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An Evaluation of the Bradford Robotic Telescope



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Executive Summary

As the Select Committee on Science and Technology (2002) noted, the UK faces a shortage of professional scientists and technicians:

“...the proportion of A level entries accounted for by chemistry and physics is falling. This matters because young people are, at age 16, closing off the option of entering a career in science or engineering at a time when the UK is suffering from a shortage of scientists and engineers. Physics A level has seen the most marked decline in popularity, while biology has largely retained its popularity...”

It is at university level that the big decreases in take up have been seen in some areas of science and engineering. Between 1995 and 2000, while there were increases in the number of students studying biological sciences at undergraduate level, the number of entrants to chemistry degrees fell by 16% and to physics and engineering degrees by 7%.”

The Bradford Robotic Telescope (BRT) website provides an excellent classroom tool for engaging young people in the practical application of science and enthusing them to consider a career in science.

“Amazing.” 10 Year Old Pupil

The website is currently completing its development and testing phase. Despite there being very little marketing of the telescope there are over 5,000 regular users of website, the majority of whom are teachers and students based in England and Wales.

The website is also used by professional and amateur astronomers providing students with access to the work of professional scientists.

A very high proportion of users would recommend the site to a friend or colleague. The website is easy to use; in fact, students find it even easier to use than their teachers do. Although the telescope is being used across all Key Stages in UK schools and within further, higher and adult education, its main benefits are at Key Stages 2 to 4, as there are no other resources targeting these age groups. Use at Key Stage 2 is seen as an important feature of the site as few primary teachers are from a science background and the website can instil a curiosity in science amongst young people. For this reason, the team have done much to support teachers at Key Stage 2.

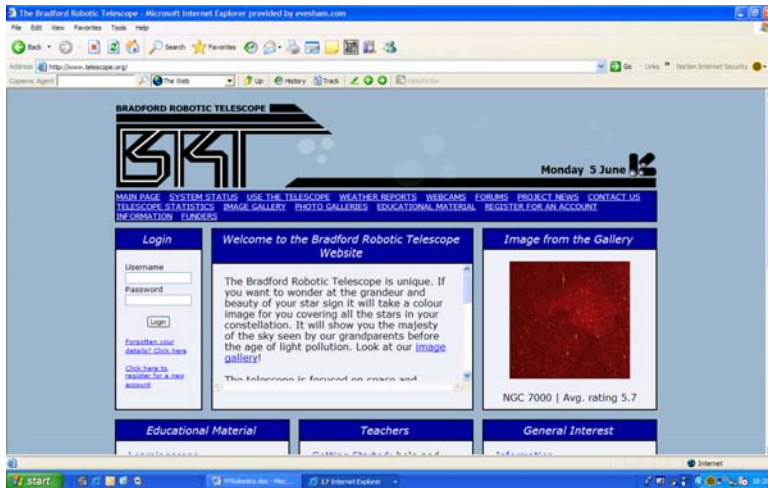
The website is being used across all ability ranges, including those with special needs. It is suited across all learning styles and this is seen as an important attribute of the site.

Although Astronomy only forms a small part of the Science curriculum, proposed changes to Key Stages 3 and 4 in England and Wales, emphasise the practical application of science. It is therefore, likely that the site will start to experience exponential growth.



The funding for the website from the Particle Physics and Astronomy Research Council, will not cover its continued use and there are no other obvious sources of funding. The website will close shortly, unless an alternative source can be found.

Background



The Bradford Robotic Telescope (BRT) provides an extensive resource for education, with teaching materials for primary and secondary schools. It allows students to learn about astronomy and other areas of the curriculum through on-line lessons and requesting jobs from the telescope. Situated in Tenerife, it operates in the visible band and looks at areas of the sky or single objects. It is accessed from a website

(www.telescope.org called the website in this document) allowing pupils to send jobs to the telescope to photograph objects. The Bradford Robotic Telescope has become an extensive e-teaching and learning website, focussed on the Earth and Beyond sections of

the National Curriculum and supported by a robotic telescope. In this role, it has demonstrated that it is a facility that is inspirational in the classroom for teachers and learners and can support the learning programmes of all students in the UK.

There are a wide range of teaching resources on the website supporting the English and Welsh National Curriculum. The website can accommodate large numbers of users at the same time.

At the heart of the website is the concept of an e-STEM laboratory. An e-STEM laboratory is a new type of learning website supported by a real world facility which provides real time access to operational data to support learning programmes. The learner has a degree of freedom to define which data they wish to obtain from the facility and to generate information in support of their learning programme. This could be extended to many other areas of the curriculum, by looking at the real world science used across a range of industries. Indeed, the BRT team have already developed this concept in a power station.

Core benefits of this approach include:

Just-In-Time Learning: deliver knowledge on-demand, with up-to-the-minute information;

Flexibility: students can choose from a variety of interactive self-paced, and they can take advantage of an extensive resources;

Customisation: e-Learning content can be tailored to the interests of individual groups;

Learning Effectiveness: retention rates of 25-60% more material in an interactive online environment;

Measurement: e-Learning can provide a myriad of tools to monitor student's progress and produce detailed usage reports.

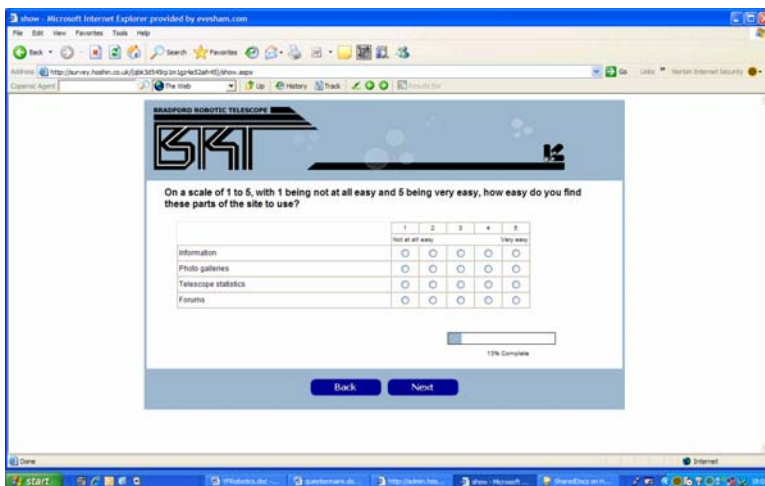
The Methodology Used

Aims

The main aims of the project were:

1. To evaluate the robotic telescope project.
2. To consider its future potential in providing an innovative and accessible facility that engages school children and maintains their interest in science.

Secondary Research and Evaluation of Management Information



Hoshin assessed and evaluated materials provided by the University of Bradford. In addition, we assessed website usage, including where possible repeat visits, Hoshin made full use of this data to develop a profile of use, time spent on the website and repeat visits.

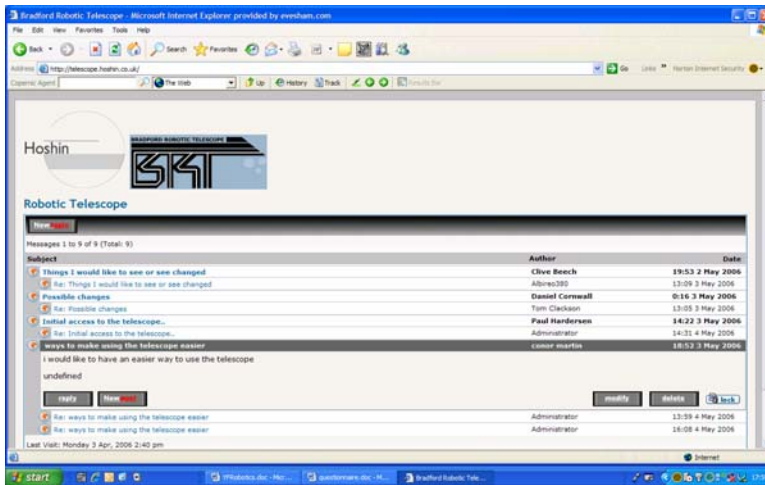
We used our proprietary web surveying and automated emailing software to engage users in our on-line survey. There are currently over 5,000 registered users, with 300 teachers and 2,000 students. At Hoshin, we have been developing on-line survey, focus group and consultation software for a number of years. The system is based on our

proprietary survey software. Unlike 'off the shelf' systems we were able to develop a look and feel to the system which complements the Bradford Robotic Telescope's corporate identity. We believe that this added gravitas to the consultation and greatly increased the response rate.

Issues we explored through this on-line survey included:

- Country of origin;
- Type of user (education, industry, private);
- Ease of use;
- Reasons for use;
- Main modules accessed;
- Satisfaction with website;
- UK Educational Users:
- Key Stage;
- Curriculum areas;
- Benefits of the system;
- Use of the system.

Virtual Focus Groups with Users



We included in the system the ability to enter lengthy textual responses and for respondents to add features to the text, such as bold and italic. This is based on the system we have developed for on-line Delphi and Focus Groups. **Hoshin** included this module within the on-line consultation suite and automatically include access to all teachers based in the UK that have used the website on a number of occasions. The great benefit of these features is that it enables two-way consultation, with respondents modifying their views as they gain more understanding of the subject. During this phase, we also explored the longer-term impact of the

website on teaching and students attitudes.

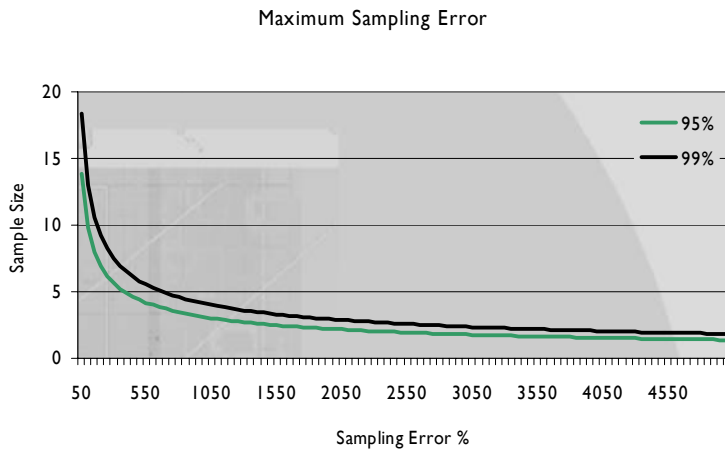
Face to Face Interviews with Users and Partners

In order to validate the results of the on-line research we augmented this with some face to face interviews. Whilst partners such as Sheffield Hallam University and SETPOINT West Yorkshire, provided evidence on the longer term impact, we are also meet with some schools to assess attitudinal and behavioural change. In total, we conducted 9 face to face interviews with users and partners and a mini focus group with trainee teachers.

Detailed Research Findings

Use of Website

There are over 5,000 registered users of the website. The web survey of users generated 1,415 responses, this suggests a response rate of around 28%. This is below that achieved in other recent web surveys Hoshin have completed, but is higher than we can currently achieve using postal survey methods. Indeed, we believe the survey to be reasonably robust with a sampling error of around +/- 2.6% at 95% probability (the norm for this sort of research).



The website generates high levels of traffic, over the year from May 2005, the website had over 1,200,000 visitors, with 59% of those occurring this year. This suggests that the website is currently enjoying high levels of growth in traffic. Around 40% of those hitting the website never return to it. The website is linked to webcam and weather report portals and we believe that a lot of traffic is generated by users who have no interest in the telescope (around 36% of all traffic). Despite these links, a group of trainee teachers claimed that the site was difficult to find from search engines.

Thirty-six percent of users go to the website by typing in its URL into their browser, or via a bookmark. Only around 10% of users reach the website via search engines the most popular searches being 'galaxies', 'stars', lifecycle of a star', 'stars and galaxies' and lifecycle of stars'. Further investment would be desirable to ensure the websites reliability and that it meets the demands of new users. This is largely to avoid the downtime that occurs during bad weather and when the robot has been damaged.

The survey reveals an extremely high gender differential with 86.2% of users being male; however, 54.0% of UK users are female. This reflects the large number of UK based teachers using the website, a high proportion of whom are female.

Overall, 36.7% of respondents were UK based and 20.2% from the US, however, amongst registered users 45.4% are from the UK and the US accounts for 19.8%. Forty-four percent of respondents are connected to teaching institutions, either as teachers or students, rising to 48.2% of UK based respondents. This included 210 who were UK based teachers, lecturers or teaching support staff and 249 UK based students. Although this is very positive, it is also true that the many of the users are amateurs with an interest in astronomy, or professional scientists, and not students. However, many educationalists see this as an extremely important feature of the website; as there is a strong belief that there is a need to connect classroom science teaching with real world science activity. Whilst games and simulation may achieve the same learning outcomes, it is only through introducing

knowledge management for the information age

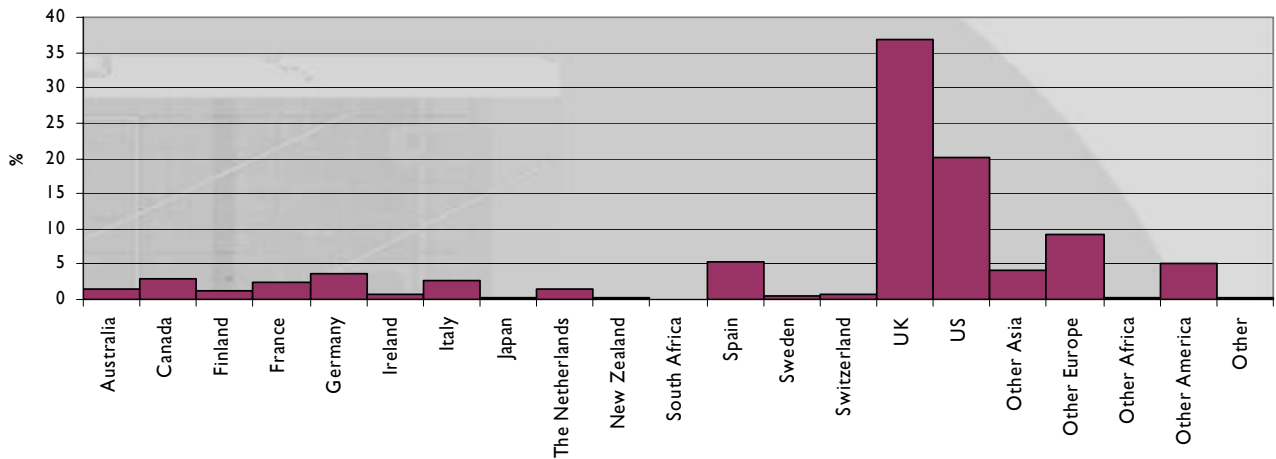
the real world into the classroom that young people may be motivated to pursue a career in science.

“There has to be real world activity not simply asking questions.”

“We attempt to involve real scientists and science.”

“Forging links with the science community is certainly important.” Trainee Teacher

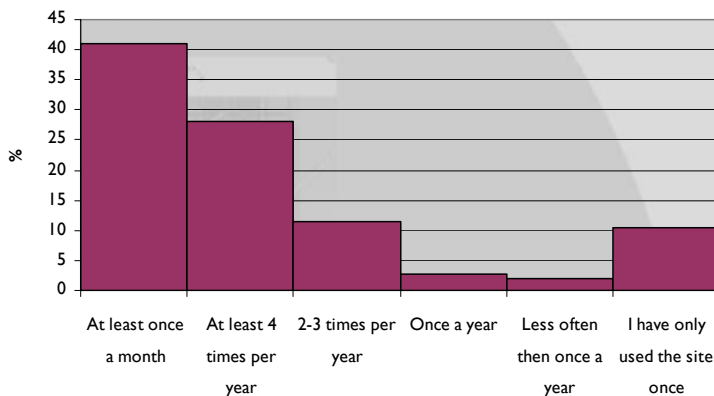
Residence (% of respondents)



This feature will become even more important as changes to the science curriculum at Key Stages 3 and 4, will place much greater emphasis on the practical application of science.

Frequency of Use

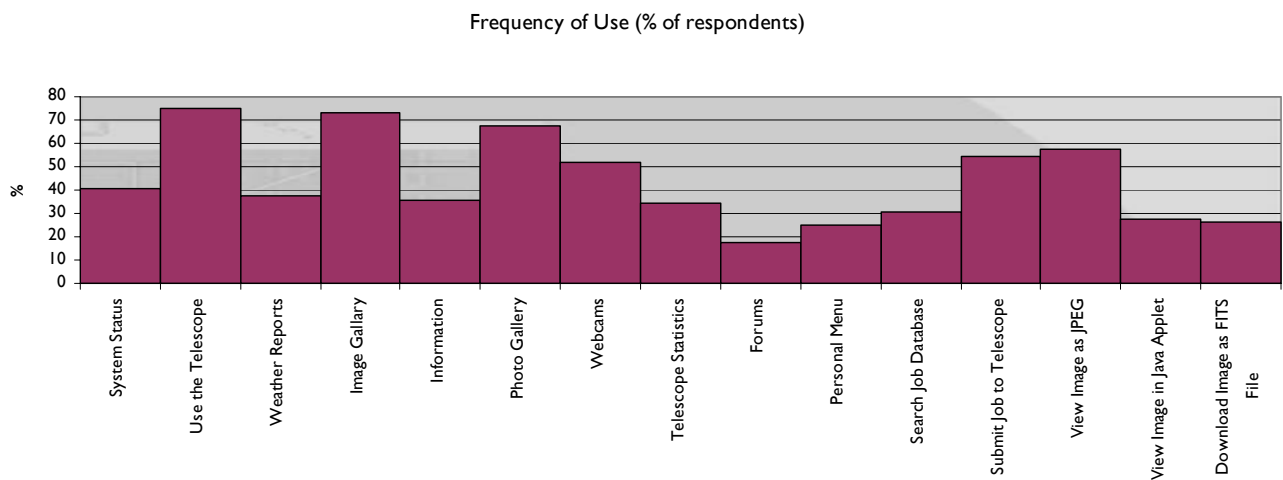
Frequency of Use (% of respondents)



The results related to frequency of use are extremely positive, 41.1% of respondents use the website at least monthly. Although frequency of use falls to 36.7% of those based in the UK, it rises again to 43.5% of those who are UK based teachers or students (and 48.3% of those connected to a further education college). Perhaps surprisingly students and teachers are about equally likely to use the website monthly. Whilst this could indicate extensive use of the website in those classrooms that are using it, it could also mean that teachers are using the website for a number of classes and students are logging onto it at home. This would appear to be an extremely encouraging feature of the website, in its ability to motivate young people to log

onto it when outside the classroom. Students at universities would appear to be the most frequent users as 53.1% of students aged 20-24 use the website at least monthly, however, a high 48.9% of students aged 16-17 use the website at least monthly (although given that many younger students have not registered using their own email addresses, the sample will inevitably be skewed towards older students). Use is more frequent in post-16 education (46.2% at least once a month), although this is fairly evenly distributed amongst the teachers of the various Key Stages.

The main use of the website is for its core features of viewing images. Much lower use is made of the various support and community resources. However, these resources are important features of the website, that underpins individual's satisfaction with it.



Ease of Use

Respondents were asked how easy they found the website to use on a scale of 1 to 5, with 1 equalling not at all easy and 5 equalling very easy. In the main teachers find the website easy to use, although many feel that the home page could be more user friendly, especially for young people. Overall, the website was rated at a respectable 3.9, however, it is clear that some people are experiencing difficulty in using the website. Indeed, 2.9% of users claim that it is not at all easy to use, fortunately this falls to 1.8% of UK based users and 1.9% of education users. Very interestingly, 17.7% of primary school children claim that the website is easy to use. Even more interesting is to find that students appear to find the website easier to use than teachers, suggesting that those who find the website least easy to use could be less experienced using the internet in general. Certainly, it is true that younger people appear to have less difficulty in using the website than older age groups.

"The websites designed to be easy to use." Teacher describing student use of the website

"It's easy to use." Trainee Teacher

Because many teachers will log on to the website to find an immediate resolution to an immediate problem (for example how to teach the space module tomorrow), it is likely that many log on, but do not use the resources. In fairness to the designers, it is a large site that simply imparts complex information ('it covers a lot of stuff', 'I probably wouldn't use it a lot'), nevertheless some redesign of the home page, or a teachers' home page, would be welcomed. One teacher who had logged on and subsequently went on a training course commented.

*"Without knowing a lot about it, I didn't use it."
 "Even within an hour you don't get that far."
 "It does a lot, but you need to have training."*

Despite most users finding the website fairly easy to use, those experiencing difficulty are highly vocal about it, mirroring consumers' criticism of web based systems, in general. In addition, it needs to be recognised that even minor usability issues can prevent user from returning to websites.

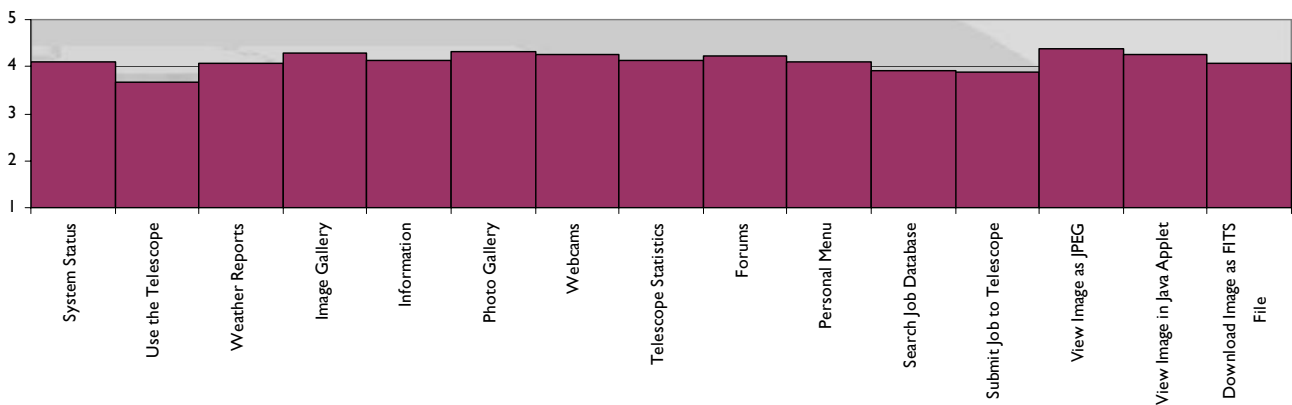
"I would like to have an easier way to use the telescope."

The sections that appear to be the most difficult to use include:

- Use the Telescope;
- Search Job Database;
- Submit Job to the Telescope.

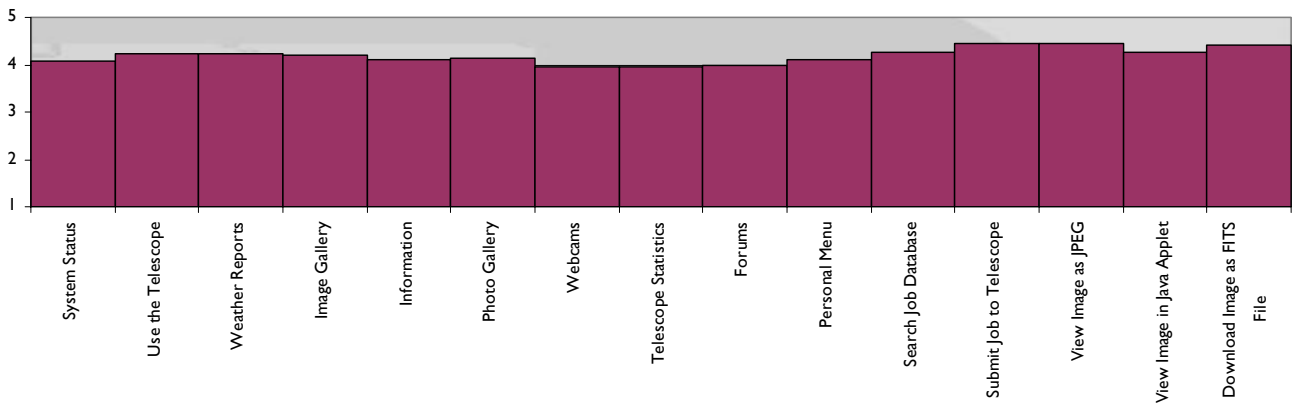
All of which are core features of the website and some redesign of these features is being progressed.

Ease of Use (Mean on a scale of 1 to 5)



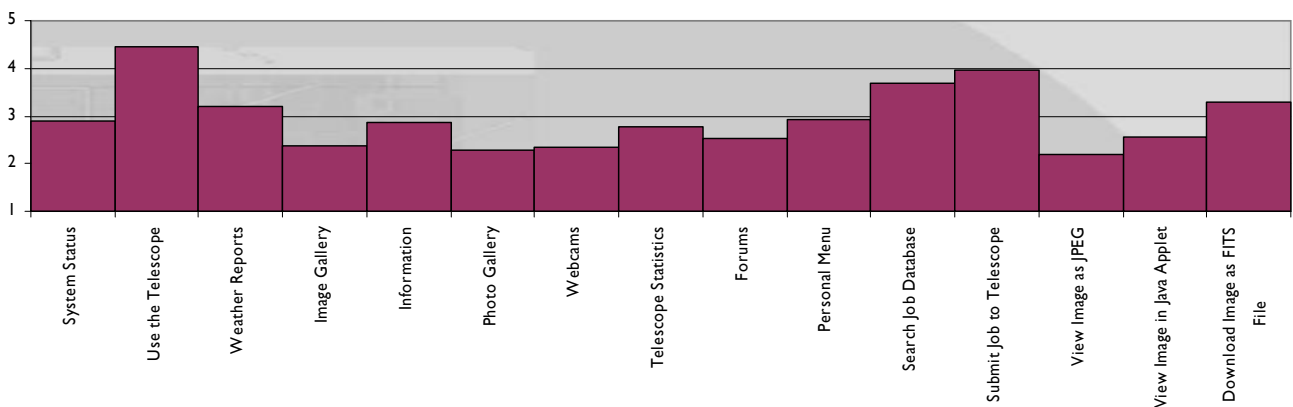
Respondents were also asked how useful features of the website were, again on a scale of 1 to 5, with 1 equalling not at all useful and 5 very useful. Overall, this reveals that users rate most features as useful, with only Webcams, Telescope Statistics and Forums rated below four.

Usefulness (Mean on a scale of 1 to 5)



By combining the score for ease of use and usefulness we are able to construct a usability index, this very clearly shows that attention needs to be paid to making Use the Telescope, Search Job Database and Submit Job to Telescope more user friendly.

Useability Impact (Index)



Very encouragingly, the mean score for likelihood of using the website again was a high 4.2, rising to 4.3 for UK based respondents. Those based in further education colleges are the most likely to use the website again (4.2), less positively teachers are more likely to return to the website than students. The mean rating for recommending the website to a friend is 4.1, rising to 4.2 for respondents from the UK and those in education. Coupled with the observed growth in use of the website, this suggests that the telescope team are likely to see an exponential growth from UK educators. In fact, with the changes to Key Stage 4 in 2006 and Key Stage 3 in 2008 to accommodate a more process approach to the teaching of science, we anticipate a groundswell of interest in the website.

Educational Use

Of those responding to the survey 210 were UK based teachers, lecturers or teaching support staff and 249 UK based students. A large proportion of students using the website do not log on using their own email addresses, therefore, the sample of students is inevitably skewed, probably towards older students, who are likely to have their own email accounts. Although these sub-samples are much lower than the total sample, it nevertheless is more than large enough for us to be very confident in our findings related to education in the UK. In fact, the maximum sampling error for teachers is +/-6.8%, at 95% probability, which is robust enough to draw conclusions from.

Educationalists (and to a lesser extent teachers) believe that the website is suitable from Key Stage 2 up to undergraduate level.

"You can get the wow factor down to 9 to 10 year olds."

It can be used across a range of subjects, but specifically for science and maths. The applications in engineering, technology and even citizenship are currently underexploited.

"It could encompass enough to be homogenous."

It is clear that the website is being used at all Key Stages and has been used across all ability ranges, indeed at one school it had been used by some very able Year 9 pupils and some special needs Year 7 pupils and appears to have been well received by both groups. In fact, the survey suggests that 3.3% of teachers are using the website for Key Stage 1 (despite not having been designed for this age group), 16.4% for Key Stage 2, 18.0% for Key Stage 3 and 30.3% for Key Stage 4. Overall 6.6% of teachers are using the website in primary schools, 40.5% in secondary schools, 5.6% at further education colleges, 3.9% in adult education colleges and 36.0% at a university.

"I found the BRT always kept students guessing at what they'd be doing next and it's this variety that is so important to keep pupils interested, engaging in learning."

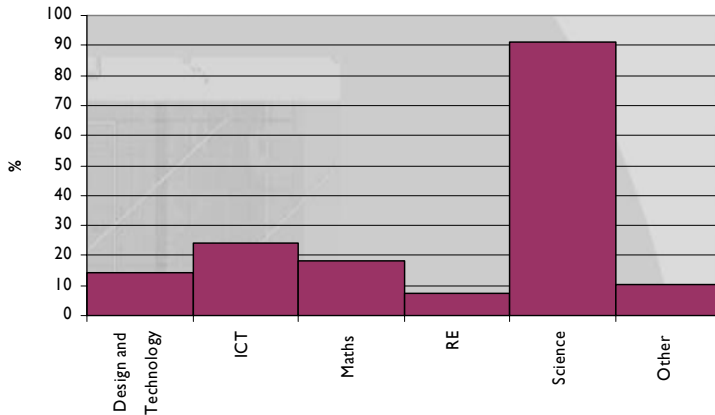
"Some kids came back and said I've got a photo and this was a school coming out of special measures."

When asked to rate the websites suitability for teaching across age ranges, on a scale of 1 to 5, with 1 being not at all useful and 5 being very useful the mean was 3.5. As this drops to 2.8 for Key Stage 1, it would appear to vindicate the view that the website is less suited to this age group. In fairness to the website team the site really has not been designed for use at Key Stage 1 and it is therefore a testament to its adaptability that it is being used for children at this young age.

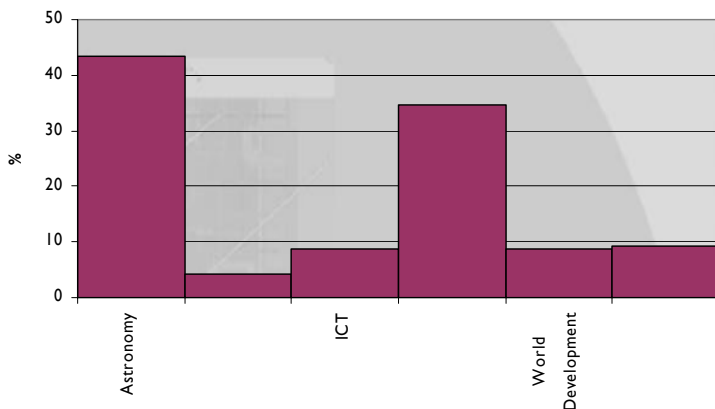
"I looked at your web page for suitable topics for children aged 7 to 11. Children of this age respond well to visual images and I found the shots of the moon in its various phases to be the most suitable. The task set as for children to write and illustrate a poem entitled 'I see the moon'. They will be able to use the telescope's surface image and photos of different phases etc, of the moon to satisfy the learning intentions outlined in

the Science National Curriculum for Primary Schools. Related topics are Earth, Sun and Moon, Light and Shadows, etc. Although not directly linked to the NC clearer images of named star formations and planets would also be of interest to children.” On-Line Post

KS2/3 Subjects Taught (% of respondents)



KS4+ Subjects Taught (% of respondents)



A number of teachers (especially trainee and new teachers) commented that the GCSE Science curriculum is so full of content that there are few opportunities to stray from the scheme of work. For this reason, they were making extensive use of the site at Key Stage 3.

“I want to use it as the main teaching tool for Year 7.”

“I see it as more relevant for Key Stage 3 than 4.”

Although it is possible that we achieved a higher response rate from more mature students (due to the sample frame not including as many younger students who have not registered using their own email addresses), the survey would suggest that independent use of the website by students is mainly amongst those at a University, with 57.2% of student respondents being 18 or over. However, this leaves 19.0% of students users in the 16-17 age group and 22.6% aged 10 to 15. There was also a response from a 8-9 year old user.

“I think some of them went home and logged on, whilst they weren’t logging onto revision websites.”
Year 9 Science Teacher

Kolb's learning theory sets out four distinct learning styles, which are based on a four-stage learning cycle. Kolb includes this 'cycle

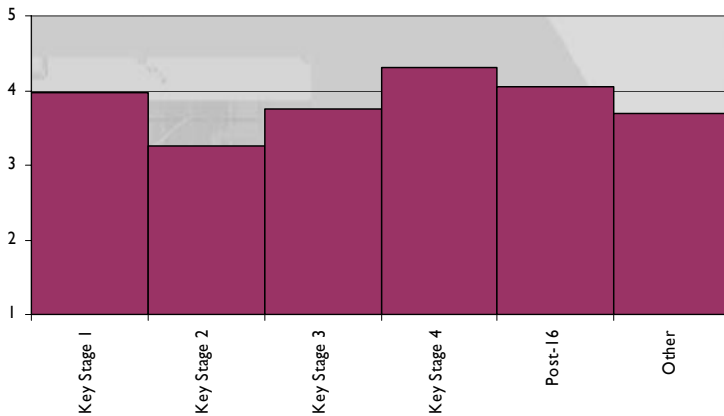
of learning' as a central principle his experiential learning theory, expressed as four-stage cycle of learning, where 'immediate or concrete experiences' provide a basis for 'observations and reflections'. These 'observations and reflections' are assimilated into 'abstract concepts' producing new implications for action which can be 'actively tested' creating new experiences.

More recently, educationalists (especially Sternberg) have looked at the senses to differentiate learners learning styles, it is normally expressed as follows, although there are a number of variations (the one that follows is referred to as VARK):

- Visual Learners;
- Auditory Learners;
- Reading/Writing Learners;

- Kinaesthetic Learners.

Usefulness for all Learning Styles (Mean on a scale of 1 to 5)



In terms of the websites ability to support a variety of learning styles the mean rating was 3.4, on a scale of 1 to 5 with 1 equalling not at all useful and 5 equalling very useful. However, this falls to 1.8 for teachers of Key Stage 1, rising to 3.8 for teachers of Key Stage 3. It would therefore seem that the website is suited to the more able students at Key Stage 1.

“There’s a lot of mathematics and visual materials for all learners.”

“They find it an abstract idea, but the website does it so simply.”

“The different learning styles worked exceptionally well.”

One teacher had used the website for a less able Dual Science GCSE group and a very able single subject Physics GCSE, she had found that the more able group had responded very well, the less able had not.

“One group were superb and loved it, the other group were not turned on by it.”

It would, however, be wrong to read too much into this observation, as it could be more a product of group dynamics than a reflection on the websites suitability by ability range.

“You show a website to one group who love it and others don’t even use it, even though they’re the same ability.”

Resistance to Educational Use

Some teachers were more guarded in their praise for the website, believing it to be marginal to the needs of most science teachers.

“If you’re teaching a syllabus and exam, that’s what you’re focusing on.”

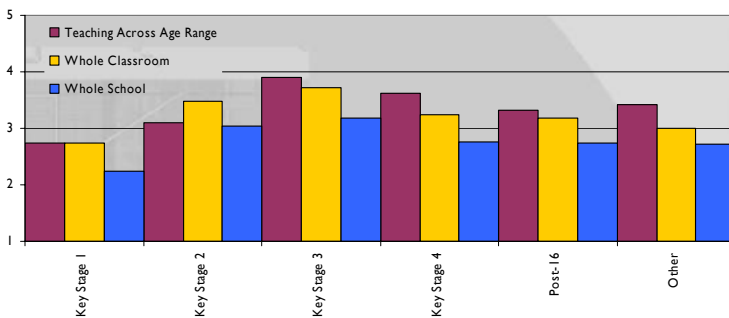
“I would use it in a fairly limited way.”

At Key Stage 2 and 3, it is clear that teachers are teaching across a range of subject, but by far the highest proportion claim to be teaching science. Whilst at a Key Stage 4 and above a high proportion claim to be teaching astronomy. The website is also clearly used when teaching science for public understanding. Even those teachers who are full of praise for the system tend only to use it within the Gravity and Space module at Key Stage 3. Although they do recognise that it can be used in other parts of the curriculum, the additional effort in developing lessons around the website is not deemed to be worth it. Unfortunately, this is fairly marginalised within the Dual Science GCSE and is a part of the reason for the low take up of the site.

“It’s a very small part of the curriculum.”

On a recent event promoted by SETPOINT West Yorkshire the take up amongst teachers in West Yorkshire was from only two percent of the schools in West Yorkshire. This probably illustrates that currently astronomy is marginalised within the curriculum and that only dedicated astronomers would make the necessary connections with other parts of the curriculum.

Appropriateness to All Students (Mean on a scale of 1 to 5)



“When you speak to teachers and those involved in promoting science, why aren’t they enthused?”

However, due to the proposed changes to Key Stage 4 and 3, the telescope begins to become much more of a mainstream resource providing an understanding of how science works.

A particular barrier to using the system may lie in the domain of IT resources, as in most schools, teachers find it difficult to arrange to use a computing lab for their lessons and

therefore find it difficult to plan for a whole class to utilise the website.

“I didn’t use it in my last school as I couldn’t get an IT lab.”

“You have to book the lab months in advance.”

“You couldn’t get the IT lab for that long.”

This problem is exacerbated for trainee teachers and newly appointed teachers, who are likely to be unsure if they can gain access to the IT lab and therefore, unlikely to include use of the telescope in their lesson plans.

This could partially explain the mean of 3.3 for teaching across the whole classroom. However, as this falls to 2.8 for Key Stage 1, it is also likely that some teachers have their reservations about the websites appropriateness for all learners. Indeed, for teaching across the whole school the mean falls to 2.9 and is only rated at 2.3 for Key Stage 1. As previously stated the website has not been designed for use at Key Stage 1 and it is a reflection of its adaptability that it is being used for this young age group. What is clear from these results is that the website is felt to be most appropriate to Key Stage 3, this is in sharp contrast to the usage of the Liverpool and Faulkes Telescopes and highlights Bradford’s unique contribution to education in the UK.

“There aren’t many resources for astronomy.”

However, this should not diminish the great interest the site will generate when the curriculum is changed at Key Stage 4 and the need to engage with young people in practical science at Key Stage 2.

“Teachers will be seeking out resources.”

Impact on Pupils and Teachers

Educationalists believe that the website has great potential.

“There’s a lot of science that is mainstream, Bradford has a lot more to offer.”

“They [teacher trainers] were very enthusiastic when they saw the website.”

Indeed, Barry Sheerman MP, Chair of the Select Committee on Education and Skills stated that:

“Its an inspirational tool for encouraging young people to take up science.”

One possible reason this has not been achieved is that the learning materials have failed to capture the real potential of the website.

“There’s not enough cutting edge input from teacher training professionals.”

“Materials need to explore blended learning to a greater degree.”

Many of the teachers we spoke to had not used the lesson plans on the website, preferring to develop their own. There was also a concern that the lessons on the website were too generic and therefore not suited to all classes (e.g. not long enough) and they felt it easier to develop their own. There is also the view that the website required further development prior to it becoming generally accepted by teachers.

“Need to take something new to the market.”

“I’ve not used the lesson plans as I didn’t have enough time with them [the students], I was only doing an hour long revision session... but I based it on one of the plans.”

Paradoxically, the take up of the resource is hampered by the extreme lack of innovation and risk taking within school science teaching.

“The science curriculum is stuffed with content.”

“We’ve very little time at Key Stage 5.”

“The risk taking has disappeared because teachers feel under-pressure from standards and OFSTED.”

In fact, the group of trainee teachers expressed how little autonomy they felt they would have as teachers, having to stick to the school’s scheme of work and in some cases even predetermined lessons. If this is the case, there is little or no room in schools in England and Wales for exciting resources like the Bradford Robotic Telescope. Certainly, it suggests that much more needs to be invested in marketing the site and that even after the site has reached a critical mass this investment needs to continue.

It could be that teachers will only look for lesson plans when teaching a new subject and therefore the lesson plans are much more likely to be used by new teachers.

“I used it on my first teaching practice.”

“As a first time teacher I found the lesson plans really helpful they’re full of interesting ideas and experiments.”

“For any teacher who would be reluctant to use this learning programme, most of the planning is already there and they need not worry, I didn’t know anything at all about astronomy and I have been able to do it. There is an extensive set of teachers’ notes that are really helpful. I am not science trained and the children were asking a lot of questions.”

Unfortunately, this view was not universally accepted by trainee teachers who saw the website as one of many resources they had been exposed to during their training and one which was marginal to their main areas of teaching.

“Given the subject, you are very limited in what you can do.”

This is because the website is still currently of greatest appeal to the professional astronomer and despite having many resources for teachers, it does not feel immediately appropriate as the Teacher Net does.

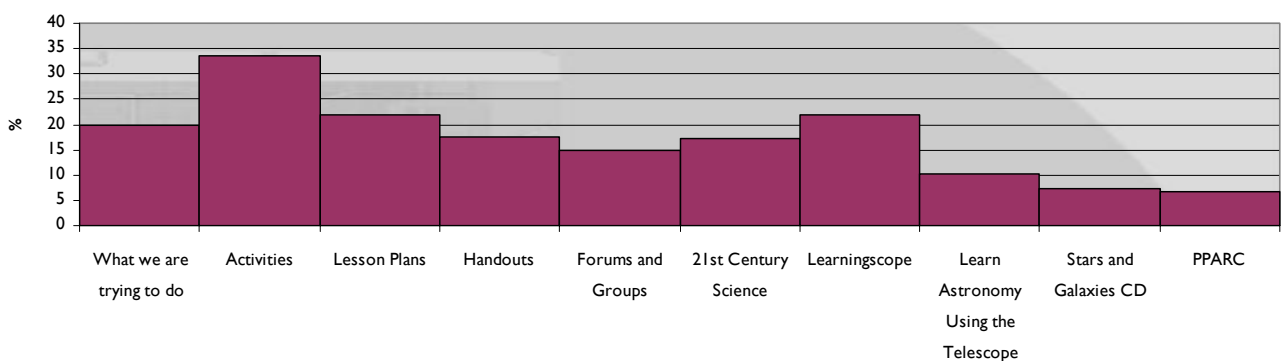
“It sounds exciting but in reality it is anything but.”

“I have used other sites.”

Although the website has not been designed to be like Teacher Net and the comparison is a little unfair (Teacher Net provides teachers with Power Point resources and lesson plans, whereas the website uses paper based plans allowing teachers greater flexibility), it is nevertheless a comparison used by teachers during the research.

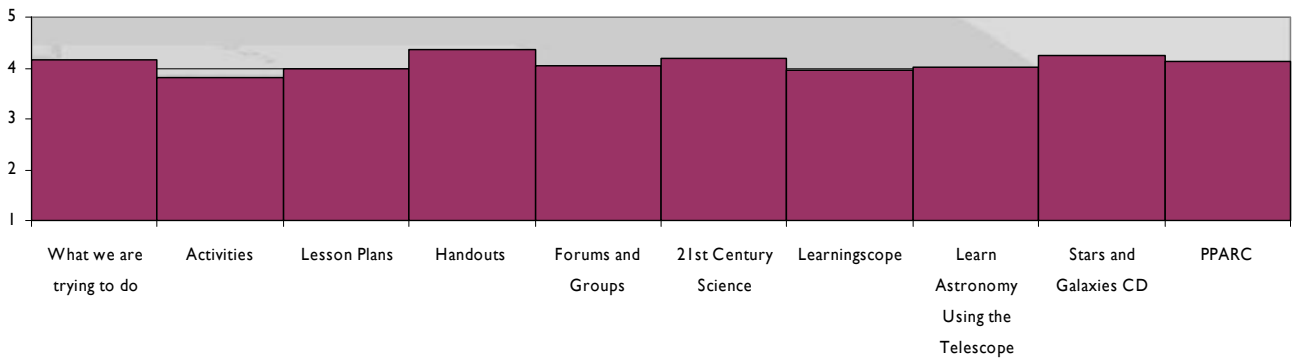
These views were born out in the survey with very few of the teaching resources being used. In fact, only 21.8% of teachers have used the lesson plans, although 33.5% used the activities.

Resources Used (% of respondents)



However, it would appear that for those who have used the teaching resources, they are very satisfied with them. This highlights the extreme difficulty in getting teachers to change their teaching methods in the classroom and the extreme time pressures they must be under, not to utilise these resources.

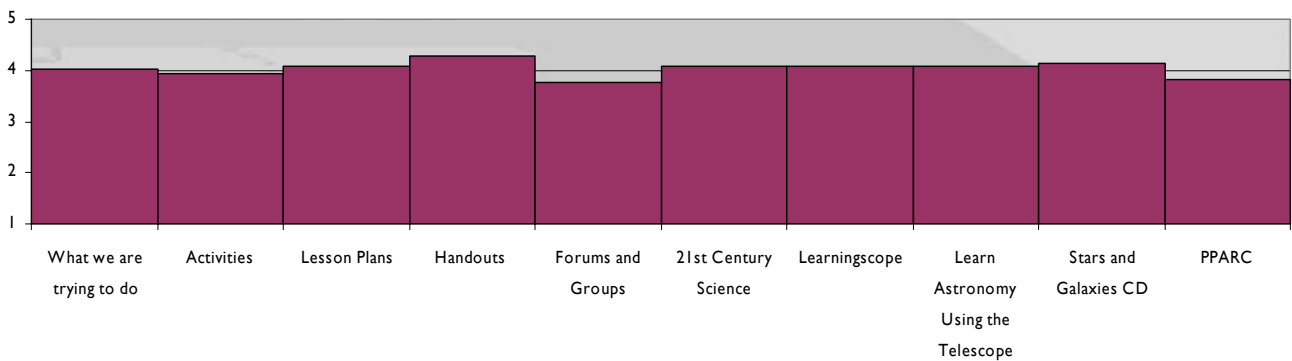
Satisfaction with Resources (Mean on a scale of 1 to 5)



“They really liked the Learning Scope.”

Teachers also feel that the resources are useful, but nevertheless fail to use them to their full potential.

Usefulness of Resources (Mean on a scale of 1 to 5)



Affect on Science in Schools

Overall teachers believe that the website has had an impact on young people’s interest in science.

“Most of the kids like space the best.”

“It’s getting them into it.”

“Amazing.” 10 Year Old Pupil

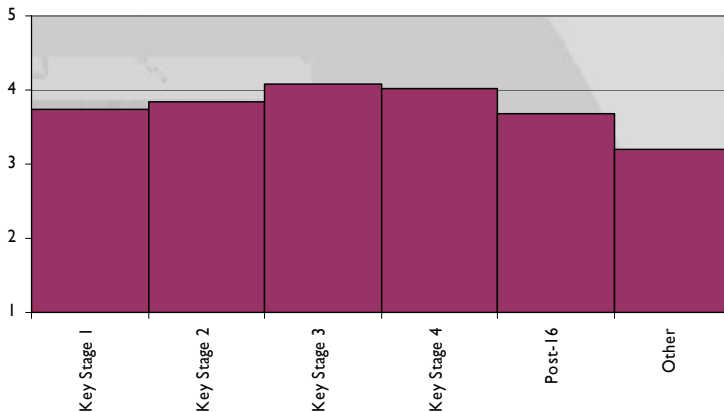
“They liked the interactiveness of the site.”

“Talking to my Year 8 class after Christmas, I mentioned the website, the class replied that they remembered using the telescope last year with their teacher. It’s good to see that the experience is still memorable long after they’d finished using it in class.

Presumably, a large number of students were sufficiently motivated by the website that

they have continued using it in their own time. One student even received a telescope for Christmas and I'd like to think that was more than a co-incidence."

Find Out More About Science (Mean on a scale of 1 to 5)



Whilst the website is yet to achieve its potential, there is a belief amongst professionals that it could have an impact on the numbers of young people pursuing careers in science.

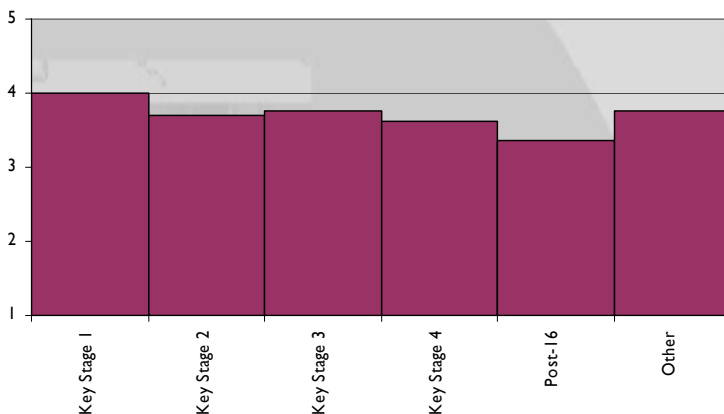
"Research tells us it helps to get kids motivated." "Every little helps."

Indeed, many are gushing with praise for the website, including Barry Sheerman MP, Chair of the Select Committee on Education and Skills.

"This is a breakthrough in the educational world that must be developed, made more accessible and promoted to the stars."

These views were substantiated during the survey, with a mean rating of 3.9 on the website resulting in users finding out more about science (on a scale of 1 to 5, with 1 equalling not at all likely and 5 equalling very likely).

Increase Students Interest in Science (Mean on a scale of 1 to 5)

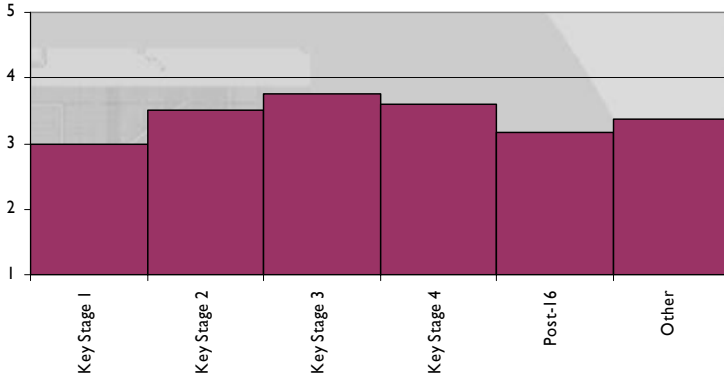


The mean remains at 3.9 for students, rising to 4.1 for primary pupils, although critically it is only 3.6 for 15 year olds, the time when they will be studying for GCSE Science. GCSE Science has been heavily criticised by Select Committee on Science and Technology for putting young people off further study, the results of this survey add further weight to this conclusion.

"The GCSE science curriculum is over-prescriptive. This puts students off science because they do not have the flexibility to explore areas which interest them. It kills the interest in science which may have been kindled at primary school." Select Committee on Science and Technology (2002, A 1).

When teachers were asked if the website had increased students interest in science the mean was 3.8. Rather unexpectedly, teachers' perceptions by Key Stage are at variance with those of their students, with teachers underestimating the impact at the critical Key Stages 3 and 4. In terms of increasing students understanding of science the mean falls to 3.7, nevertheless this is still positive. This rating is highest for Key Stage 3 and lowest for Key Stage 1 (perhaps not unexpectedly). For understanding the practical application of science the rating only rises to 3.8, suggesting that more materials could be devoted to the practical application of astronomy and space.

Increase Students Understanding of Science (Mean on a scale of 1 to 5)

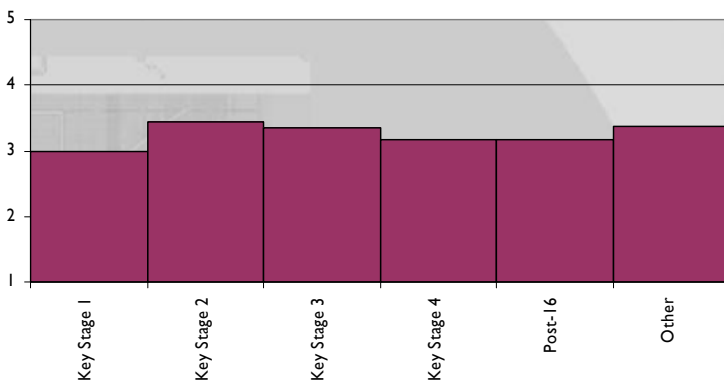


“Some people could become really turned on by it.”

However, it is also true to say that most users claim that they are already very interested in science in general (with a mean score of 4.5 on a scale of 1 to 5, where 1 equals not at all interested and 5 equalling very interested). This falls to 4.4 for those based in the UK, suggesting that whilst UK users include many educational user, many overseas users are amateur astronomers. Positively, the mean rating amongst UK students is 4.5, which bears out the findings of earlier research by Hoshin (2005) for Yorkshire Forward, which suggested that

there is no lack of interest in science amongst pupils in the UK, but a lack of interest in studying science, especially GCSE science. Also critically, interest in science is lowest at the age of 15 with a mean of 4.1.

Increase Likelihood of Students Continuing to Study Science (Mean on a scale of 1 to 5)



Overall teachers rated the website at 3.6 in terms of its usefulness in encouraging students to continue to study science in later years. Whilst not particularly high this is nevertheless positive. Again, this is highest at Key Stage 3, but remains fairly high for the critical Key Stage 4.

“It might get students more interested in astronomy.”

The mean for continuing to study science is 4.3, although falls to 4.1 for the UK. Once again, interest trails off for secondary school pupils to 4.1 and 3.9 for 15 year olds. Despite these somewhat pessimistic results, they still show that even 15 year olds are interested in

continuing to study science and that the telescope is contributing towards this.

The mean for working in a science-based occupation is a high 4.0, but falls to 3.7 in the UK, this rises again to a positive 4.0 for UK based students. Perhaps the most positive feature of the website in promoting science to young people, are the forums which allow students to enter dialogues with professional scientists, providing a concrete link to a career in science.

Value for Money

Professionals recognised that there exist a number of relatively inexpensive ways of marketing the website to teachers. Notwithstanding this, we believe that the

marketing costs represent the sorts of costs that have not so far been considered in the development of the website.

“The current push should be via teacher training institutes, so that all future teachers would get use of the website.”

Teachers and professionals believe that in terms of integration into the science curriculum the website is still experimental and that there is a more work required with teaching professionals before the website can be mainstreamed. In terms of the technology the website is clearly working, however, there needs to be more attention paid to teaching innovation for the website to be mainstreamed in schools. In reality, much of the work has been done and the product is close to market, but it would be wrong to underestimate the costs of developing the website further and marketing it.

“I see it as real innovation.”

“Unless you get an enthusiastic astronomer in the classroom, it won’t be used.”

These concerns were highlighted by **Hoshin** (2005) in our report on STEM activities to Yorkshire Forward.

“Our concerns can be summarised with reference to the Ansoff Matrix. Where activities are delivered within an organisation with natural links to schools they are simply engaged in market penetration (or product development), whilst when delivered by an outside body this is an example of market development (or diversification).”

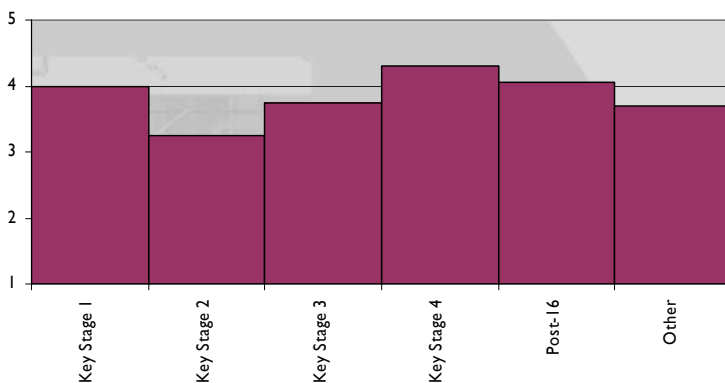
	Existing Products	New Products	
Existing Markets	Market Penetration	Product Development	<p><i>When Ansoff developed the matrix in the 1960s, manufacturing dominated the economy and it was felt that market penetration was the easiest option followed by market development, with diversification being the most problematic. We believe that times have changed, and that in the service economy developing new markets is now much more difficult, especially if that market is schools. Indeed, on average across all sectors of the economy around 40% of costs and effort can be attributed to marketing. We believe that 60-80% is more normal in marketing to education.”</i></p>
New Markets	Market Development	Diversification	

However, it was recognised that there is a strong potential to offer courses to existing teachers via the Science Learning Centres, although again this is not without its cost implications. Unfortunately, our focus group with trainee teachers suggested that the majority were unlikely to use the site once in post. This was not so much because they did not feel that the site was of use it was simply that they felt completely inundated with information and uncertainty. Whilst we agree that marketing via teacher training centres and Science Learning Centres is a sound idea, it also needs to be recognised that simply communicating the benefits of the site to teachers will not result in its universal adoption.

The use of viral marketing (an internet based approach that often uses an amusing video or animation for people to send to friends and colleagues, that also carries with it the marketing message) should also be considered as an effective way of reaching teachers whom most marketers would recognise as an extremely hard to reach group. The mean rating for recommending the website to a friend or colleague is 4.4 (on a scale of 1 to 5, with 1 equalling not at all likely and 5 equalling very likely, for teachers).

Best Practice

Usefulness as an Educational Resource (Mean on a scale of 1 to 5)



Respondents were asked how useful they find the website as an educational resource, on a scale of 1 to 5. The overall mean rating was a high 4.0, falling to 3.9 in the UK, but rising again to 4.1 for those at adult education colleges and 4.3 for those teaching Key Stage 4.

Teachers would like the ability to register a whole class at one time (e.g. 30 pupils) and not simple ten with additions. In addition, they would like some system for mass registration.

“It would be useful if we could mass register students by uploading an Excel sheet with their names on it.”

We received a number of more specific suggestions from teachers.

“Great resource. My Ideal would include the following

- 1 *A series of images available next to each option so students can see the likely effect of different exposure times, filters etc before submitting a job.*
- 2 *A quick listing of a image capture schedule window so students know how long they will need to wait for their images (roughly).”*

“... think the telescope is an incredible resource - unimaginable when I was doing O level astronomy about 35 years ago! I am thrilled with the images I can make...”

One of the great attractions of the telescope is its robotic nature - it would be fantastic to have access to some sort of read-out display so you could see what the telescope was actually doing now - where it was pointing, which job it was processing, which filter was in etc...

Finally for now, the telescope is a great example of University work - it is very hard to explain to students what the difference is between University and school and saying that constructing and operating the telescope is about developing new techniques and approaches to extend knowledge and develop new applications is an excellent example of the difference between school and University teaching/learning. More ‘interpretation’



of the research and learning behind the telescope, and the astronomy done with the telescope, who is doing what projects and why, and what outcomes there are, would be extremely useful.”

Recommendations

Submitting and resubmitting the site and key words teachers are likely to use to the major search engines will be important in growing traffic to the website.

To date very limited marketing to schools has been undertaken. Even though the team plan to market via teacher training establishments, there is a need for a significant and sustained investment in marketing to schools. This is largely to overcome the major constraints that teachers feel to conform to an unimaginative curriculum. In addition, to marketing the website through teacher training establishments, use should also be made of viral marketing, appealing directly to teachers.

Although there are a number of sources (often temporary) of operational funding that the team may be successful in securing, there are few, if any, obvious sources of capital funding (even though many of the sources are for capital investment, they are for initial capital investment and not reinvestment). As some capital investment is required to ensure that the website is reliable, this presents the team with a dilemma.

“I don’t see anyone providing that sort of funding.”

It is possible that more opportunities will develop when the curriculum changes, **Hoshin** therefore recommend maintaining the operation of the site through applying for operational funding and waiting to see if opportunities for capital funding emerge. Overall, the University needs to work in partnership with other delivery partners, such as SETPOINT West Yorkshire and Sheffield Hallam University to ensure that they are a part of joint bids for more specific funding.

There may be opportunities outside the English and Welsh curriculum to target, as the international use of the website suggests. In addition, the website is currently being used in adult education and outside school, some opportunities for funding may emerge outside of the formal curriculum. Obviously if new sources do not appear by 2008, the Bradford Robotic Telescope will have to close, this would be a major blow to the promotion of science within our schools.



Select Bibliography

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On-Line Questionnaire

BRADFORD ROBOTIC TELESCOPE RESEARCH (BRAND AS BRADFORD ROBOTIC TELESCOPE)

Thank you for agreeing to take part in this research. We are interested in your use of the telescope and the website. I would like to start by asking you some questions about yourself.

Q1) Which Country do you live in?
MUST COMPLETE ONE, ONLY TO PROCEED

Afghanistan	30	
Albania	31	
Algeria	32	
Andorra	31	
Angola	32	
Antigua and Barbuda	33	
Argentina	33	
Armenia	30	
Australia	1	
Austria	31	
Azerbaijan	30	
Bahamas	33	
Bahrain	30	
Bangladesh	30	
Barbados	33	
Belarus	31	
Belgium	31	
Belize	33	
Benin	32	
Bhutan	30	
Bolivia	33	
Bosnia and Herzegovina	31	
Botswana	32	
Brazil	33	
Brunei	30	
Bulgaria	31	
Burkina Faso	32	
Burundi	32	
Cambodia	30	
Cameroon	32	
Canada	2	
Cape Verde	32	
Central African Republic	32	
Chad	32	
Chile	33	
China	30	
Colombia	33	
Comoros	32	
Congo	32	

Congo, Democratic Republic of the	32	
Costa Rica	33	
Côte d'Ivoire	32	
Croatia	31	
Cuba	33	
Cyprus	31	
Czech Republic	31	
Denmark	31	
Djibouti	32	
Dominica	33	
Dominican Republic	33	
East Timor	30	
Ecuador	33	
Egypt	32	
El Salvador	33	
Equatorial Guinea	32	
Eritrea	32	
Estonia	32	
Ethiopia	32	
Fiji	30	
Finland	3	
France	4	
Gabon	32	
Gambia	32	
Georgia	30	
Germany	5	
Ghana	32	
Greece	31	
Grenada	33	
Guatemala	33	
Guinea	32	
Guinea-Bissau	32	
Guyana	33	
Haiti	33	
Honduras	33	
Hungary	31	
Iceland	31	
India	30	
Indonesia	30	
Iran	30	
Iraq	30	
Ireland	6	
Israel	30	
Italy	7	
Jamaica	33	
Japan	8	
Jordan	30	
Kazakhstan	30	
Kenya	32	
Kiribati	30	

Korea, North	30	
Korea, South	30	
Kuwait	30	
Kyrgyzstan	30	
Laos	30	
Latvia	31	
Lebanon	30	
Lesotho	32	
Liberia	32	
Libya	32	
Liechtenstein	31	
Lithuania	31	
Luxembourg	31	
Macedonia	31	
Madagascar	32	
Malawi	32	
Malaysia	30	
Maldives	30	
Mali	32	
Malta	31	
Marshall Islands	30	
Mauritania	32	
Mauritius	30	
Mexico	33	
Micronesia	30	
Moldova	31	
Monaco	31	
Mongolia	30	
Morocco	32	
Mozambique	32	
Myanmar	30	
Namibia	32	
Nauru	30	
Nepal	30	
The Netherlands	9	
New Zealand	10	
Nicaragua	33	
Niger	32	
Nigeria	32	
Norway	31	
Oman	30	
Pakistan	30	
Palau	30	
Palestinian State	30	
Panama	33	
Papua New Guinea	30	
Paraguay	33	
Peru	33	
The Philippines	30	
Poland	31	

Portugal	31	
Qatar	30	
Romania	31	
Russia	31	
Rwanda	32	
St. Kitts and Nevis	33	
St. Lucia	33	
St. Vincent and The Grenadines	33	
Samoa	30	
San Marino	31	
São Tomé and Príncipe	32	
Saudi Arabia	30	
Senegal	32	
Serbia and Montenegro	31	
Seychelles	32	
Sierra Leone	32	
Singapore	30	
Slovakia	31	
Slovenia	31	
Solomon Islands	30	
Somalia	32	
South Africa	11	
Spain	12	
Sri Lanka	30	
Sudan	32	
Suriname	33	
Swaziland	32	
Sweden	13	
Switzerland	14	
Syria	30	
Taiwan	30	
Tajikistan	30	
Tanzania	32	
Thailand	30	
Togo	32	
Tonga	30	
Trinidad and Tobago	33	
Tunisia	32	
Turkey	31	
Turkmenistan	30	
Tuvalu	30	
Uganda	32	
Ukraine	31	
United Arab Emirates	30	
United Kingdom	15	
United States	16	
Uruguay	33	
Uzbekistan	30	
Vanuatu	30	
Vatican City	31	



Venezuela	33	
Vietnam	30	
Western Sahara	32	
Yemen	30	
Yugoslavia	31	
Zaire	32	
Zambia	32	
Zimbabwe	32	
Other	94	
Prefer not to say	95	



Q2) Approximately how often do you visit the Bradford Robotic Telescope Website (<http://www.telescope.org> screenshot)?

At least once a month	1	
Not as often as once a month but at least 4 times a year	2	
2-3 times per year	3	
Once a year	4	
Less than once a year	5	
I have only viwebsited the website on one occasion	6	
Prefer not to say	95	
Don't Know	96	

Q3) On a scale of 1 to 5, with 1 being not at all easy and 5 being very easy, how easy do you find the website to use?

	Not at all Easy			Very Easy	
Ease of website to use	1	2	3	4	5

Q4) Which of the following parts of the website have you used?

Q5) On a scale of 1 to 5, with 1 being not at all easy and 5 being very easy, how easy do you find these parts of the website to use (only if checked at Q4)?

Q6) And also on a scale of 1 to 5, with 1 being not at all useful and 5 being very useful, how useful do you find each part of the website to be (only if checked at Q4)?

	Q4	Q5					Q6				
		Not at all Easy					Very Easy				
		Not at all Useful		Very Useful		Not at all Useful		Very Useful			
System status	1	1	2	3	4	5	1	2	3	4	5
Use the telescope	2	1	2	3	4	5	1	2	3	4	5
Weather reports	3	1	2	3	4	5	1	2	3	4	5
Image gallery	4	1	2	3	4	5	1	2	3	4	5
Information	5	1	2	3	4	5	1	2	3	4	5
Photo galleries	6	1	2	3	4	5	1	2	3	4	5
Webcams	7	1	2	3	4	5	1	2	3	4	5
Telescope statistics	8	1	2	3	4	5	1	2	3	4	5
Forums	9	1	2	3	4	5	1	2	3	4	5
Project news	10	1	2	3	4	5	1	2	3	4	5
Personal menu	11	1	2	3	4	5	1	2	3	4	5
Search job database	12	1	2	3	4	5	1	2	3	4	5
Submit job to telescope	13	1	2	3	4	5	1	2	3	4	5
View image as JPEG	14	1	2	3	4	5	1	2	3	4	5
View image in Java Applet	15	1	2	3	4	5	1	2	3	4	5
Download image data as FITS file	16	1	2	3	4	5	1	2	3	4	5



Q7) And overall how satisfied are you with the website? On a scale of 1 to 5 with 1 being very unsatisfied and 5 being very satisfied.

	Not at all Satisfied			Very Satisfied	
Satisfaction with the Website	1	2	3	4	5

Q8) Also on a scale of 1 to 5, with 1 being not at all likely and 5 being very likely, how likely are you to use the website again.

Q9) How likely would you be to recommend the website to a friend, or colleague?

Q10) And how likely is it that as a result of the website you will find out more about science?

	Not at all Likely			Very Likely	
Q8 Use again	1	2	3	4	5
Q9 Recommend to a friend	1	2	3	4	5
Q10 Find out more about science	1	2	3	4	5



THE WEBSITE AS AN EDUCATIONAL RESOURCE

Q11) Are you connected to a teaching institution (e.g. a school, college or university) as either a teacher or a student?

Yes	1	
No	2	GO TO Q27
Don't Know	3	GO TO Q27

Q12) Which of the following best describes your institution?

A Primary or Elementary School (for young people aged 11 and under)	1	
A Secondary School (for young people over 11 years of age, but normally below 18)	2	
A VI Form College, College of Further Education (a college for tertiary education, normally for young people aged 16-18 years of age)	3	
A University (an institution that awards degrees)	4	
An Adult Education College (a College specialising in educating people over 18, but not awarding degrees)	5	
Other Teaching Establishment	6	

Q13) And which of the following best describes you?

I am a teacher/tutor/trainer/lecturer/demonstrator/teaching assistant	1	GO TO Q16
I am a pupil/student	2	
I am employed at the institution, but not in a teaching capacity	3	GO TO Q16
Other	94	GO TO Q16
Prefer not to say	95	GO TO Q16

Q14) How old are you?

1-4 years of age	1	
5-7 years of age	2	
8-9 years of age	3	
10-14 years of age	4	
15 years of age	5	
16-17 years of age	6	
18-19 years of age	7	
20-24 years of age	8	
25 and over	9	
Prefer not to say	95	



Q15) Please rate your level of interest to the following issues, on a scale of 1 to 5, with 1 being not at all interested and 5 being very interested?

	Not at all Interested			Very Interested	
a Science in general	1	2	3	4	5
b Continuing to study science	1	2	3	4	5
c Working in a science based occupation	1	2	3	4	5

GO TO Q27

Q16) On a scale of 1 to 5, with 1 being not at all useful and 5 being very useful, how useful do you find the website as an educational resource?

Q17) How useful is the website in supporting the different learning styles of your students?

Q18) How useful is the website in teaching across about ranges?

Q19) How useful is the website in teaching the whole classroom?

Q20) How useful is the website in engaging the whole school?

	Not at all Useful			Very Useful	
Q16 Educational Resource	1	2	3	4	5
Q17 Learning Styles	1	2	3	4	5
Q18 Educational Resource	1	2	3	4	5
Q19 Learning Styles	1	2	3	4	5
Q20 Educational Resource	1	2	3	4	5

ONLY ASK Q21-23 IF ANSWERED Q1 15 UNITED KINGDOM (MANDATORY)

Q21) Which key stage are you teaching?

Key Stage 1	1	GO TO Q23)
Key Stage 2	2	Ask Q22a)
Key Stage 3	3	Ask Q22a)
Key Stage 4	4	Ask Q22b)
Post 16	5	Ask Q22b)
Other	6	Ask Q22a)
Don't know	95	

Q22) And which subjects are you teaching?

Q22a)	Art and design	1	
	Citizenship	1	
	Design and technology	2	
	English	1	
	Geography	1	
	History	1	
	Information and communication technology	3	
	Mathematics	4	
	Modern foreign languages	1	
	Music	1	
	Personal social and health education	1	
	Religious education	1	
	Science	5	
	Other	94	
	Don't Know	95	
Q22b)	Applied science	5	
	Accounting	1	
	Ancient history	1	
	Archaeology	1	
	Art and design 14-19	1	
	Astronomy	6	
	Biblical Hebrew	1	
	Biology	5	
	Business	1	
	Chemistry	5	
	Citizenship	1	
	Classics	1	
	Communication Studies	1	
	Construction and the Built Environment	2	
	Critical thinking	1	
	Dance	1	
	Design and technology	2	
	Drama and theatre studies	1	
	Economics	1	
	Electronics	5	
	Engineering	5	
	English	1	
	Environmental science	5	
	European studies	1	
	Expressive arts	1	
	Film studies	1	
	General studies	1	
	Geography	1	
	Geology	5	
	German	1	
	Government and politics	1	
	Health and social care	5	
History of art	1		

History	1	
Home economics	1	
Hospitality and catering	1	
Human physiology and health	5	
Information and communication technology	3	
Irish	1	
Land and environment	5	
Latin	1	
Law	1	
Leisure and recreation	1	
Manufacturing	5	
Mathematics	5	
Media studies	1	
Modern foreign languages	1	
Music	1	
Performing arts	1	
Personal, social and health education	1	
Philosophy	1	
PE	1	
Physics	5	
Psychology	1	
Retail and distributive services	1	
Religious studies	1	
Rural and agricultural science	5	
Science	5	
Science for public understanding	5	
Social policy	1	
Social science	1	
Sociology	1	
Spanish	1	
Welsh	1	
Welsh as a second language	1	
World development	1	
Other	94	
Don't Know	95	



- Q23) Can you tell me if you have used the following features of the website?
 Q24) On a scale of 1 to 5, with 1 being not at all easy and 5 being very easy, how easy do you find these parts of the website to be (only if checked at Q23)?
 Q25) And also on a scale of 1 to 5, with 1 being not at all useful and 5 being very useful, how useful do you find each part of the website to be (only if checked at Q23)?

	Q23	Q24					Q25				
		Not at all Easy			Very Easy		Not at all Useful			Very Useful	
What are we trying to do	1	1	2	3	4	5	1	2	3	4	5
Activities	2	1	2	3	4	5	1	2	3	4	5
Lesson Plans	3	1	2	3	4	5	1	2	3	4	5
Handouts	4	1	2	3	4	5	1	2	3	4	5
Forums and Groups	5	1	2	3	4	5	1	2	3	4	5
21 st Century Science	6	1	2	3	4	5	1	2	3	4	5
Learningscope	7	1	2	3	4	5	1	2	3	4	5
Learn Astronomy with the telescope	8	1	2	3	4	5	1	2	3	4	5
Stars & Galaxies - CD ROM	9	1	2	3	4	5	1	2	3	4	5
PPARC	10	1	2	3	4	5	1	2	3	4	5

- Q26) On a scale of 1 to 5, with 1 being totally disagree and 5 being totally agree, please rate your agreement with the following statements?

	Totally Disagree			Totally Agree	
	1	2	3	4	5
a The website has increased students' interest in sciences	1	2	3	4	5
b The website has increased students' understanding of sciences	1	2	3	4	5
c The website has increased students' understanding of the practical appliance of sciences	1	2	3	4	5
d The website has increased the likelihood of students continuing to study sciences in later years	1	2	3	4	5

FOR ALL COMPLETING Q26 INVITE TO TAKE PART IN ON-LINE DISCUSSION (TAKE THEM THERE ON COMPLETION OF THIS SURVEY)



Q27) And finally can you tell me if you are male or female?

Male	1	
Female	2	
Prefer not to Say	3	

YOU HAVE NOW COMPLETED THE QUESTIONNAIRE, THANK YOU FOR YOUR TIME

Details of Organisations Consulted With

Date	Time	Person	Organisation
4/5/6	10.00	Professor Ken Mannion	Sheffield Hallam University
5/5/6	10.00	Barry Sheerman MP	Chair of the Select Committee on Education and Skills
9/5/6	13.00	David Ross/Stuart Butcher	SETPOINT West Yorkshire
9/5/6	14.00	Martyn Chesters	Space Connections
26/5/6	11.00	Vicki Wright	Brighouse High School
30/5/6	12.00	Matt Anderson	Trainee Teacher Bradford College
1/6/6	10.00	Jan Packitt	CAPITA DfES
5/6/6	09.10	Dr Joanne Lord	Queen Elizabeth Grammar School, Wakefield
5/6/6	11.00	Tom Swire	Thornton Grammar School, Bradford
5/6/6	15.00	Kath Norris	Bradford College
5/6/6	16.00	A Group of Trainee Teachers	Bradford College



Face to Face Script

Phil Smith from **Hoshin**

Funded by Yorkshire Forward to support bids for mainstream funding

Overall views on the telescope?

Ease of use

Suitability for UK schools

Key Stages

Subjects

Pedagogy – Learning Styles

Ability Range

Whole Classroom

Learning Materials (Activities, Lesson Plans, Handouts, Forums and Groups, 21st Centaury Science, Leaningscope, Learn Astronomy with the telescope, Stars and Galaxies, CD Rom)

Impact (increase in students interest in science, understanding of science, practical application of science, likelihood of continuing in science)

Thank and Close