romania] – After the workshop the teachers were expected to implement an activity from the workshop within their classroom, and to participate in a subsequent discussion with their local course organiser. A series of prompt questions were provided to the workshop organisers to assist in facilitating these discussions; the main points were then captured by the workshop organisers (where possible actually during the discussions) and fed back to the evaluation team. The prompt questions again included contextual information on the level of engagement and backgrounds of the teachers involved, as well as aspects relating to how well teachers were

⁶ Different versions (each consisting of a subset of statements) were created for each of the different workshop types in order to reduce the burden on individual respondents.

⁷ In this case the pre-course survey was printed on one side of the paper, and the post-course survey on the other, in order to avoid any problems in separating the two datasets.

able to implement the Space Awareness activities in their own classroom, and any successes or challenges encountered.

- c. *Workshop reporting template* [Annexe 6, n=26] – As part of their contractual reporting requirements nodes were expected to provide a short summary of their workshop, regardless of what type it was (including Type D). This included basic information such as the date and duration of the course, the number and type of participants, the workshop focus and/or content covered, as well as examples of photos and materials used.

Additionally, participants were invited to complete the (optional) *Research registration* form [Annexe 7, n=50 teachers]. This form was designed to be completed by both teachers and workshop organisers to potentially enable longitudinal follow-up after 1-3 years. Since many of the workshops occurred in May – June 2017 this follow-up did not occur within the lifetime of the Space Awareness project, however this baseline will allow us to explore the longer-term impacts of the programme should further funding be secured in the future.

An overview of the evaluation protocols for the teacher training workshops is available in Annexe 8. This document was designed to assist nodes in implementing all of the above elements.

The teacher feedback forms were completed anonymously, though some basic information regarding teacher backgrounds was requested for context purposes. Likewise, the workshop organiser forms were completed anonymously and additionally they were managed directly by the Space Awareness Evaluation lead organisation (UCL) in order to encourage node representatives to be as open and honest as possible in their feedback.

Overall, the combination of these various elements was designed to provide both a robust comparison across different workshops held in different locations, whilst still ensuring sufficient local context to be able to usefully interpret local results.

2.2 Analysis

The majority of the data collected was quantitative in nature, and was handled using descriptive statistics in Microsoft Excel, including cross-tabulations to explore variations by category, for example by country or participant gender. In the main this report focuses on breakdowns at country level in order to facilitate feedback and comparison by the partner delivery nodes.

In the case of open-response comments, these were first translated where necessary (using an online computerised translation tool⁸) and then manually coded into common thematic categories.

⁸ <https://translate.google.co.uk>

3 Summary of results

This section summarises the main findings from the training workshop feedback datasets. Section 3.1 provides an overview of the courses delivered, including their type and duration as well as their geographic reach. Section 3.2 focuses on the course participants, exploring their backgrounds and levels of experience, as well as basic information about the students they teach (where possible). Section 3.3 presents the overall course ratings and a summary of the open-response feedback provided, whilst section 3.4 draws together evidence regarding what outcomes were achieved as a result of the courses delivered. Finally, section 3.5 considers the extent to which the participating teachers were able to embed learning from the courses into their everyday teaching practice.

3.1 Courses delivered

In total, 34⁹ teacher training courses were run as part of the Space Awareness programme, across 15 countries (Figure 1). The most common of these courses (n=14) were Type A1 – Our Wonderful Universe, though all of the Space Awareness course types were delivered by at least one node (Figure 2).

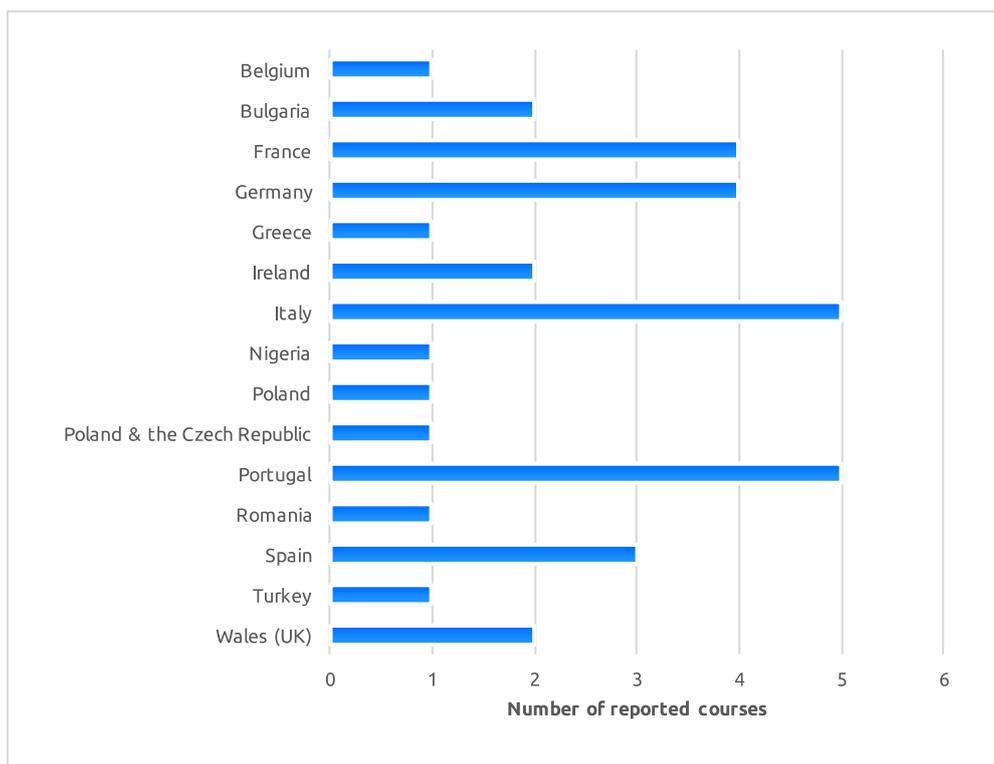


Figure 1 - Space Awareness teacher training courses delivered (by country) [n=34]

⁹ Eight of these courses were run after the data collection window closed for this report, so their data are not included in further figures here. Additionally, as described in section 1, courses which ran type “D” training were not expected to use the evaluation tools described here.

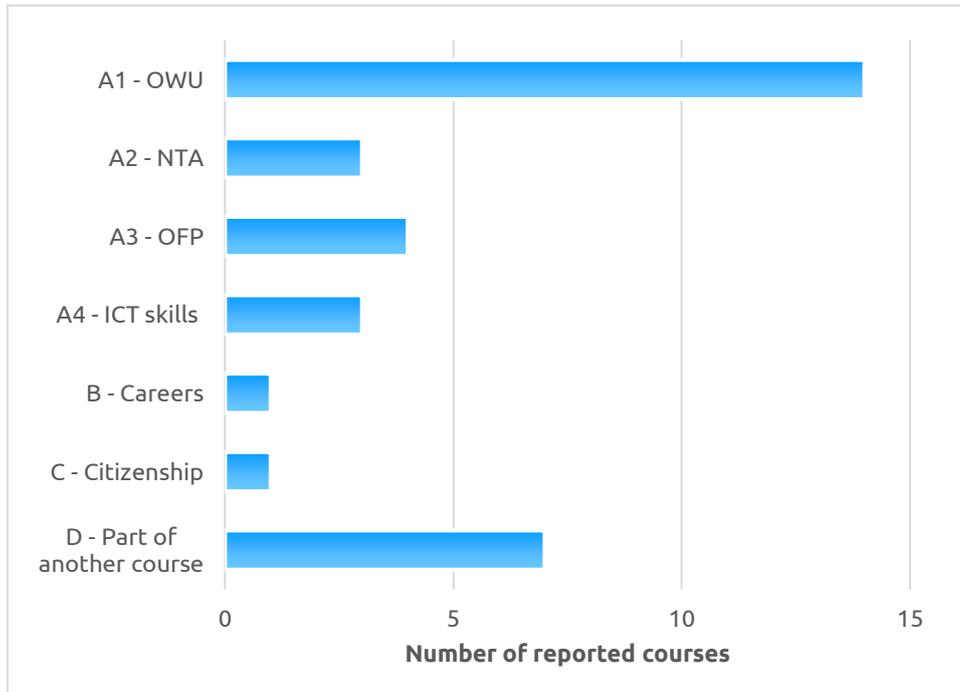


Figure 2 - Type of course delivered (note that many nodes reported delivering content from multiple different course types within the same session) [n=25]

Course organisers were not explicitly asked why they chose to run a particular course, so the reason for the strong popularity of the Our Wonderful Universe course is not certain. Given that many of the organisers had astronomy backgrounds it is likely that it may have required less effort for many delivery nodes to prepare, and/or could build on their existing materials and resources.

This perspective changes however if we look at the number of reported participants per course type (Figure 3), where it is clear that although not many courses of type A3 (Our Fragile Planet) were offered, they attracted relatively strong levels of participation, representing approximately one-quarter of the overall cohort.

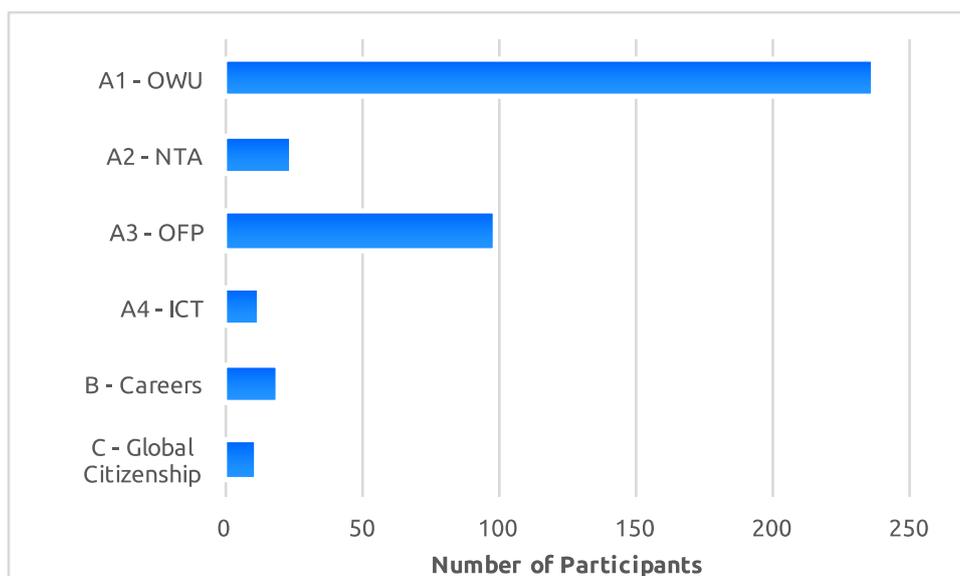


Figure 3 - Reported distribution of participants by course type [n=405]

Figure 4 provides an overview of participant numbers broken down by country. It is clear that the majority of project partners and dissemination nodes met or exceeded the target of 20 teachers per country. Indeed, Italy (83), Portugal (73) and Bulgaria (62) reached more than three times the intended target. Workshop timings were reported to have particularly affected uptake in Ireland and Spain, with both those countries having attracted many more registrations, but suffering from many participants not turning up on the day.

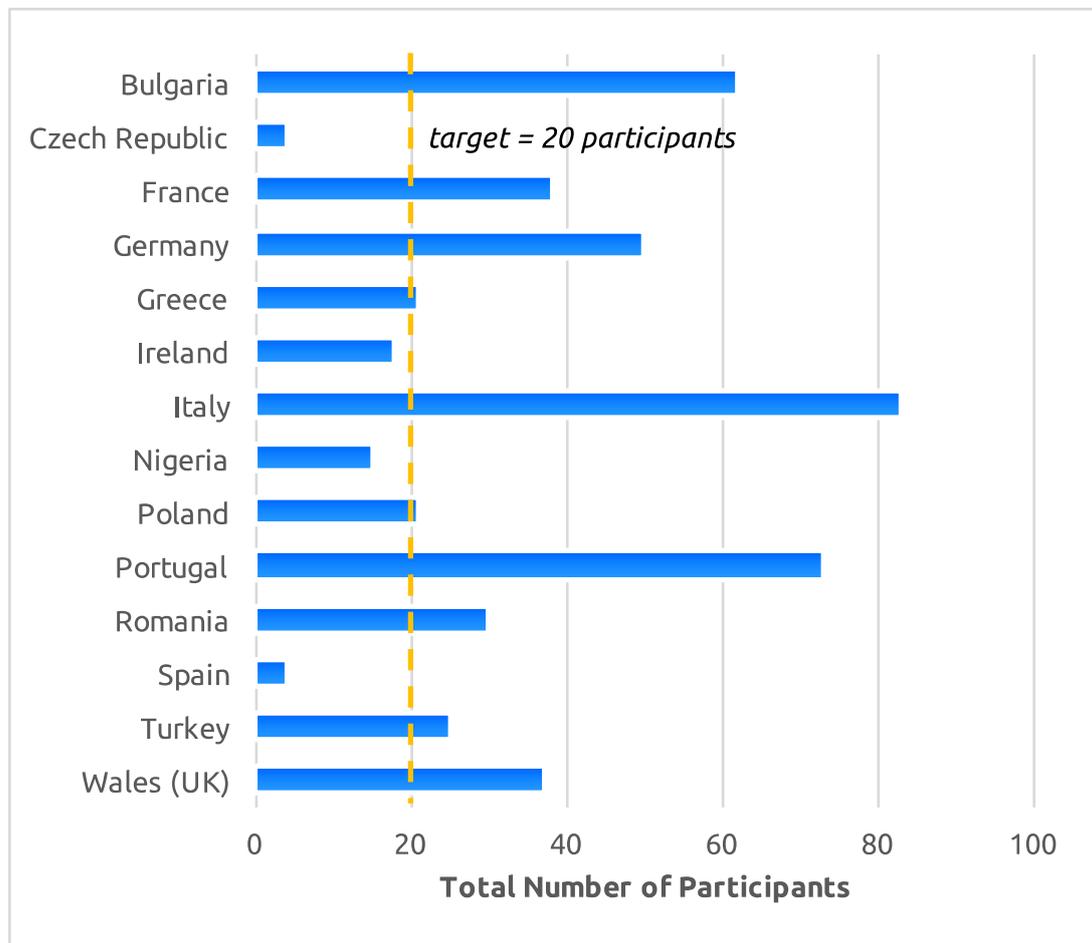


Figure 4 - Participant numbers per country as reported by the nodes. (Note that participant numbers from the final courses run by Latvia and Spain were not available at time of writing so those totals are currently incomplete)

There was a fairly substantial variation in the reported course durations, ranging from short 1-hour workshops as part of a larger event, to multi-session commitments spread over a number of weeks (Figure 5).

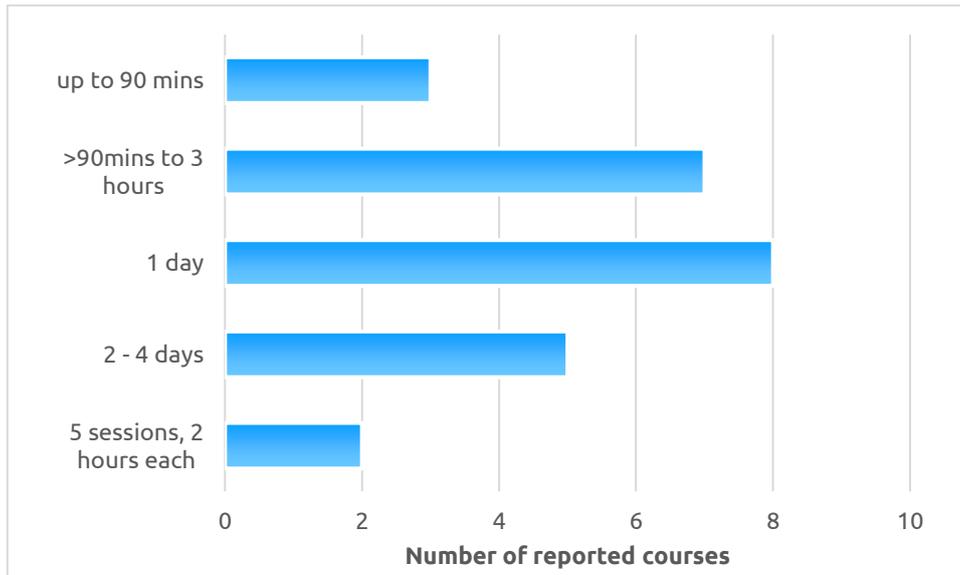


Figure 5 - Variation in reported course duration [n=25]

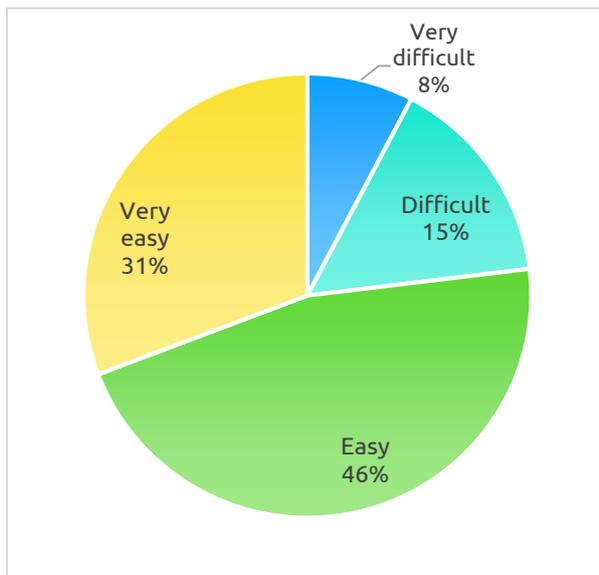


Figure 6 - Workshop organisers' experience of teacher recruitment [n=13]

Workshop organisers generally found teacher recruitment fairly straightforward, mainly due to their existing strong networks and connections with teachers in their regions / countries (Figure 6). Occasionally issues were encountered, mainly to do with the timings of the workshops and other issues familiar from other similar training programmes. Organisers noted that workshops run out of school time tended to have a high sign-up rate, but only around half of those people actually turned up on the day. Likewise, dates that coincided with other commitments (exams, end of the school year etc.) suffered low recruitment.

Eleven of the twelve course organisers who completed the workshop feedback form indicated that they had made at least minor changes to the workshop content. In particular, many workshop organisers made changes to the presentation files, for example:

"I rearranged the sequence and added more images (e.g. black female student experiencing zero G etc.) to the presentation" (Course organiser)

"We included more practical activities and we made the presentation more clear and accessible. We also included more background information to make the concepts more easily understood. We improved the text to make it more scientifically correct." (Course organiser)

3.2 Participant backgrounds

Nodes reported involving at least 481 participants across the courses delivered, coming from a range of backgrounds (Figure 7). Teachers from across the different school levels were involved, including kindergarten through to specialist STEM (science, technology, engineering and maths) and separate mathematics teachers at secondary school level. In addition, at least one node reported involving school students directly in the training sessions, though no evaluation feedback was obtained from that cohort.

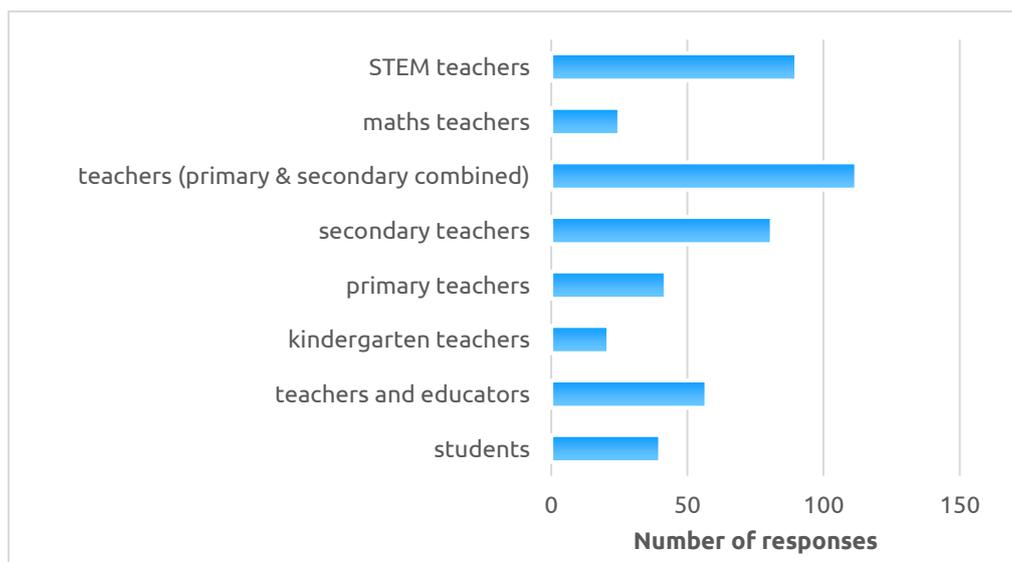


Figure 7 - Participant backgrounds as reported by the nodes [n=481]

Of this cohort, 225 responses were able to be tracked across both the pre- and post-course surveys, with 280 responses to the pre-course survey, and 293 responses to the post-course survey. This represents just under half of those involved in the training sessions overall – a relatively high response rate for this sort of initiative, especially considering that Type D courses were not expected to report any evaluation centrally.

From the participants' own responses there remains a good geographical spread, with 10 countries represented (Figure 8). The dissemination nodes in Portugal, Italy, Bulgaria and the United Kingdom were particularly successful in encouraging participants to complete the evaluation processes, with each of those countries more than doubling the expected participant target of 20.

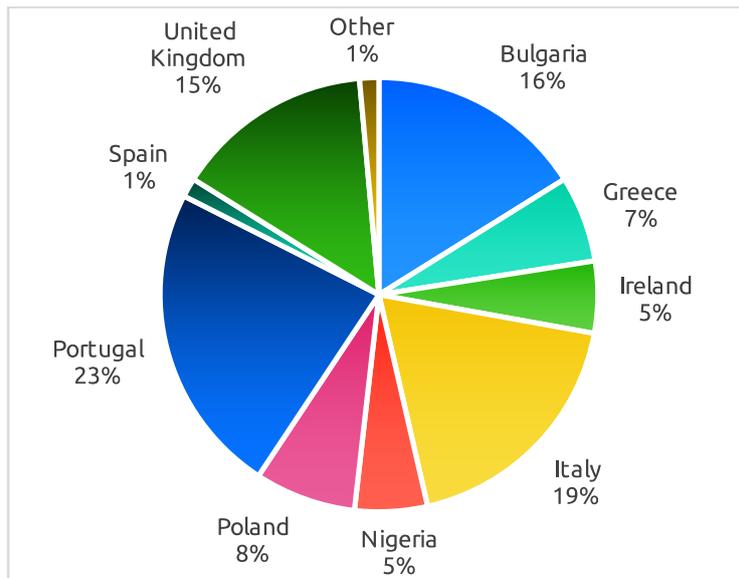


Figure 8 - Respondents' countries of origin (pre-course survey) [n=280]

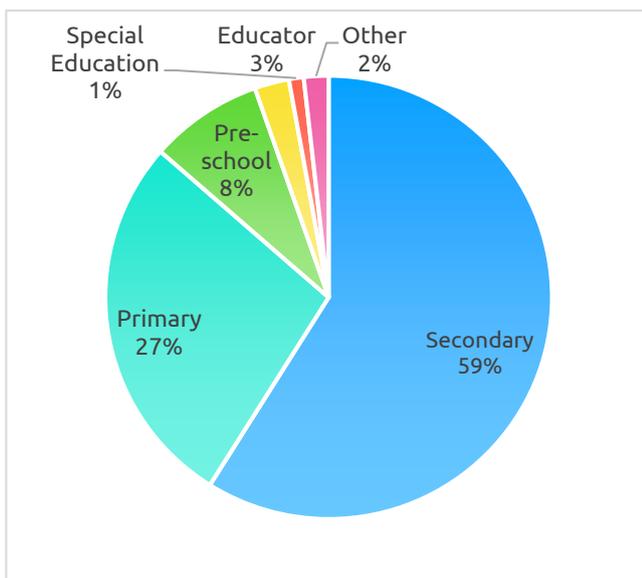


Figure 9 - Type of students taught [n=280]

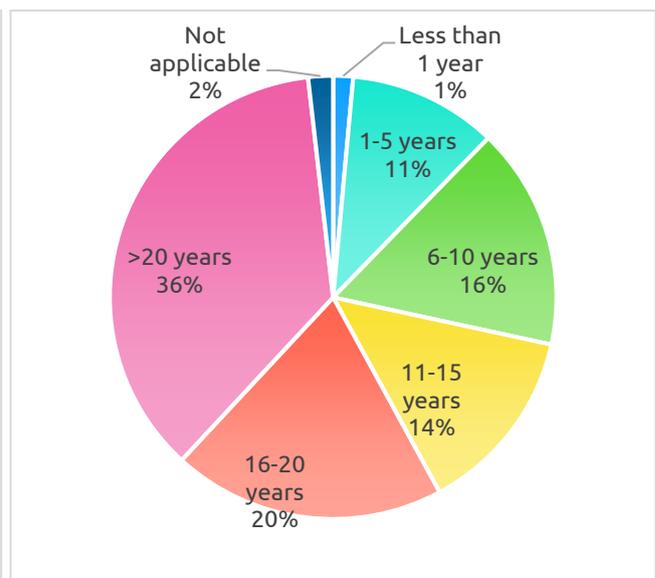


Figure 10 - Level of teaching experience [n=278]

In line with Figure 7, the courses were successful in reaching a range of teacher types, including pre-school (kindergarten) as well as special education teachers (Figure 9). Just over half were secondary teachers, with just over a quarter at primary level. The teachers were relatively experienced, with more than half having taught for at least 15 years, and a further 30% having between 6-15 years' experience (Figure 10).

Given these data it is perhaps not surprising that the majority of the participating teachers were female (Figure 11), and aged 36-55 (Figure 12).

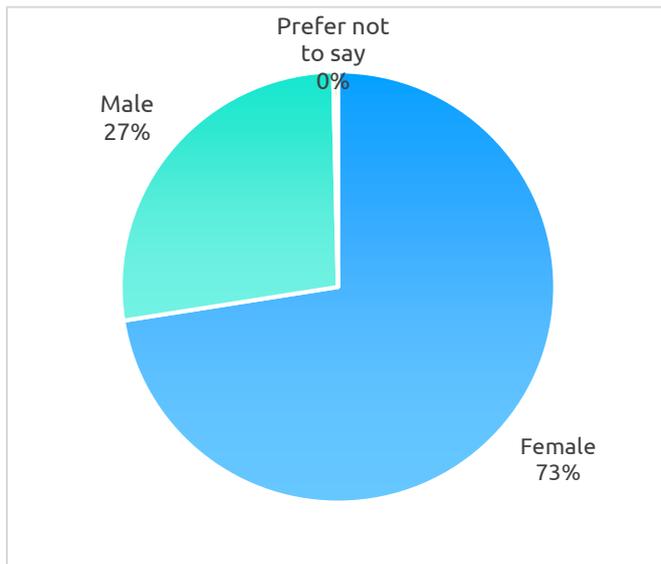


Figure 11 - Gender distribution [n=280]

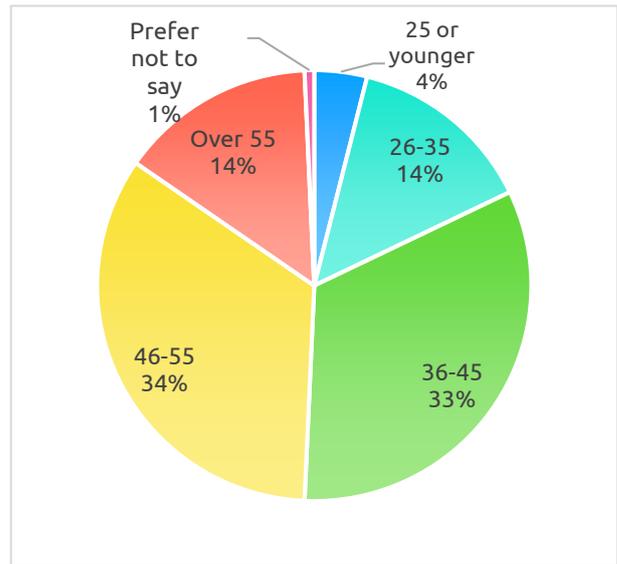


Figure 12 - Age distribution [n=280]

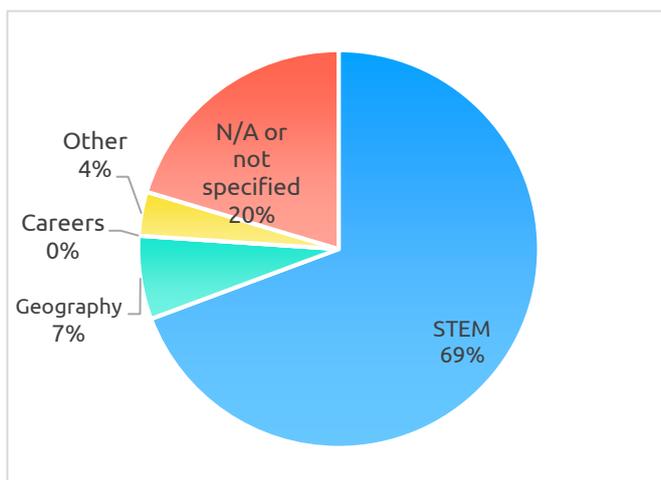


Figure 13 - Teaching specialisms [n=280]

Looking at the participants' teaching specialisms, just over two-thirds of respondents currently teach STEM-related subjects (science, technology, engineering or mathematics, Figure 13). However, the project did have some success in reaching out to teachers more widely. In particular, over 10% of respondents specialised in subjects that on initial inspection appear unrelated to space science – in particular geography¹⁰ (7%) but also music, economics and other (mainly humanities) topics. Sadly however, no careers advisors were reported to be part of any of the teacher training workshops.

Linked to this, participants were asked whether space science was part of their curriculum, as an indicator of how “central” such content was to their teaching. Curriculum links were a clear motivating factor: almost two-thirds of respondents (n=170, 63%) reported that space science is part of their required curriculum that they personally teach (Figure 14). However, more than a quarter of respondents (n=78, 29%) indicated that their decision to include space science content was their own personal choice.

¹⁰ Some countries include geography within the overall STEM umbrella, whilst others do not; for clarity we have considered it separately here.

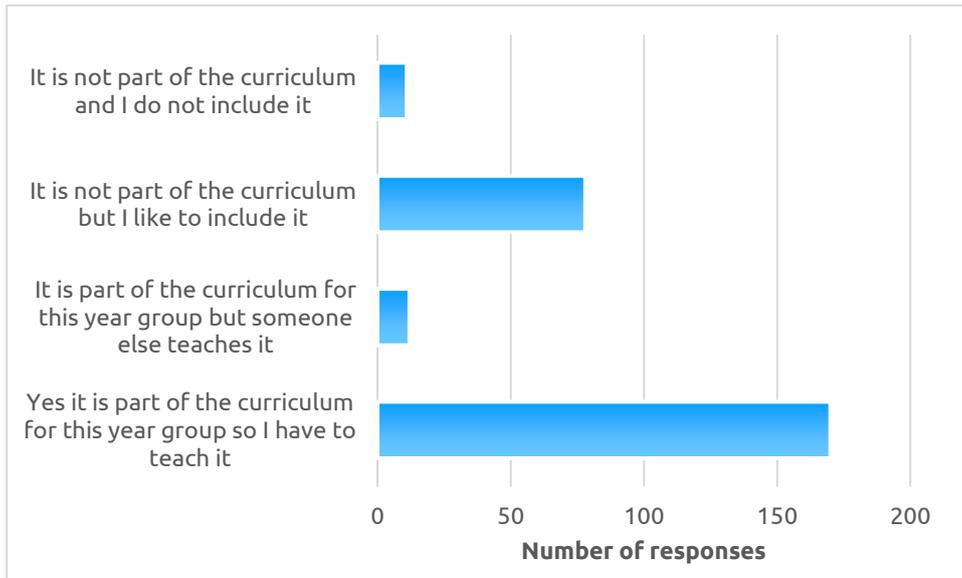


Figure 14 - Curriculum links to space science [n=271]

Finally, participating teachers were asked to provide brief details about the students they teach. This included total numbers as well as gender distribution and the proportion of students from minority backgrounds (where known¹¹).

In total, at least 22,152 students were reported to receive a direct influence from Space Awareness due to their teachers’ participation in the training workshops. The influence of one particular teacher varied from a handful of students up to many hundreds (Figure 15).

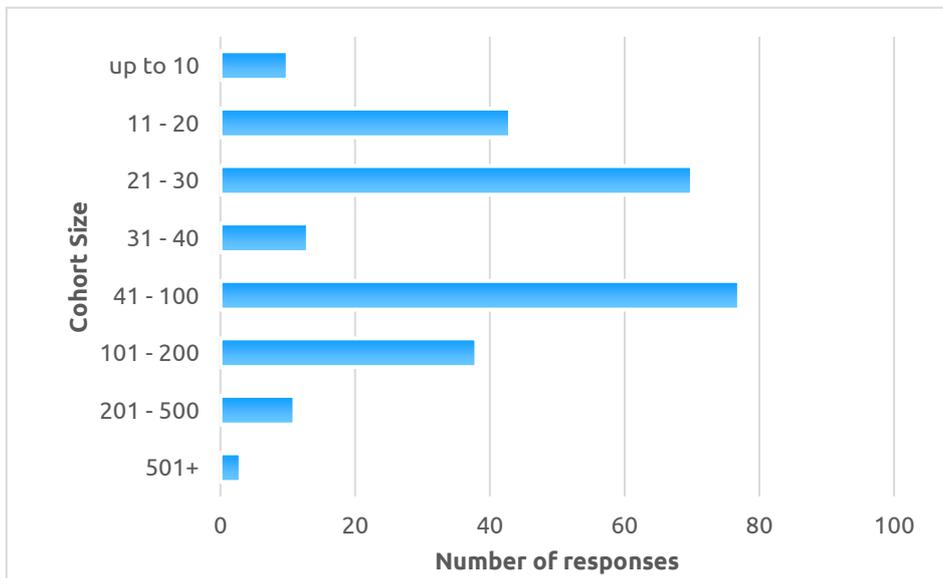
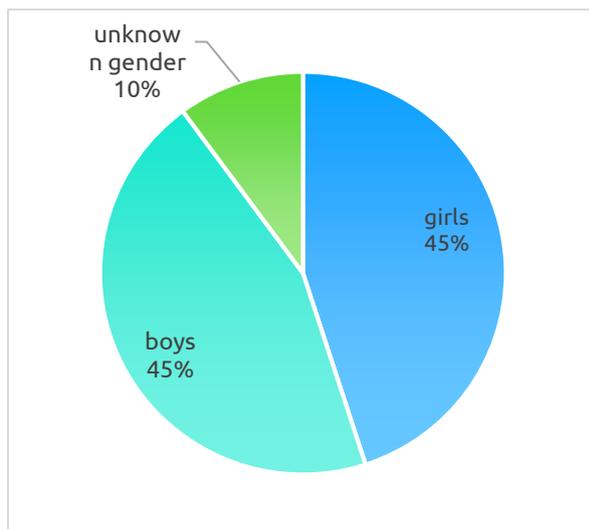


Figure 15 - Teaching cohort sizes of participating teachers

¹¹ See section 3.2.1 for further discussion of the difficulties encountered in collecting data on pupils’ gender, minority and socio-economic status.



The gender split within the cohort taught by participating teachers was remarkably even, with 9,971 girls reported within this group, and 9,942 boys (a further 2,239 students did not have their gender reported, Figure 16). This even gender distribution held true whether the school was co-educational or single-sex: of 22 single-sex groups reported, 987 girls were attending 11 all-girls schools and 1,063 boys attending 11 all-boys schools.

Figure 16 - Genders of students taught
[n=22,152]

The minority status of students taught is more difficult to report accurately, given that over a quarter of respondents selected “prefer not to say” in response to this question. Of those that did answer, approximately 10% of students came from a minority background. The proportion of students from minority backgrounds did of course differ by country, with Italy, Portugal and Nigeria reporting particularly high numbers.

3.2.1 Problems in collecting ‘sensitive’ data

For the benefit of future similar projects it is perhaps worth taking some time to reflect on the processes and veracity of the questions relating to gender and minority status. A key intention of the evaluation work package was to specifically explore Space Awareness project impacts on diverse audiences, for example according to gender, minority status and/or socio-economic background. However various practical and cultural barriers were encountered in implementing such efforts, for example:

- Feedback from both partners and nodes indicated that asking participants (teachers, pupils, parents etc.) overtly about socio-economic background, gender, religion and/or ethnicity is considered inappropriate and even illegal in some countries.
- Similarly, within some countries it became apparent that mentioning minority ethnic or religious groups is likely to raise suspicions and distrust and mean that participants do not complete the remainder of the evaluation activities (surveys, interviews etc.), or may create bias in the responses they provide.

In practice, what this has meant is that within the teacher training evaluation tools the gender and minority status questions were designated as optional. Figure 17 demonstrates the proportion of respondents from different countries who selected the ‘prefer not to say’ option when responding to questions about their students’ gender and minority status. It is clear that minority status in particular is fairly problematic, with over half of the ten countries reported here having more than 20% of respondents selecting this option, and in two cases (Bulgaria and Nigeria) this figure reaching or exceeding half of the respondents. Gender however appears to be less problematic.

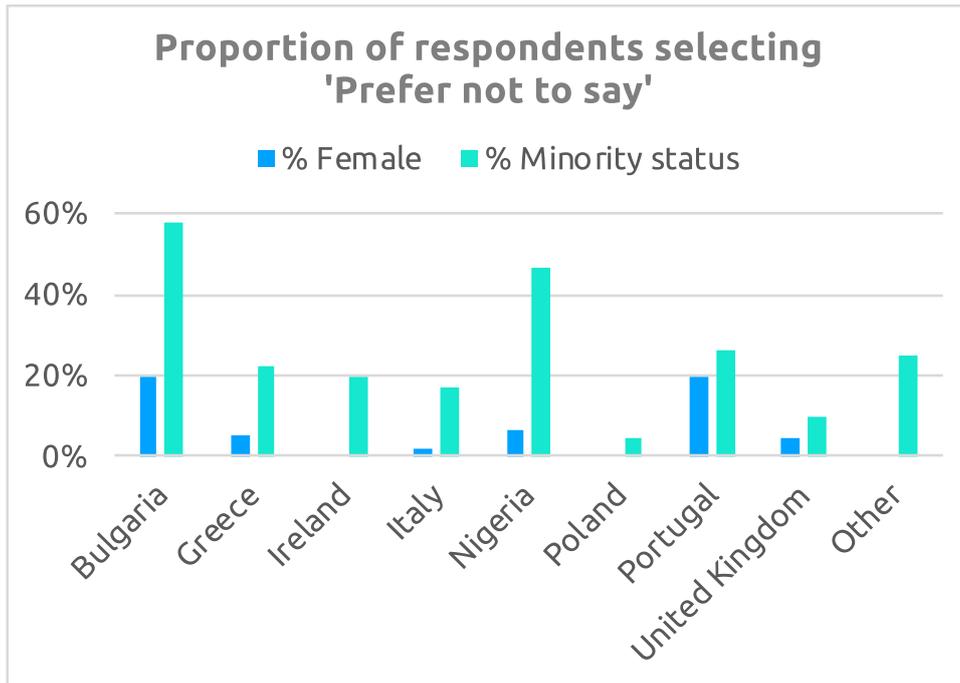


Figure 17 - Proportion of respondents selecting the 'prefer not to say' option - by country

Of course, there are many simple reasons, unrelated to ethical or cultural issues, why an individual may select 'prefer not to say'. For example, they may not have the data to hand, or they don't know the answer, or it's easier than trying to enter a response when they're pushed for time. However, anecdotal feedback from various partners suggested that the underlying tensions around asking these questions were fairly serious, and certainly our data would support that belief (especially relating to minority status). Regardless of the reason, it is important that we recognise that such factors are very difficult to reliably ascertain, especially at international level.

3.3 Course ratings

The overall ratings for the courses were very high, with almost three-quarters of respondents selecting the highest option (“Very good”), and 99% agreeing it was at least “Good” (Figure 18). Workshop organisers were similarly very positive about the quality of the courses (Figure 19).

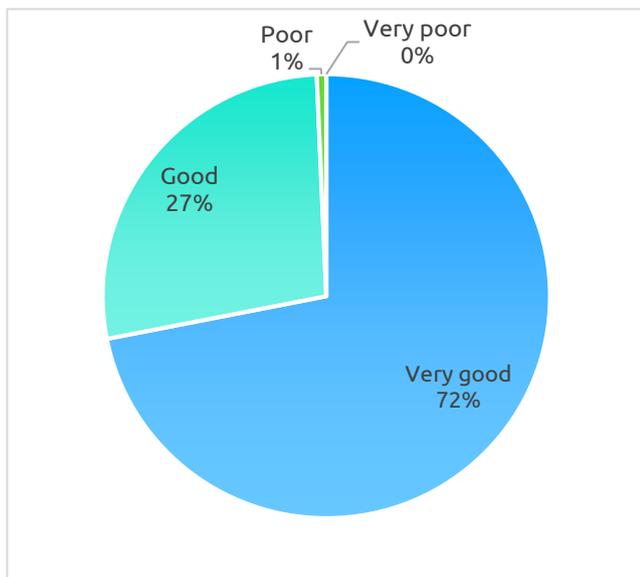


Figure 18 - Overall course ratings: teachers [n=292]

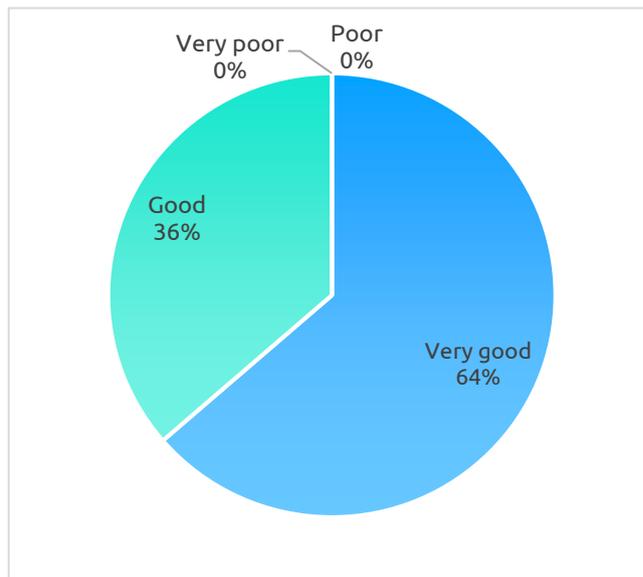


Figure 19 - Overall course ratings: workshop organisers [n=11]

Feedback from the workshop organisers suggested that the training guidelines that were provided did contribute to the success of the workshops they ran:

“The training guidelines were very good: very clear with easy access to the resources that were to be used.” (Workshop organiser)

“The training guidelines was very useful and it helped us focus on the important points and aspirations of the project” (Workshop organiser)

Breaking the teacher feedback down by country shows that in all cases at least half of the respondents selected the “Very good” rating (Figure 20), with eastern European countries in particular tending to score very highly (Romania, Bulgaria, Poland).

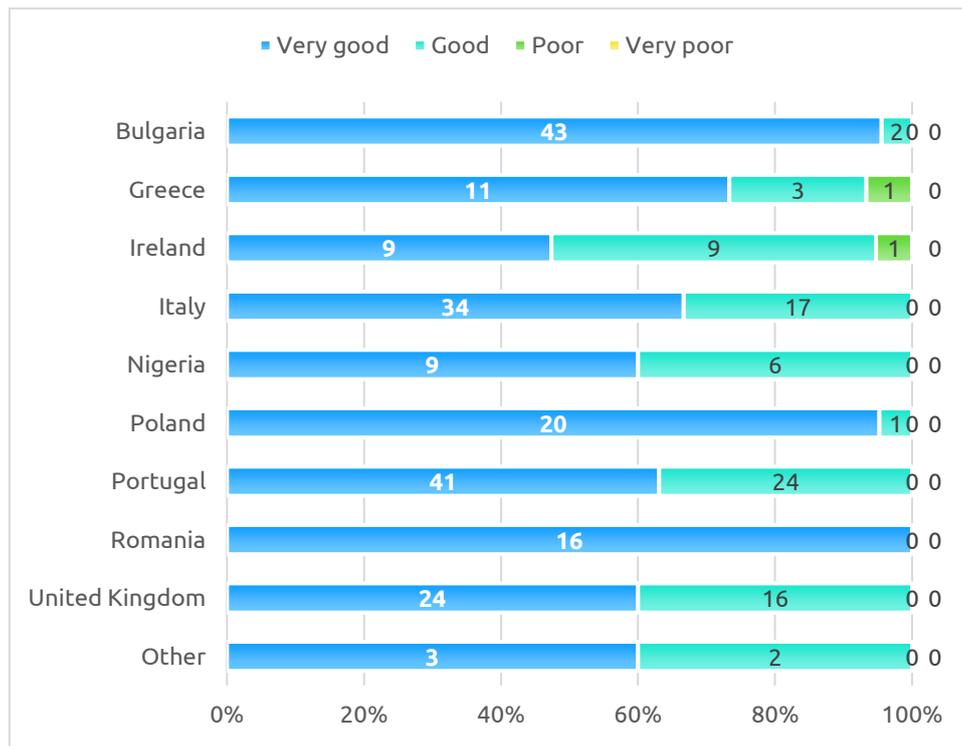


Figure 20 - Overall teacher course ratings: by country [n=292]

The overall teacher course ratings were also broken down according to other participant characteristics (Figure 21). Pre-school (kindergarten) teachers were slightly less positive than teachers at other levels, though over 65% still gave the highest rating of “Very good”. Geography teachers were extremely positive about the courses they attended, with over 80% selecting a rating of “Very good”. On the other hand, teachers from other subject areas (not STEM or geography) were more lukewarm – though still positive overall, slightly less than half of teachers in the ‘other’ category (which included subjects such as music and economics) chose the highest rating. The courses appear to have been particularly successful in supporting female teachers to develop their skills: almost 80% of female teachers gave the courses a rating of “Very good”.

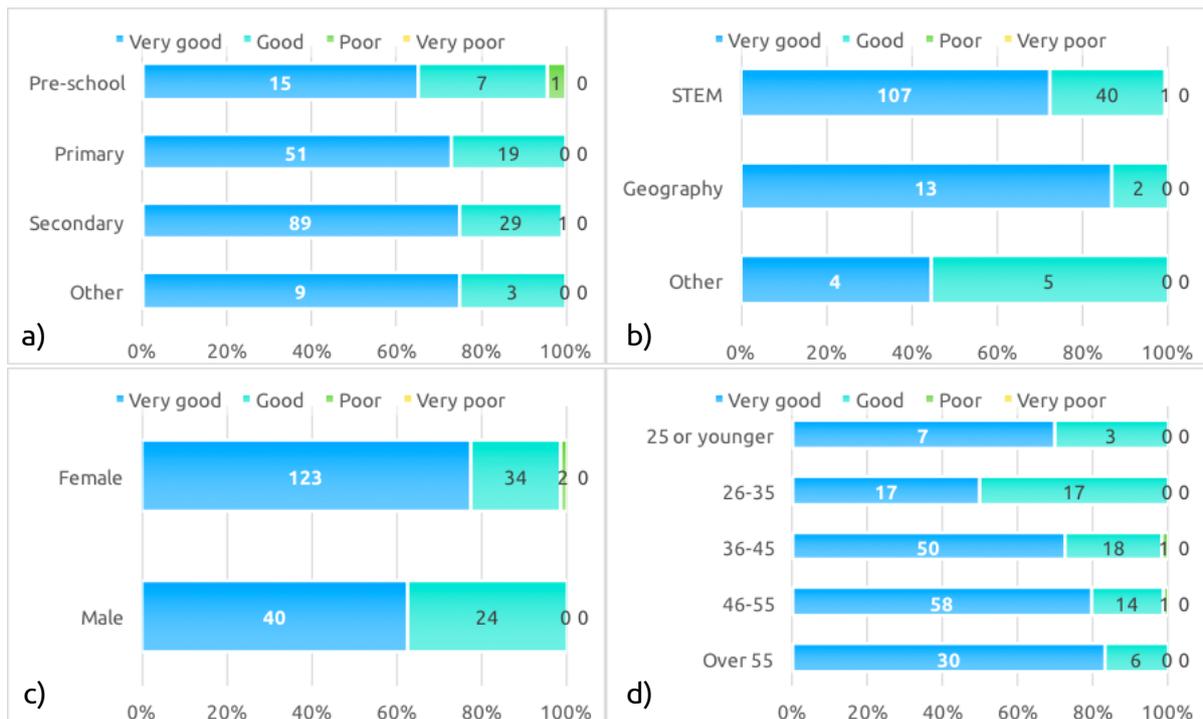


Figure 21 - Overall course ratings broken down by a) type of school the participant teaches in [n=224]; b) subject specialism [n=172]; c) gender [n=223]; and d) age category [n=222]

To further explore the strengths and weaknesses of the courses delivered respondents were asked to give specific feedback on what was the “best or most useful part of the course” as well as what could be improved. These responses were freeform, allowing respondents to define their own characteristics. The open-response questions were then coded into common categories as shown in Figure 22.

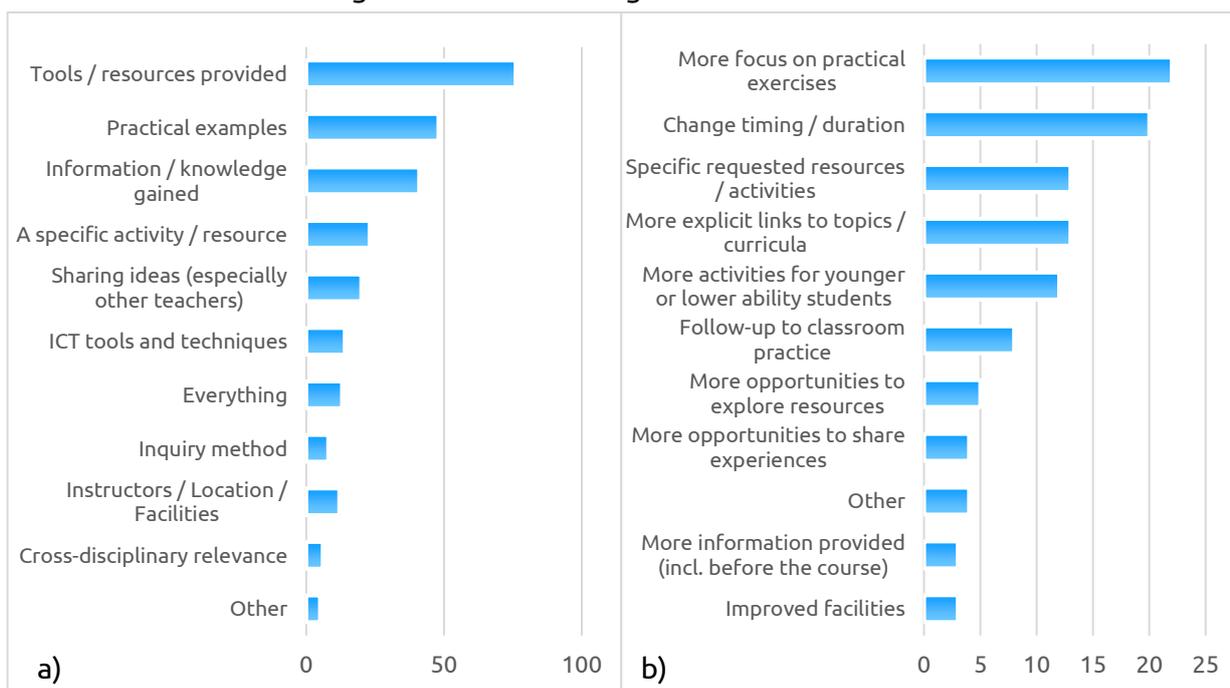


Figure 22 - Specific participant feedback regarding the courses: a) the "best or most useful" part of the course [n=218], and b) what could be improved [n=83]

There was a clear appreciation of practical activities and useful tools resources – three of the top four “best” parts of the course all referred to these aspects, as well as being the most common aspect participants would have liked to see extended within the programme. For example, respondents commented that:

“The ideas and activities proposed in this course were simple and concrete and allow you to visualize concepts that are not always easy to explain theoretically.” (Teacher, Portugal)

“[The best part was] That we could try and realise the experiments before proposing them to the students” (Secondary teacher, Italy)

“The practical activities that make it possible to live, finish, learn and transmit to others” (Educator, Spain)

“More hands on resources would be more useful” (Teacher, Ireland)

There was also recognition of other key elements of the Space Awareness aims for these courses, specifically relating to ICT tools and techniques, the inquiry method, and multidisciplinary perspectives. Participants were also appreciative of the host organisations’ skills and ways the courses were handled, and the opportunity to share ideas (especially with other teachers). From the workshop organisers’ perspective, common successes noted included:

- offering credits for teachers to attend the training (which are important for their career)
- the activity based on the Space Scoop
- the enthusiasm and participation of the teachers involved (especially those that had previously attended similar courses, who were more readily willing to enter into the discussion sessions)
- high levels of interest in citizen science
- tying in with existing large-scale annual events
- the introduction of Toon Doo
- specific Space Awareness resources (e.g. the following activities: Sun, Earth and Moon Model; History of the universe; What is a constellation; Living in the Milky Way)

For the shorter courses it was common for the participating teachers to be critical when practical activities were lacking, and indeed almost one-quarter of “improvements” noted were to extend the duration of the course they had attended. There were also two recommendations that are explicitly relevant to future similar programmes: teachers were keen to see more explicit links to school topics / curricula, and also requested more activities specifically for younger or lower ability students. Finally, in certain countries both workshop organisers and teachers expressed disappointment that more resources weren’t available in their local languages:

“A fantastic course and very inspirational, just would like to see it focussed more on activities we have to teach -- or more depth on these.” (Primary school teacher, Wales)

“Needs to discuss how to cater for students with learning difficulties or weak students (differentiate learning)” (Teacher, Ireland)

“Develop a range of levelled activities around images. Engage with youngest learners. Progression of skill to enable older learners to engage with more focused science work.” (Primary school teacher, Wales)

“Have more resources on the web site translated into Italian, so that they could be usable by more people (students included)” (Secondary school teacher, Italy)

In follow-up feedback two teachers in Ireland also commented that the existing resources could be improved in terms of the assumed maths knowledge (for the students), as well as the background support and resources provided to teachers so that they could answer further questions:

“The students needed a high standard of maths for some aspects of the activity and some did not get the full benefit because they were weak in this area.” (Teacher, Ireland)

“Questioning from students - need more background information as students very inquisitive” (Teacher, Ireland)

The workshop organisers also reiterated teachers’ comments about the importance of linking to local curricula, and were pleasantly surprised by the successful integration of non-science teachers:

“Discussion topics e.g Sun, Earth and Moon models were particularly of interest because this appears in the curriculum both for Junior Secondary and Senior Secondary School. Introducing the inquiry-based learning for teaching different topics (in arts and STEM subjects) which related to this topics was especially well received.” (Workshop organiser)

“Rich input from non-physics teachers” (Workshop organiser)

In addition to the open-response questions above, respondents were also asked to rate specific elements of the course as indicators of how they perceived its quality (Figure 23).

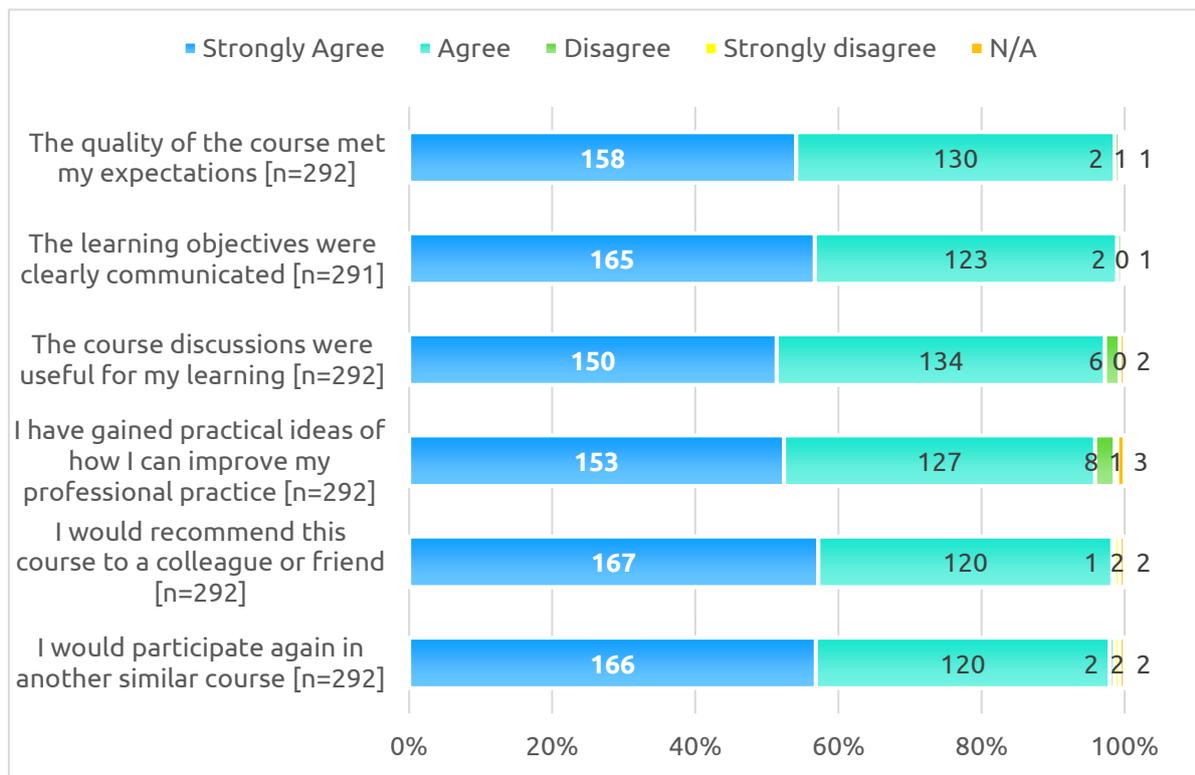


Figure 23 - Quality indicators

The quality indicator ratings were all fairly consistent, with just over half of the respondents selecting “Strongly agree” in response to each of the statements listed, and over 95% of respondents at least agreeing with each statement. This is a very strong result, suggesting that the courses were generally high quality, and were successful in meeting the needs of those who participated. It is particularly notable that 98% of respondents would both recommend the course to a colleague or friend, and also that they would be interested in participating in a similar course again. Participants were particularly supportive of the relevance of the training workshops to teachers outside traditional STEM subjects:

“Noting that it's not just science related. History colleagues and others can benefit from my attendance if I discuss my participation on today's course with them.” (Teacher, Ireland)

“This course gave me ideas for my future work in geography and economy for grade 5. Shared good practices were very interesting and useful.” (Secondary school teacher, Bulgaria)

“More teachers teaching non science topics should be involved in the future.” (Secondary school teacher, Nigeria)

For the purposes of feeding back to the delivery partners and nodes, the quality indicators have also been broken down according to country (Figure 24).



Figure 24 - Quality indicators - by country

3.4 Outcomes achieved

As outlined in section 1, there were various specific outcomes that were intended for each of the different course types. Figure 25 summarises the responses to each of the indicator statements, grouped under the major learning outcome categories as described in Table 1.

The participants were overall generally very positive in their responses to each of the outcome indicator statements. In almost all cases the proportion of people either agreeing or strongly agreeing with each statement was very high, with an average¹² of 85%. The average proportion of those selecting the highest rating of "Strongly agree" was 45%. Participants were generally equally positive across all the outcome categories, demonstrating that the courses had impacted on them (and/or their students) across a range of emotional, attitudinal, behavioural, intellectual and skills-based domains e.g.:

"I have been finding it difficult to teach space travel as a topic in my course but I am more confident now to do so." (Secondary school teacher, Nigeria)

"[I] feel supported and enthused about ideas to incorporate within my school; add STEM ideas into other subject areas - rather than just special ones." (Primary school teacher, Wales)

"Children need inspiration. This is a wonderful way!" (Primary school teacher, Bulgaria)

"My pupils are very excited about what I shared with them, they are curious to learn more about Space." (Teacher, Romania)

Of particular interest are statements a), d), e), g) and o) as these were identified during the course design process as being the priority areas of intended impact (see section 1¹³). Certainly the survey respondents were very positive about all five of these statements, with over 88% of respondents at least agreeing in each case. This rises to over 98% for a) "feel inspired", with over 50% of respondents selecting the top rating of "Strongly agree" for both a) "feel inspired" and e) "appreciation that school science is relevant to space science". Though still positive, the success of the training courses in achieving outcomes d) "space science as a global / European endeavour" and o) "using enquiry" was somewhat lower, with just over a third of respondents selecting the top rating for each of those statements. Given that these are non-superficial concepts, requiring for the most part a change in teachers' attitudes and/or practice, the slightly lower ratings for these statements is not all that surprising.

¹² These calculations have excluded any statements which received 20 or less responses as those data may not be representative of the population as a whole.

¹³ Note that this focuses on the intended outcomes of courses A1 (Our Wonderful Universe), A2 (Navigation through the Ages) and A3 (Our Fragile Planet) as the vast majority of respondents attended these courses, see Figure 3).

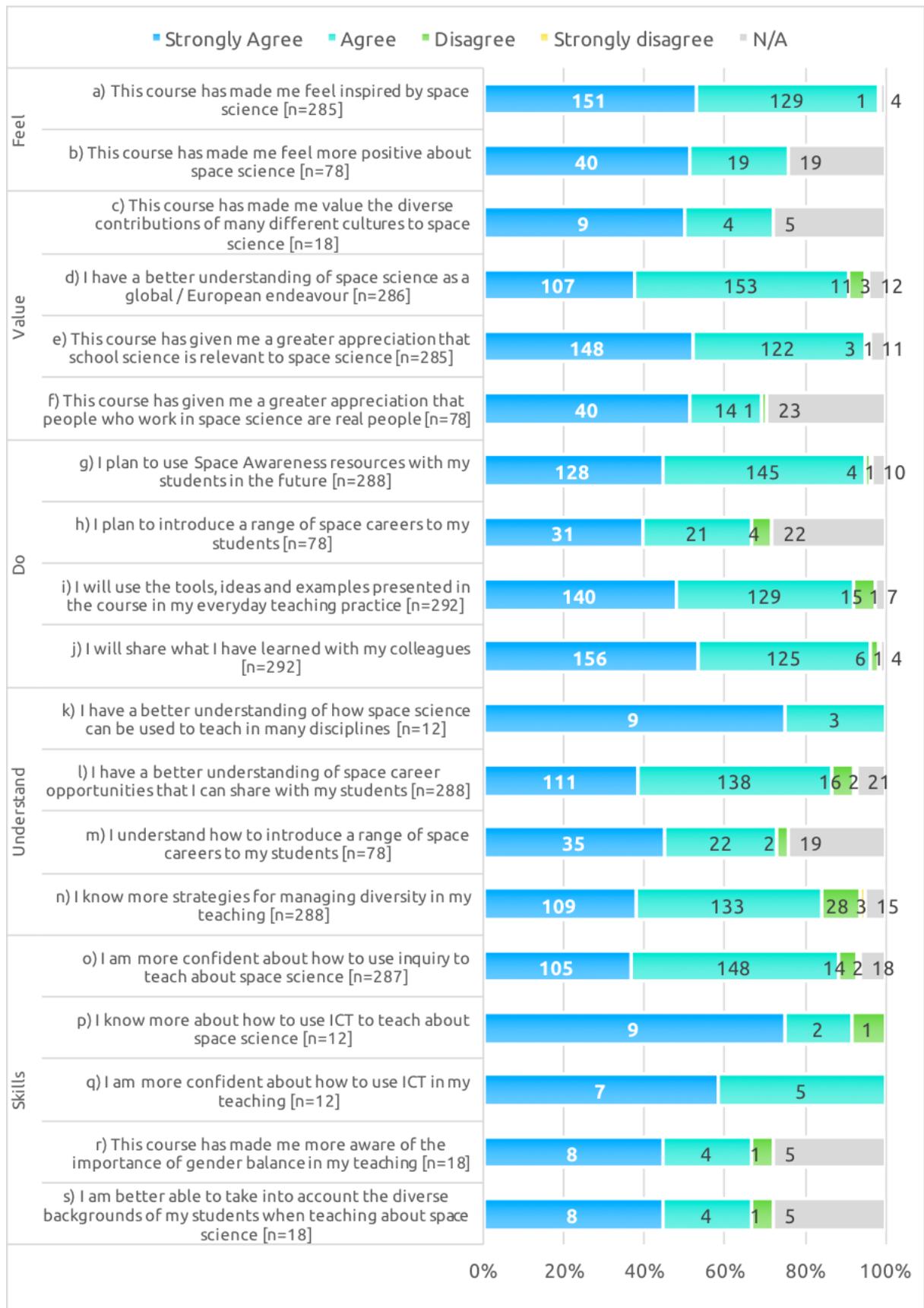


Figure 25 - Outcome indicator statements (Note that in order to reduce the burden on participants, not all questions were asked to all respondents; they were instead differentiated according to course type as outlined in section 2.1)

Separately, over 44% of respondents strongly agreed that they g) “plan to use Space Awareness resources” with their students in the future, this means that at least 4,714¹⁴ students were directly influenced by the Space Awareness training courses.

In addition to the self-reported outcome indicator statements described in Figure 25, pre/post comparisons were also conducted in order to gauge any direct outcomes that could be more directly attributed to the training course they attended. Focusing on the key Space Awareness project outcomes, specific questions were asked both before and after the training course relating to participants’ familiarity and confidence in space science careers, inquiry-based teaching approaches and strategies for managing diversity in the classroom¹⁵ (Figure 26).

Respondents were generally fairly confident about their skills prior to the course with around 70% agreeing with the respective skills statements in each case (rising to 81% for their familiarity with strategies for managing diversity in the classroom). However, for all three skill sets there were still notable increases in these elements as a result of attending the course. In the case of space science careers and inquiry-based teaching approaches, not only did the overall proportion of respondents who at least agreed with those statements increase, but many of those who selected “Agree” previously also changed to “Strongly agree” (in the case of space science careers this more than doubled), suggesting a greater depth was added to their existing knowledge. For example, one respondent commented:

“I have learned about inquiry in the past and the idea is much more clear for me now (after this workshop).” (Teacher, Portugal)

In the case of strategies to manage diversity, the overall proportion who at least agreed with this statement did not change, however there was still an increase in the number of people who selected “Strongly agree” instead of “Agree”. One teacher did emphasise the importance of nuances in managing diversity, highlighting that it is about meeting the individual needs of each student rather than broad-brush focus on “girls” or “ethnic minorities”:

“I don't make a point of seeing that girls/ethnic minorities need extra encouragement in my classes in order to pursue science or related careers. They are already motivated and I take each student on an individual basis.” (Teacher, Ireland)

Overall these results suggest that even for participants to whom some of the key content was familiar, the training workshops were successful in strengthening their existing skills and strategies in a positive way.

¹⁴ This is the total number of students reportedly taught by teachers who selected “Strongly agree” to the statement g) “plan to use Space Awareness resources”. This figure is likely to be an underestimate of the real figure as it does not include students in other academic years, nor those taught by participants who selected “Agree” or who did not complete the questionnaire.

¹⁵ A fourth question relating to using ICT was also asked, however very few type A (*Extension*) – *Developing ICT Skills* courses were run so these data are not reported here.

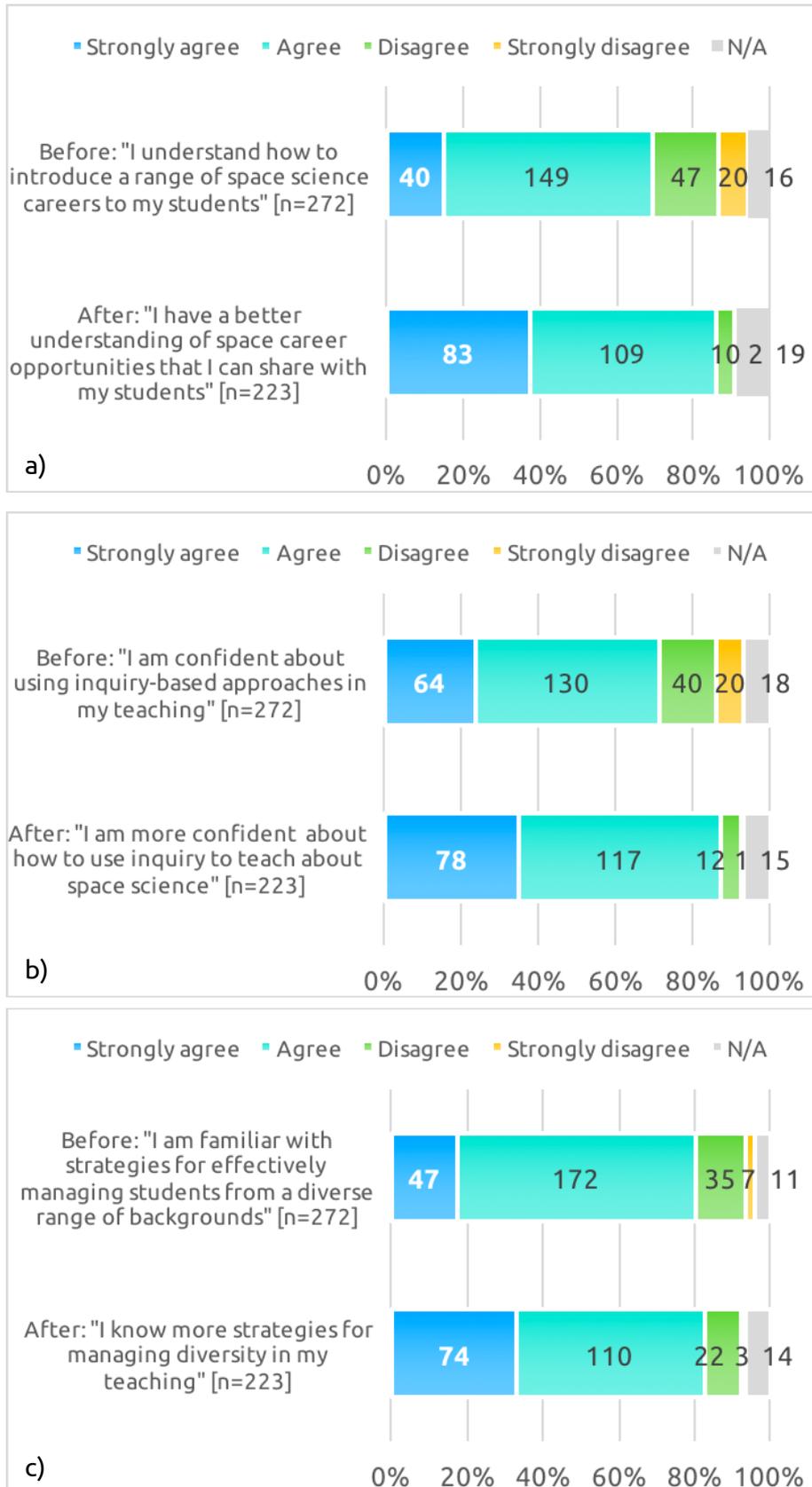


Figure 26 - Comparison of pre- and post- responses to key indicator outcome statements relating to participants' familiarity and confidence in a) space science careers; b) inquiry-based teaching approaches; and c) strategies for managing diversity in the classroom.

3.5 Embedding practice

Workshop organisers were encouraged to follow up with their participating teachers approximately a month after the course to explore how well the teachers were able to implement the content covered. Follow-up feedback was only reported by four workshop organisers, so may not be representative. However, there was clear evidence of changes in practice, both for the individual teachers involved,

Some teachers specifically highlighted noticeable impacts on individual students, relating to a variety of outcomes including inspiration, progression, sharing their knowledge and enthusiasm with others, as well as improving individuals' self-esteem.

*"One student who had more or less been asleep all year came alive when she heard of the big bang theory - and was really mad that my answer was 'I don't know, they don't know!' Mad enough to go home and read more, and have more questions the following day. This student isn't experiencing much academic success in other areas of school, but in Science participates and is developing some good physics skills. Regardless of whether she pursues any career in Science, the inspiration has kept her engaged and been really great for her self-esteem in particular with regards to Science."
(Teacher, Ireland)*

"I wish to participate in as many such workshops. My students were excited about what we presented to school! Paxi became their friend!" (Teacher, Romania)

In both of these cases the teachers involved particularly emphasised the wider impacts of the project – although they were pleased that the students they referred to were so well engaged with the science content, it was the wider inspiration, increased self-esteem, and liaison with family and other students that had really impressed them. Others emphasised the benefit of a multidisciplinary perspective:

"As a teacher who is interested in literacy and the influence of language in developing literacy, I am thrilled to hear students discuss these ideas out of genuine interest, before or after a class." (Teacher, Ireland)

"[I] feel supported and enthused about ideas to incorporate within my school; add STEM ideas into other subject areas - rather than just special ones." (Primary school teacher, Wales)

It is clear from the follow-up feedback that the teachers involved saw the relevance and benefits of space science across their respective curricula.

Conversely, there was also recognition of external factors, such as curriculum requirements, that created barriers for teachers in trying to implement their learning from Space Awareness as fully as they would have liked:

“The usual challenge of the curriculum and that the exam influences a students' perception of the value of what is being taught to them. Some other teachers are less likely to engage is something other than the book for fear that either they don't get the content covered or that they will be criticised for not covering what is in the book.” (Teacher, Ireland)

Despite their existing experience in working with teachers, the workshop organisers frequently expressed surprise at the level of engagement and multidisciplinary uptake of their participating teachers:

“The teachers were REALLY happy about the reaction of their students to learning about space in the classroom. I got the impression that a lot of the teachers were actively looking for ways to teach space and this workshop empowered them to do so. But I was surprised by their enthusiasm.”
(Workshop organiser)

“They are amazing! Even language teachers use astronomy & space during their work with pupils.” (Workshop organiser)

This level of surprise is perhaps indicative of a wider recognition that not all courses meet with such success or enthusiasm, and reflects positively on the Space Awareness teacher workshops programme.

4 Conclusions

This section compares the observed results reported in section 3 with the originally intended outcomes as described in section 1¹⁶. Eleven formal dissemination nodes and three project partners were expected to each run at least one workshop, aiming for 20 participants or more in each case. All but one dissemination node succeeded in delivering at least one training course prior to July 2017, with the last course due to occur before February 2018. Ten nodes and partners succeeded in achieving the target, sometimes across multiple separate sessions, with Italy, Portugal and Bulgaria all reaching more than three times the originally intended number of participants in total.

In line with the Space Awareness identified priorities, these covered a range of teaching levels, from kindergarten through primary school and into secondary level. Of those respondents who specified a subject specialism, more than 10% were non-STEM (science, technology, engineering and mathematics), and comments regarding the involvement of teachers from broader backgrounds were highly favourable, from both participating teachers and workshop organisers alike. This suggests that the aim of embedding space science into broader areas of the curriculum beyond physics and mathematics was (at least in part) achieved.

In total, at least 22,152 students were reported to have received a direct influence from Space Awareness due to their teachers' participation in the training workshops, with an approximately even gender split. Though there was some reluctance to report on ethnic and minority status, indications are that at least 10% of students came from a minority background. These figures indicate that the impacts of the teacher training workshops will be felt by a diverse range of students, including those for whom access to space science activities is not normally straightforward.

The overall course ratings were very high, with 99% of respondents agreeing that the course they attended was at least "Good", and more than 50% in each country giving a top rating of "Very good". More specific quality indicator questions were also very highly rated; it is particularly notable that 98% of respondents would both recommend the course to a colleague or friend, and also that they would be interested in participating in a similar course again.

Participants were particularly supportive of the relevance of the training workshops to teachers outside traditional STEM subjects. Compared to their wider cohorts, geography teachers and females reported particularly positive responses to the overall course rating, suggesting that they found the courses well-suited to their needs. Conversely, further work is perhaps needed to tailor such content to pre-school (kindergarten) teachers in future similar courses.

The focus on practical activities within the training workshops was very well received; this was by far the most popular aspect reported as the "best or most useful" part of the course. Linked to this, the most common reported improvement was a desire for more focus on practical exercise, or an extended duration (to accommodate such opportunities).

¹⁶ For a broader summary of this report overall see the Executive Summary at the start.

Teachers also desired more explicit links to school topics / curricula, and requested more activities specifically for younger or lower ability students. Delays in translating the Space Awareness resources into local languages was also reported as a source of frustration in some countries.

Table 2 provides a visual summary of which priority intended learning outcomes were achieved within the Space Awareness teacher training workshops. The final column serves as a “traffic light” indicator of the extent to which the evidence gathered supported whether each outcome had been achieved¹⁷.

Theme	Priority intended learning outcome	Course Type	Rating						
Feel	xiv. Feel inspired by space science	A	Strong						
	xv. Feel positive about space science	B	Some						
Value	xvi. Value the diverse contributions of many different cultures to space science	C	Some						
	xvii. Appreciate that school science is relevant to space science	A	Strong						
	xviii. Appreciate that people who work in space science are real people	B	Some						
Understand	xix. Space science can be used for teaching in many disciplines including cross-disciplinary contexts and non-science subjects	A ext	Strong						
	xx. Understand space science career opportunities are diverse, rewarding and highly accessible (particularly to girls and ethnic minorities)	B	Some						
	xxi. Space science is a global/European endeavour	A,C	Strong						
	xxii. Career opportunities in space science and technology at all levels	B	Strong						
Do	xxiii. Access and use Space Awareness activities confidently	A, A ext	Strong						
Skills	xxiv. Develop inquiry-base skills for teaching/learning about space science	A	Strong						
	xxv. Learn how to use IT to teach/learn about space science	A ext	Some						
	xxvi. Learn how to be more inclusive while teaching, particularly for girls and minorities	C	Some						
<i>Strong evidence this outcome was achieved</i>		<i>Strong but sporadic evidence this was achieved</i>		<i>Some evidence this outcome was achieved</i>		<i>Evidence this outcome was NOT achieved</i>		<i>No evidence either way</i>	

Table 2 - Summary of achieved learning outcomes. Note that for the sake of brevity only the high priority outcomes identified in Table 1 have been included here. “Course type” refers to the type of training workshop: A – specific space-related content (A1 - Our Fragile Planet; A2 - Navigation through the Ages; A3 - Our Wonderful Universe); A (ext) – extension option to workshop type A focusing on developing ICT skills with space; B – Introducing space sciences and careers in education; C – Space for global citizenship.

It is clear from Table 2 that there was strong evidence (albeit sporadic in places) of all 13 priority learning outcomes having been achieved within the Space Awareness teacher

¹⁷ In addition to teachers’ self-reported responses to direct statements on these aspects (see Figure 25 and Figure 26), these judgements have been based on a synthesis of both teacher and workshop organiser feedback as described in sections 3.4 & 3.5. Note that the key to the colour scale used is included at the bottom of the table.

training workshops. It is clear that participating teachers (and their students) felt inspired by space science (i), and gained a greater appreciation of the relevance of school science (iv). Teachers (and students) demonstrated strong abilities to access and use the Space Awareness activities, and were confident in doing so (x). Teachers also reported better understanding of both space science as a global/European endeavour (viii), and the associated career opportunities (ix). Through both quantitative and qualitative feedback it was clear that the inquiry-based approach was highly successful and valued by the participating teachers (xi), and that they gained a better appreciation of and value for space science as relevant across many disciplines (vi). This last point is perhaps particularly interesting as multiple workshop organisers expressed overt enthusiasm and even surprise at how successful they were in engaging and involving teachers from disciplines outside science. The fact that this outcome was achieved not only within the teacher cohort, but also for the workshop organisers suggests that it may have wider knock-on effects for future training programmes run by those individuals.

For the remaining (lighter green) outcomes, there was again evidence that these were achieved, but either the numbers responding to those questions were comparatively small, or related to anecdotal feedback from a small number of participants. For these reasons, we could not assume that such outcomes were representative of the cohort as a whole.

Overall these results are extremely positive. There is evidence that all of the intended priority outcomes were achieved within the teacher training workshops, and that they are likely to have encouraged a shift in the everyday practice of teachers across Europe (and beyond), with subsequent impacts on learners' individual experiences which will be beneficial far beyond the life of the project.

4.1 Recommendations

This section summarises key recommendations from the evaluation of the Space Awareness teacher training workshops which may be relevant for the development of future similar initiatives. These recommendations have been broken down into thematic sub-headings for clarity.

The teacher training programme and materials

1. The Space Awareness teacher training workshops were perceived to be very high quality, providing useful and diverse materials and content for workshop organisers, and inspiring and practical examples for teachers and other participants. The training materials should be made publicly available and disseminated widely to ensure their successful uptake beyond the lifetime of the Space Awareness project.
2. The flexible model of delivery, where workshop organisers could adapt the content, focus and duration of the teacher training courses at local level worked very well, and should be continued in projects with similar dissemination models.
3. "Our Wonderful Universe" and "Our Fragile Planet" proved to be the most popular course types (in terms of recruitment) for both course organisers and participating teachers. It appears there is further scope for improving the uptake of "Navigation

through the Ages”, “Introducing space sciences and careers in education” and “Space for global citizenship”.

Resources and activities

4. The practical nature of the Space Awareness resources and activities proved extremely successful, and should be replicated in future similar workshops.
5. Translation of key resources into local languages is crucial to ensure greater uptake by both teachers and students in many countries.
6. Further effort could be made to adapt the course content and materials to suit the needs of pre-school (kindergarten) teachers, as well as more activities for younger or lower ability students.
7. Curriculum requirements are a major factor in influencing whether space science is taught in schools. Further opportunities to link space science to explicit content within the various curricula across Europe are essential to ensuring broader uptake.
8. Certain existing resources could be improved in terms of the assumed maths knowledge (for the students), as well as the background support and resources provided to teachers so that they could answer further questions.

Workshop arrangements and delivery

9. Workshop timings greatly affected uptake; those run outside school time tended to have a high sign-up rate, but only around half of those people actually turned up on the day. Likewise, dates that coincided with other commitments (exams, end of the school year etc.) suffered low recruitment, and participants frequently found that courses shorter than 90minutes were too short to fully engage with the content available (especially any practical activities). Future courses should be planned to avoid such problems.
10. Space Science teacher workshops are capable of attracting participants from across the teaching spectrum, including pre-school (kindergarten) to upper secondary levels. They also (somewhat uniquely) cater very well for non-STEM specialists (especially geography teachers); such opportunities should be pursued further to encourage space science content to be embedded across the curriculum.

Data collection

11. Collecting ‘sensitive’ data regarding student cohorts (especially minority status but also gender) proved extremely challenging in many countries (see section 3.2.1 for further details).

In compiling this report we wish to acknowledge the very important contributions of the various partners and nodes who ran the training workshops and managed the data collection processes at local level, as well as the teachers who willingly contributed. Your efforts have been a tremendous help in determining the impacts of the training workshops, and offer a valuable contribution to ongoing space science teaching throughout Europe and beyond. Thank you.

5 List of appendices

Note that to avoid overburdening this document, the annexes have been [provided online](#) (to download individually, click on the links below).

[Annexe 1. Teacher training – pre course form](#)

[Annexe 2. Teacher training – post course form](#)

[Annexe 3. Teacher training – data entry for nodes](#)

[Annexe 4. Workshop feedback form – course organisers](#)

[Annexe 5. Follow up feedback form – course organisers](#)

[Annexe 6. Workshop reporting template](#)

[Annexe 7. Research registration form](#)

[Annexe 8. Evaluation protocol overview](#)

[Annexe 9. Space Awareness teacher training workshops guidelines](#)



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