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# Evaluation of Techniquest and Techniquest Glyndŵr School Services



# **Evaluation of Techniquest and Techniquest Glyndŵr School Services**

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Views expressed in this report are those of the researchers and not necessarily those of the Welsh Government

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Views expressed in this report are not necessarily those of the Department for Education and Skills or any other department within the Welsh Government.

## **Executive Summary**

### **Introduction**

In October 2012 the Department for Education and Skills commissioned ICF GHK and Beaufort Research to conduct an evaluation of Techniquest (TQ) and Techniquest Glyndŵr (TQG) services for schools funded under the Welsh Government core grant funding. This is the final report for the evaluation and provides practical recommendations for the Welsh Government and both centres.

### **Aims and study method**

The aim of this study was to assess the effectiveness of the support provided to schools through Welsh Government funding, to inform future decisions on TQ/TQG funding and the evidence base for future Welsh Government STEM support. Specific objectives included assessing:

- The extent to which TQ and TQG are achieving the aims and objectives agreed with Welsh Government for providing support to schools;
- The effectiveness and efficiency of TQ and TQG in providing centre-based and outreach services to support the science and mathematics curricula;
- The effectiveness of collaborative working between TQ, TQG and their key partners and stakeholders from service planning through to delivery; and
- Whether the core grant and Mathcymru grant funding is being used appropriately, economically and efficiently to support and enrich curriculum delivery – and identifying the implications of any reductions in funding.

Drawing on a combination of qualitative and quantitative methods the study included: a review of programme documentation; a literature review; the analysis of management information; qualitative interviews with delivery staff and partners, Welsh Government and national stakeholders; a quantitative survey of 200 teachers using TQ/TQG services – with qualitative follow up

interviews with 15 respondents to explore experiences in depth; and a quantitative survey of 50 teachers in schools not using TQ/TQG. While Welsh Government were keen to capture learning about the impacts of both TQ and TQG school services, within the limits of this study it was recognised that we would be mainly drawing on the views of teachers in terms of the perceived impacts for both pupils and teachers, supplemented by any additional impact evidence provided by the centres themselves.

### **Policy and Practice Context**

In common with the rest of the UK, a key priority for Welsh Government in recent years has been to address the shortage of STEM skills in order to boost economic development and high value added growth. The Welsh Government enshrined in law support for the provision of STEM in Sections 14-16 of the Education Act 2002, and in May 2010 appointed a Chief Scientific Adviser for Wales. In 2012 the Welsh Government also published its most recent STEM strategy: “*Science for Wales – A strategic agenda for science and innovation in Wales*” along with a comprehensive guidance document. There is a rich array of external STEM support accessible by schools across Wales. These include a number of coordinating umbrella bodies and over 35 individual providers based either in Wales or elsewhere within the UK.

### **Techniquiest and Techniquiest Glyndŵr: An Overview**

TQ and TQG are educational charities, based in Cardiff and Wrexham respectively, that work as separate entities and in partnership to deliver STEM-related onsite, outreach and continuing professional development (CPD) activities for schools. While independent organisations, both centres operate under the Techniquiest brand, formalised through a Service Level Agreement and share a common understanding that their role is about enhancing and complementing the STEM and wider school curriculum, rather than directly delivering it. They deliver onsite provision through their respective science and discovery centres, and provide outreach through a range of interactive shows and hands-on workshops. In contrast to many of the other providers of external STEM support available to schools in Wales,

TQ and TQG deliver across the STEM agenda and cater for the whole school spectrum, from the Foundation Phase to post-16. Key features of their respective delivery models are set out in Table 1 below.

**Table 1 TQ and TQG: An Overview**

	<b>Techniquest</b>	<b>Techniquest Glyndŵr</b>
History	Established in 1986 and located in Cardiff Bay.	Established in 2003 by North Wales Science co-located with Glyndŵr University in Wrexham.
Staffing	66 FTE posts with a dedicated Education Team. This includes four Welsh speaking Presenters.	8 FTE posts with a dedicated Education Team. This includes three Welsh speaking Presenters.
TQ's All Wales Strategy Roles and Responsibilities	Lead for the All Wales Strategy, which includes sub-contracting and managing a number of 'out-reach' hubs in other parts of Wales	North East Hub for the All Wales Strategy responsible for delivery of outreach in: Wrexham, Flintshire, Denbighshire, north Powys and east Conwy.
WG Funding	For 2012-13 Welsh Government funding was £1,350,600 including the core grant, in year project funding, and £125,000 for delivery of the Mathcymru Initiative to schools across Wales.	For 2012-13 Welsh Government funding was £332,239 including the core granting and in year project funding.
Other sources of income	Admission fees; charges for outreach. Other earned income such as sale/hiring of exhibits and other non-core WG grant income which for 2012-13 totalled £311,012.*	Glyndwr University funding; admission fees, charges for outreach workshops, other earned income including kit hire and other non-core WG grant income which for 2012-13 totalled £45,885.*
School activities and services	School visits to TQ Cardiff Bay centre; Outreach with schools; Mathcymru funded maths workshops; CPD	School visits to the TQG Wrexham site including university tours; maths workshops; outreach with schools; and CPD.
Marketing activities	Production and dissemination of marketing materials; TQ website; direct sales phone calls; use of soft market intelligence; special offer promotions; cluster bookings and promotion of TQ via education providers.	Production and dissemination of marketing materials; TQG website; direct sales phone calls; face to face visits; cluster bookings and special offer promotions.
Partnerships	TQ has links with: LEA Maths Advisers, industry representatives; universities; the Nuffield Foundation. Plus a range of providers of external STEM support through the emerging All Wales hub network.	TQG has links with: Glyndŵr University, industry partners such as Toyota; various professional bodies such as the Institutions of Mechanical Engineers and the Wrexham Science Festival.

*\*This includes NSA Funding.*

## **Stakeholder views**

The vast majority of stakeholders interviewed were aware of both TQ and TQG and their respective school offers – although they had less of a detailed understanding of the outreach provision. Whilst acknowledging the external challenges faced by both centres, most stakeholders held both TQ and TQG in high regard. The public funding from Welsh Government was seen as important for supporting innovation and sustainability. Stakeholders through their own teacher networks reported that the TQ brand was well recognised and that teachers expressed generally high levels of satisfaction. However, there was a common perception that the main focus of the centres was on primary rather than secondary, particularly in terms of the on-site exhibits. The added value of TQ and TQG was generally seen as lying with the centres, however the additional overheads that come with this were acknowledged and were seen as perhaps restricting capacity to regularly refresh and update exhibits and resources. It was generally felt that the onsite offer had to be a sufficiently strong pull factor for schools to outweigh perceived barriers to costs and the efforts required to take pupils out of schools. Overall, stakeholders felt that TQ and TQG will need to evolve and adapt to negotiate the difficult economic times and the shifting trends in demand for onsite and outreach provision.

## **Techniquest: Key Findings**

### *Throughput*

- Since 2010 TQ has engaged with over 990,000 adults and children, of which 31% have been with pupils through school engagements (just over 306,000).<sup>1</sup>
- Over the last three years, TQ has consistently exceeded its targets for outreach provision, although they have fallen slightly behind target for onsite provision.
- Engagement with both onsite and outreach provision is consistently dominated by primary phase pupils, i.e. Key Stage 2 and Foundation Phase.

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<sup>1</sup> Available MI does not allow for the identification of the number of unique schools engaged.

- In 2012-13, TQ engaged 20,394 primary school pupils in their Mathcymru activities with Welsh Government funding, with additional secondary pupils being engaged through the Reach the Heights project.
- Pupils from schools in England accounted for 6% of all pupils engaged in 2012/13 – dominated by schools visiting the centre compared to receiving outreach.
- Overall engagement with TQ services shows a concentration in local authorities in the South, and particularly South East, of Wales<sup>2</sup>.
- For 2012-13, TQ has engaged 5,791 pupils in activities delivered in Welsh, 54% of whom engaged in onsite activities and 46% in outreach activities. Overall they accounted for 6% of all of TQ's engagements with schools in Wales, higher than in previous years with the exception of 2011-12, where the figure was 5,895.

### *Experiences of users*

This presents the survey findings as they relate to TQ. Of the 203 teachers interviewed, 145 (71%) were from schools using TQ services with 120 from Primary schools and 25 from Secondary schools. A small share of respondents (11 schools) had previously used both of the centres, comprising 10 primary and one secondary school. It also draws on a series of more in-depth follow up telephone interviews with a small sample of teachers that had responded to the survey.

- In our teacher survey, TQ users reported first hearing of TQ's offer to schools through a variety of means – most commonly through marketing materials, word of mouth and direct contacts. The majority of respondents felt they had a good understanding of the services TQ provided.
- In the last four years the most commonly reported engagement type was through a centre visit, although this was markedly less for secondary than primary schools. In the last year the spread of

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<sup>2</sup> See Table 3.5 in main report for distribution of TQ engagement by local authority

engagement type for primary schools has widened to concentrate less on centre based activities, with secondary schools also being more evenly spread between onsite and outreach activities. For the majority of schools Techniquiest services were used once or twice a year.

- Of the 40 Welsh medium schools using TQ in the survey, 80% reported awareness that learning and promotional materials were available in Welsh and 53% reported receiving services in Welsh.
- Almost half of all schools reported receiving pre-materials, and 28% post-materials. Where received, they were found to be of high quality, appropriate and easy to use.
- The vast majority of schools, 95%, rated their most recently received service as good to excellent in terms of overall quality. TQ services were also rated highly in terms of their fit with the curriculum and their suitability for the specific pupil audiences accessing them.

### *Perceived Impacts*

- The vast majority of schools found their most recent service to be fun and exciting for their pupils. Teachers also reported positively on the achievement of tangible learning outcomes<sup>3</sup>, with 109 (75%) rating them to be good or excellent.
- The most commonly cited pupil impacts were: increased motivation and enthusiasm for STEM learning; increased interest in STEM subjects; improved understanding of the concepts covered in the specific sessions; and improved overall understanding of STEM subjects.
- The majority of teachers also considered that they and their schools had benefited from TQ provision, most commonly in terms of providing ideas for practical and other sessions, and introducing new ways of introducing STEM concepts.

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<sup>3</sup> By this question we were keen to capture views about any perceived impacts in terms of tangible outcomes beyond levels of enjoyment and interest such as increased knowledge or skills among pupils.

### *Added Value*

- One in three schools considered that TQ provision fully met their needs, and over half that it met their needs in part.
- TQ school provision compared well to teachers' experiences of similar providers, with just under half considering that TQ provision was better, or much better, than similar provision received elsewhere, and 30% considering it to be about the same.
- The vast majority of schools (85%) agreed that TQ provision represented value for money.

### *Future use*

- Almost two thirds (62%) of schools reported being highly likely to use TQ services in the next 12 months, with an additional 26% being likely to use them and 8% possibly using.
- Cost issues and in particular travel costs emerged as the most common factors limiting the likelihood of use in the next 12 months.

## **Techniquet Glyndŵr**

### *Throughput*

- Overall since 2010, TQG has engaged with just under 150,000 adults and children, of which just under half have been with pupils through school engagements (just over 73,000).
- While TQG has experienced a steady increase in the numbers of pupils engaging with their outreach provision, they have achieved their outreach target in just one of the last three years. In terms of onsite provision, TQG has failed to achieve their targets in each of the last three years, achieving 84%, 88% and 68% of targets respectively.
- In common with TQ, the majority of pupils engaging with TQG services were from the Foundation and Primary stages.
- Although relaxed recently, TQG is now exceeding its former target of a 60:40 ratio for engagements with pupils from schools in Wales and England. This follows a steady increase in the numbers of pupils from schools in Wales and their share of overall provision.

- TQG reports an increase in the number of pupils engaging in activities delivered through the medium of Welsh, with 565 total onsite engagements (9% of all onsite Wales engagements) and 742 outreach engagements delivered in Welsh (6% of all outreach engagements).

### *Experiences of users*

This presents the survey findings as they relate to TQG. Of the 203 teachers interviewed, 58 (29%) were from schools using TQG services with 40 from Primary schools and 18 from Secondary schools. A small share of respondents (11 schools) had previously used both of the centres, comprising 10 primary and one secondary school. It also draws on a series of more in-depth follow up telephone interviews with a small sample of teachers that had responded to the survey.

- TQG users reported hearing of TQG through a range of means – mostly by marketing materials and word of mouth, with the majority reporting a good understanding of available TQG services.
- In the last four years the types of reported engagement types were equally shared between onsite and outreach and overall, for the majority of schools, TQG services were used once or twice a year.
- Of the 26 Welsh language schools using TQG provision in the survey, 81% reported receiving promotional and learning materials in Welsh, and 62% reported receiving services in Welsh.
- 50% of all schools using TQG services reported receiving pre-visit materials and 22% post-visit materials, with the majority of these reporting them to be of high quality, appropriate and easy to use.
- The vast majority of schools (93%) rated the quality of their most recent service as good or excellent, and their fit with the curriculum and suitability for pupil audiences also rated highly.

### *Perceived Impacts*

- The vast majority of schools using TQG services found their most recent service to be fun and exciting for their pupils. The responses

in terms of providing tangible learning outcomes were also strongly positive, with 86% of schools rating this to be good or excellent.

- The most commonly cited pupil impacts were: increased interest in STEM subjects (incl. computing), improved understanding of concepts covered in session, increased motivation and enthusiasm for STEM learning, improved overall understanding of STEM subjects and increased interest in STEM subjects for future study.
- The majority of teachers reported benefits from TQG provision, most commonly in terms of providing ideas for practical and other sessions, and introducing new ways of introducing STEM concepts.

#### *Added Value*

- In line with TQ, one in three schools considered that TQG provision fully met their needs and 62% that it met their needs in part.
- TQG provision for schools also compared well to schools' experiences of similar providers: with 28% of all the respondents considering that TQG provision was better, or much better, than similar provision received elsewhere, while 18% considered it to be about the same.
- The vast majority of schools (84%) said the provision represented good value for money.

#### *Future use*

- Almost two thirds (60%) of schools were highly likely to use TQG services in the next 12 months, with an additional 28% being likely to use them and 10% possibly using.
- Only one school reported they were unlikely to use TQG services in the next year, for a combination of financial and awareness/scheduling reasons.

#### **Non-user Survey Findings**

Teachers in 50 schools not using TQ or TQG services in the last 4 years were surveyed, comprising 49 primary and 1 secondary school across the TQ and

TQG catchments. Each reported accessing a range of external STEM support on an on-going basis.

### *Awareness*

- All the teachers were aware of TQ or TQG, with the vast majority (47 of 50) aware that they provided services for schools. However, while almost all respondents knew about the centres' onsite provision, fewer were aware of their outreach services. Even fewer teachers were aware of support for mathematics and of teacher CPD – while none were aware of the TQG University tour opportunity.
- This suggests that opportunities exist for both centres to promote their services/new activities introduced, to schools where recent contact has been limited. However, and seemingly contradictorily, the majority of the non-user schools described receiving information on a regular basis from TQ or TQG – highlighting the challenges of communicating effectively and raising awareness amongst the school audience.

### *Decision Making*

- Costs emerged as the most common consideration when deciding to use external enhancement and enrichment provision, followed by relevance to the curriculum, recommendations from colleagues, expected benefits for pupils, and transport/distance and quality issues. The single main factor influencing decisions appeared to be costs, followed by benefits for pupils, relevance to the curriculum and delivery quality.

### *Reasons for Non-use*

- The vast majority of teachers aware of TQ/TQG services for schools reported facing barriers to using their services (89% or 42 schools), while five actively deciding not to use TQ/TQG:
  - Barriers most commonly cited were costs (of transport and of visits/services), followed by access/distance issues – with a lack of provision at specific times also being mentioned.

- Reasons cited for deciding not to use TQ/TQG services included previous poor experiences, having sufficient provision already and provision being considered poor value for money.

#### *What Would Help?*

- Unsurprisingly support to help schools with costs (admission, transport and teacher cover – reported by almost two thirds of teachers), followed by additional outreach provision and stronger curriculum links. Other factors included improving marketing/raising awareness and more Welsh language provision.

### **Conclusions**

#### *Performance*

Both centres are by and large meeting their aims and objectives, although not always consistently achieving against the Welsh Government core grant targets. In summary:

- Performance against target for TQ outreach provision has been good in the previous three years, safely exceeding the target set in each year. However onsite provision has failed to meet its target in each of the three years.
- TQG have struggled to reach their both their onsite and outreach targets over the last three years. For outreach, targets were exceeded in 2011/12 but missed in 2010/11 and 2012/13 – although this is despite showing a year on year increase in outreach numbers. TQG have however increased the proportion of schools engaged from Wales, and have exceeded the 60:40 ratio for the last two years.
- Both centres displayed similar rates of delivery through the medium of Welsh, with 6% of all TQ and 8% of all TQG engagements in Wales having been in the Welsh language in 2012/13. The school survey responses on the provision of materials and services through the medium of Welsh indicated that for the majority their language needs were being met.

- Across both centres, recent years have seen an expansion of their offers beyond maths and science to include engineering and design and technology, with examples of these provided in the report.

*What is working well*

As described above, TQ and TQG are generally held in high regard by stakeholders and teachers alike, and the TQ brand is widely recognised and associated with quality. Teachers see TQ and TQG services as relevant to and enhancing STEM curricula, and in most cases as meeting their needs at least in part. It was also recognised that TQ and TQG contribute to STEM learning as part of a wider range of STEM provision and providers within Wales that schools can, and do, draw upon. This study has shown that both centres are delivering services mostly in line with what the research evidence tells us about ‘what works’, although some challenges remain.

**Good Practice Principles - TQ and TQG**

<b>Good Practice</b>	<b>Performance</b>
Providing resources that are interactive, easy to use, inquiry led, and tailored to the curriculum and audience interests and experiences	Both centres have developed workshops and shows that are interactive and easy to use – features noted and valued by teachers.
Engaging with pupils from an early age	Both TQ and TQG engage with primary aged pupils – and while this represents good practice it needs to be followed through by continued engagement throughout secondary schooling.
Providing STEM activities that link to the real world	Both centres recognise this as important, with TQG providing particularly good examples of links with the university and local industries to offer real life experiences – particularly linked to engineering – a priority of the 2012 WG STEM Strategy.
Proactively engaging with schools and teachers to communicate the full extent of their offer	Both centres deploy a mix of tactics in communicating with teachers, with teachers in the survey considering they had a good understanding of the TQ and TQG offer. The non-user survey however shows

Good Practice	Performance
	maintaining awareness of the range of services available is an on-going challenge, and that no single method can be relied upon. The stakeholder interviews usefully highlight that more could be done by both centres to link into and engage the support of local authority advisers in reinforcing their message.
Offering interactive science centres that capitalise on the role they can play in helping to develop positive attitudes towards science	Both centres make efforts to capture satisfaction and some level of impact. For TQ this is in relation to some but not all their activities; for TQG data is collected across all their activities but with no longer term follow up. Other science centres have prioritised this and developed more robust ways of capturing impact – partly by investing in surveys and also by partnering up and sharing costs with other science centres; a model worth exploring for TQ and TQG.

### *Key challenges and areas for improvement*

The stakeholder interviews and consultations with schools also identified areas of continued challenge and where improvements could be made.

These are set out below.

#### ■ **Reaching all schools throughout Wales**

In terms of coverage, and despite the new hubs introduced to the network, engagement with schools for TQ remains concentrated in the South, and particularly the South East, of Wales, and for TQG within their specific catchment area with some engagement in the adjoining local authority areas. Highlighted as an issue by the wider stakeholders, the challenge remains of how best to engage schools in the more remote parts of Wales – with both centres seeking to better communicate their offers, providing subsidised travel costs and offering a ‘cluster booking’ approach. However the ambition in the All Wales Strategy of reaching each pupil in Wales on an annual basis continues to remain challenging.

### ■ **Addressing barriers associated with cost**

While similar proportions of users of both centres considered that their services represented good value for money, the key issue of travel costs seems to be the main barrier to accessing TQ and TQG services, particularly onsite activities. TQ and TQG are attempting to attract more on-site provision through offering travel grants, special offers and for TQG in particular promoting the university tour to secondary pupils as an additional attraction to the main centre exhibition.

### ■ **Making onsite offer more attractive particularly to secondary schools**

In common with other science centres across the UK, secondary audiences are particularly challenging to engage, particularly in terms of onsite provision. A number of stakeholders, delivery staff and partners stated that TQ and TQG are perceived by some schools as focussing on provision for primary stage pupils, and that the exhibits in each of the centres were in need of more frequent updating/refresh to maintain interest, to allow for repeat engagements and to cater to a wider range of age groups. Although this issue did not emerge as clearly in the survey of schools, the follow-up qualitative interviews did identify a similar view, and in a couple of cases drew unfavourable comparisons with the nature of exhibits offered by the At Bristol science centre. In terms of appealing to a secondary audience, the ability of TQG to offer tours of the University STEM Departments, as well as their links with local industry, were felt to offer an enhanced experience for older pupils. These features may account for the increased share of TQG schools reporting impacts regarding increased interest in future STEM study and STEM careers for both primary and secondary pupils.

### ■ **Demonstrating impact with robust evidence**

Part of the challenge in communicating the TQ and TQG offers to teachers is the ability to robustly demonstrate how their services contribute to the curriculum, and more widely to the development of enhanced positive attitudes to science, amongst their pupil groups. Currently, impact data are mainly in the form of evaluation feedback on specific programmes or those in

their early stages of delivery, or from customer satisfaction surveys, neither of which are systematically collected across both centres. There is scope for enhancing the mechanisms by which both centres collect impact data, which we discuss in our recommendations below.

### *Collaborative Working*

TQ and TQG have formal partnership arrangements in place as part of their Service Level Agreement, which establishes certain obligations on the part of both centres particularly in relation to branding and reputation management. Beyond this, the extent of collaborative two-way working between the two centres has been to some extent limited, and although said to be improving there could be much to be gained from greater partnership working. TQG and TQ are currently in discussions about the potential change in role and status of TQG within the All Wales Strategy, including the potential for and implications of TQG marketing their outreach as well as onsite offer to schools more widely across Wales. However a number of important factors must be considered if the catchment of TQG is to be expanded such as the extent to which the centre currently has sufficient numbers of staff to provide high quality onsite and outreach provision to a larger customer group; the fact that TQG has not met their existing onsite or outreach targets; and assuming a finite amount of funding is available for school provision, any re-allocation of responsibility for provision of school services will need to be matched with a re-distribution of funding between TQ and TQG.

In terms of wider partnership engagement, both TQ and TQG have a strong network of partnerships with other STEM support providers and universities, and have been successful in attracting additional funding from a range of sources including the Welsh Government's National Science Academy. TQ have a strong track record in securing funding from industries in Wales, such as from Wales and West Utilities to fund the Gas Detective exhibits. Their role in sub-contracting primary outreach hubs has also highlighted how the bringing together of different organisations, including non-STEM specialists, can enhance the STEM offer to schools.

In the case of TQG, their close links with Glyndŵr University and local industry employers such as the Toyota UK Engine Plant were highlighted as being mutually beneficial, enhancing the TQG offer to secondary schools while also providing access to potential new students or recruits for their partners. The building of such networks in terms of securing new funding sources and of allowing for joint delivery signals an important direction of travel for the two centres, with opportunities available to further enhance this.

### *The effectiveness of the Welsh Government Grant Funding*

We conclude that while the current use of Welsh Government funding to pay for mainly primary pupil engagements is **appropriate** given what we know about the benefits of engaging pupils early, there is the need to engage more with secondary schools. Schools, and particularly secondary schools, increasingly want STEM support that closely matches the curriculum. While the schools surveyed considered that curriculum appropriateness was a strength for both centres, we consider that this more direct support for curriculum delivery could be more clearly articulated in the objectives of the funding agreement with WG.

In terms of **efficiency** the vast majority of the schools surveyed felt that TQ and TQG represented good value for money, and there was an almost unanimous view from teachers and stakeholders that without Welsh Government funding the centres could not maintain current services nor enhance their existing offer. Teachers also expressed the view that they would not be able to afford TQ services without the Welsh Government subsidy. This would suggest that the WG grant is performing an important function that would be difficult to replicate from other sources.

This study provides a timely opportunity for Welsh Government to revisit the aims and objectives behind the grant. Currently its broad rationale is to pay for enhancement and enrichment activities for schools in order to enthuse pupils and engage them more in science. Within this the focus has shifted over time, and Welsh Government is also increasingly keen for the grant to fund activities that are more closely linked to the curriculum.

As part of this, we have seen a number of incremental changes to MI reporting requirements for both centres. However, a number of gaps remain, namely:

- Pupil, rather than school, engagement is the main reporting variable. While school level information may be collected internally by each of the centres, it is not included in the routine quarterly monitoring reports to Welsh Government.
- The MI data does not show whether the engagements represent unique or repeat participants.
- There are differences in how TQ and TQG report on the distribution of engagements within Wales and on the number/proportion of pupils engaged in Wales vs England.
- There is limited comparable evaluative data collection across both centres: TQG routinely collects GLO satisfaction data but TQ does not.

## **Recommendations**

### *For Welsh Government*

#### *The core Grant*

- Recommendations include: 1. Continuing the grant funding for school services; 2. Reviewing the strategic aims and objectives for the core grant to TQ and TQG; 3. Stipulating that the core grant pays for education services to schools in Wales that are explicitly linked to curriculum delivery; 4. Revising the performance management framework for the grant; 5. Ensuring that the process for establishing targets for the core funding is robust.

#### *Capturing Impact*

- Recommendations include: 6. Together with TQ and TQG establishing a realistic approach to assessing the impact of their school provision; 7. Undertaking a survey of schools in Wales to explore their use of external STEM support on an annual/bi-annual basis; 8. Providing specific funding for discrete studies to contribute to

the evidence base on the contribution of science centres to the take-up of STEM to help make the case more widely for Welsh Government's continued investment in science centre provision.

*Progressing the All Wales strategy*

- Recommendations include: 9. Facilitating discussions between the two centres about a more expanded role for TQG as part of the TQ All Wales Strategy; 10. Encouraging TQ to continue to explore the 'hub' model of providing outreach services to the most remote parts of Wales (including evaluating those hubs already up and running); 11. Continuing to support the development of a comprehensive and coherent approach to STEM support provision for schools across Wales through the National Science Academy, and its key partner bodies and organisations; and 12. Supporting the facilitation of closer partnership working between the various providers of external STEM support operating in Wales to help provide a continuum of support through the learner pathway.

*For Techniquest and Techniquest Glyndŵr*

*The Delivery Model and Maximising Impact*

- **For both centres**, we recommend that they: 13. Link services directly to school curriculum delivery, and promote as such to schools; and 14. Take steps to increase the share of secondary pupils accessing their services on an onsite and outreach basis. As part of this consider: new approaches that will be attractive to secondary schools; investing in specific exhibits or experiences which would be of particular interest to secondary pupils; and launching a high-profile inter-schools STEM competition for Wales, delivered annually in partnership with local authorities and employers.
- **For both centres**, more broadly: 15. Review the adequacy of the level of funding provided to the pilots, 16. Work more closely with each other and other partners; 17. Given the issues of travel cost and the distance from some schools to the centres, explore the feasibility of delivering online sessions through ICT; 18. Offer more tailored

approaches; 19. Ensure all schools are aware of the availability of Welsh medium provision; 20. Continue to make efforts to engage schools with post-visit materials and potential follow-up activities; 21. Review the vocabulary used by presenters for school sessions to ensure standardisation with that used in schools and in examinations; 22. Continue to take efforts to address the common barriers of accessing both onsite and outreach provision including continuing to offer subsidised travel costs; and 23. Continue and build on the cluster booking approach.

- **For Techniquest**, specifically: 24. Increase the involvement of STEM employers; and 25. Include visits to Universities and colleges in their portfolio.
- **For Techniquest Glyndŵr** specifically: 26. Take steps to ensure performance targets for the grant are met; and 27. Expand further their university and industry links.

#### *Measuring impact*

- **For both centres**, 28. Meet with Welsh Government to establish a realistic approach to assessing the impact of their school provision, and develop a programme of routine evaluation data collection on all school activities drawing on existing tools and approaches and including the collection of data from both teachers and pupils; 29. Consider undertaking a survey of schools using TQ/TQG services on an annual/bi-annual basis; and 30. Explore opportunities for discrete studies that could contribute to the evidence base on the role of science centres in influencing STEM take-up.

#### *Marketing and Promotion*

- **For both centres**: 31. Take a more proactive approach to recruiting schools directly and engaging more with the wider STEM and local authority education infrastructure; and as part of this consider taking steps to promote specific services separately, such as the Mathcymru and wider mathematics offer, to ensure awareness is raised of new provision or services where substantial change has been introduced.

## 1 Introduction

In October 2012 the Department for Education and Skills commissioned ICF GHK and Beaufort Research to conduct an evaluation of Techniquest (TQ) and Techniquest Glyndŵr (TQG) school services. The study builds on an earlier evaluation of Techniquest conducted in 2007-8<sup>4</sup>, and focuses specifically on the core grants provided by Welsh Government to the two centres to support their services for schools.

This is the final report for the evaluation and presents findings and recommendations specific to each centre as well as those that are common across both. It also provides practical recommendations for the Welsh Government on the future funding of TQ and TQG and on their role in supporting the teaching of science, technology, engineering and mathematics (STEM) in schools more broadly.

### 1.1 Study Aims

The aim of this study was to assess the effectiveness of the support provided to schools through WG funding, to inform future decisions on TQ/TQG funding and the evidence base for future Welsh Government STEM support. Specific objectives included assessing:

- The extent to which TQ and TQG are achieving the aims and objectives agreed with WG for providing support to schools;
- The effectiveness and efficiency of TQ and TQG in providing centre-based and outreach education services to support the science and mathematics curricula in schools – including exploring teacher and stakeholder views of quality, appropriateness and impacts on pupils, and identifying best practice and areas for improvement;
- The effectiveness of collaborative working between TQ, TQG and their key partners and stakeholders – from service planning through to delivery; and

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<sup>4</sup> Richard Lloyd and Andy White, GHK Consulting (2008) *Evaluation of Techniquest – Final Report*, The Department for Children, Education, Lifelong Learning and Skills, Welsh Government, February.

- Whether the core grant and Mathcymru grant funding is being used appropriately, economically and efficiently to support and enrich curriculum delivery – However just nine schools reported using Mathcymru in the survey, and stakeholder experiences of it were limited, so this was not reported on in depth.

Other areas of interest include:

- The extent to which TQ/TQG are delivering the full STEM agenda, beyond maths and science;
- The extent to which TQ/TQG are providing services bilingually;
- Exploring why some schools do not use TQ/TQG services;
- The locational implications of the two centres for pan-Wales coverage;
- Any early lessons from the hub pilots – although none of the teachers surveyed had used the hub provision and stakeholder understanding of the hubs was limited;
- How TQ and TQG activities compare with similar services elsewhere in the UK; and,
- How data collection can be improved to capture impacts.

## **1.2 Methodology Overview**

Our approach was developed in consultation with Welsh Government and was designed to address the study aims and objectives set out above.

Drawing on a combination of qualitative and quantitative methods the study included:

- The review of programme documentation – including Operational Plans, grant agreements, and the service level agreement between TQ and TQG;
- A review of the literature on enhancement and enrichment services for STEM teaching;
- The analysis of management information – including monitoring reports, performance data and user satisfaction data;

- A comprehensive programme of qualitative interviews with:
  - Delivery staff in TQ and TQG, and their key partners;
  - Welsh Government staff with responsibilities for TQ/TQG contracts and for STEM provision more widely; and
  - Key stakeholders with an interest and involvement in STEM provision in Wales and more widely.
- A programme of consultation with teachers and schools. Further details are included in Annex 2 but in summary this included:
  - A quantitative survey of 203 teachers using TQ/TQG services – with qualitative follow up interviews with 15 respondents to explore experiences in depth; and
  - A quantitative survey of 50 teachers in schools not using TQ/TQG.

While Welsh Government were keen to capture learning about the impacts of both TQ and TQG school services, within the limits of this study it was recognised that we would be mainly drawing on the views of teachers in terms capturing perceived impacts for both pupils and teachers. This would however be supplemented where possible by any additional impact evidence provided by the centres themselves.

### **1.3 Report Structure**

The remainder of this report is structured as follows:

- Section 2 provides the policy context, an overview of the available research evidence on what works in engaging schools in STEM enhancement and enrichment activities, an introduction to the TQ and TQG school services and the stakeholder views.
- Section 3 presents the findings for TQ in terms of performance, user experiences, perceived impacts, areas for improvement and plans for future use;
- Section 4 presents the findings for TQG in terms performance, user experiences, perceived impacts, areas for improvement and plans for future use;

- Section 5 provides the non-user findings exploring teacher decision making processes and key barriers to use.
- Section 6 provides our conclusions and recommendations for Welsh Government, Techniquest and Techniquest Glyndŵr.

Finally the report has five Annexes:

- Annex 1: References
- Annex 2: Overview of interviewees and survey respondents.
- Annex 3: Overview of Additional Grant Income for TQ and TQG
- Annex 4: Techniquest School Activity Examples
- Annex 5: Techniquest Glyndŵr School Activity Examples

## 2 Background

### Summary

- In common with the rest of the UK, a key priority for Welsh Government in recent years has been to address the shortage of STEM skills in order to boost economic development and high value added growth. The Welsh Government enshrined in law support for the provision of STEM in Sections 14-16 of the Education Act 2002, and in May 2010 appointed a Chief Scientific Adviser for Wales. In 2012 the Welsh Government also published its most recent STEM strategy: “Science for Wales – A strategic agenda for science and innovation in Wales” along with a comprehensive STEM guidance document for schools and colleges.
- There is a rich array of external STEM support providers accessible by schools across Wales. These include a number of coordinating umbrella bodies and over 35 individual STEM support providers based either in Wales or elsewhere within the UK.
- We know from the research literature that awareness of and interest in science among the general public is high, but that challenges remain in engaging and sustaining the interest of schools pupils in science beyond the final year of primary schooling. There is also a wealth of evidence both in UK and internationally on what works in supporting schools and education professionals to more effectively engage pupils in STEM enhancement and enrichment activities. Key examples of ‘what works’ include:
  - Resources that are interactive, easy to use, inquiry led, and tailored to the curriculum as well as to the interests and experiences of the audience;
  - STEM support providers that engage with pupils from an early age;
  - STEM activities that link to the real world;
  - Informal STEM support providers that proactively engage with schools and teachers to communicate the full extent of their offer; and
  - Interactive science centres that capitalise on the role they can play in helping to develop positive attitudes towards science.
- TQ and TQG are independent educational charities, based in Cardiff and Wrexham respectively, that work as separate entities and in partnership to deliver STEM-related onsite, outreach and continuing professional development (CPD) activities for schools. They deliver onsite provision through their respective science and discovery centres, and provide outreach through a range of interactive shows and hands-on workshops. In contrast to many of the other providers of external STEM support available to schools in Wales, TQ and TQG deliver across the STEM agenda and cater for the whole school spectrum, from the Foundation Phase to post-16. Between them and the newly extended TQ hub network they also deliver outreach STEM provision to schools across Wales.

### 2.1 Introduction

This section explores the STEM agenda and provider landscape in Wales, and presents key research evidence on ‘what works’ in the provision of STEM support to teachers and pupils before introducing Techniquest and Techniquest Glyndŵr.

### 2.2 The STEM Policy Agenda in Wales

It has long been an area of concern in the UK and Wales that a STEM skills gap exists which, if not addressed, could have significant implications for the

UK's economic development and prosperity.<sup>5</sup> The response of Welsh Government has been to enshrine in law support for the provision of STEM, as set out in Sections 14-16 of the Education Act 2002, appoint in May 2010 a Chief Scientific Adviser for Wales, Professor John Harries and establish the National Science Academy. Further to this, and superseding the 2006 STEM strategy<sup>6</sup>, Welsh Government in 2012 published "*Science for Wales – A strategic agenda for science and innovation in Wales*".<sup>7</sup> This outlines the Welsh Government's commitment to investing in the building of a "*strong and dynamic science base that supports the economic and national development of Wales*".<sup>8</sup> As part of this a key priority is for Wales to achieve a greater share of Research Council funding and to create an environment where learners want to study science and progress in science-related careers. In particular, the Science Agenda identified three Grand Challenge areas which would form the future focus of activity: Life sciences and health; Low carbon, energy and environment; and Advanced engineering and materials.<sup>9</sup>

Welsh Government aims to strengthen these areas under the following four themes: STEM outreach; E-infrastructure; Intellectual Property exploitation; and, Fundamental research. These include a number of new initiatives in particular, the 'Sêr Cymru' (Stars Wales) initiative seeking to establish new academic 'stars' and National Research Networks in each of the Grand Challenge areas.

September 2012 also saw the publication of STEM guidance by Welsh Government for 3-19 year olds.<sup>10</sup> Building on a range of previous documents, this guidance brings together information on the full range of support materials and activities available to support STEM provision within and beyond the

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<sup>5</sup> Bevins, S, E Byrne and M Brodies (2011) English Secondary school students' perceptions of school science and engineering, *Science Education International*, Vol.22, No.4, December 2011 (Special Issue), pp. 255-265.

<sup>6</sup> Welsh Government (2006) *A Science Policy for Wales*, November.

<sup>7</sup> Welsh Government (2012) *Science for Wales – A strategic agenda for science and innovation in Wales*, Science Advisory Council for Wales, March.

<sup>8</sup> WG (2012) p.3.

<sup>9</sup> WG (2012) Science p. 4

<sup>10</sup> Welsh Government (2012) *Science, Technology, Engineering and Mathematics (STEM) Guidance for schools and colleges in Wales*, September.

curriculum, including advice on resources and suggestions for improved partnership working. It is provided for all those with a responsibility for the planning and delivery of STEM education, including governing bodies, senior management teams and practitioners in primary, secondary and special schools and colleges.

‘Science for Wales’ has also led to the development and publication of an initial Innovation Strategy in March 2013, which looks specifically at the commercial exploitation of Research and Development and the promotion of innovation. This identified five key themes for action on innovation:

- Improving collaboration between funding bodies inside and outside of Wales and between universities and businesses;
- Promoting a culture of innovation within Welsh Government and among wider stakeholders both across Wales and internationally;
- Providing flexible support and finance for innovation, including the support of private sector financing;
- Innovation in government in terms of approaches to procurement and partnership working ; and
- Prioritising and creating critical mass through specialising and focusing on Wales' strengths and existing assets.

More broadly, it is worth emphasising that STEM is just one of a number of priorities for schools in Wales. The previous Minister for Education and Skills for example highlighted three key priorities in terms of education in Wales: literacy, numeracy and closing the achievement gap between socioeconomic groups.<sup>11</sup> While there are overlaps with the STEM agenda, particularly regarding mathematics provision and other cross-curricula approaches, for teachers and schools on the ground the different policy drivers can have practical implications in terms of the decisions taken about how and where to prioritise funding for enhancement and enrichment activities.

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<sup>11</sup> His commitment to these three priority areas is evident in his speeches *Teaching Makes a Difference* (February, 2011) and *Raising School Standards* (June, 2011) as well as *Programme for Government*.  
<http://wales.gov.uk/about/programmeforgov/education/?view=Standard&lang=en>

### 2.3 The STEM Provider Landscape in Wales

There is a rich array of external STEM support providers accessible to schools in Wales. These include a number of coordinating umbrella bodies and over 35 individual STEM support providers based either in Wales or elsewhere within the UK. Key coordinating or membership bodies include:

- **The National Science Academy (NSA).** This has a key role in coordinating STEM provision across Wales through consultation exercises, programme coordination and information sharing. Established in 2010 by the Welsh Government, the NSA consists of an alliance of ‘hubs’ i.e. key organisations with STEM interests. Working closely with the Chief Scientific Adviser for Wales, the NSA hubs include: Techniquest, Techniquest Glyndŵr, the Centre for Alternative Technology, the National Botanic Garden for Wales and the Wales Institute of Mathematics and Computational Science in Swansea;<sup>12</sup>
- **STEMNET and STEM Ambassadors.** A UK Government initiative funded by the Department for Business, Innovation and Skills (BIS), the Department for Education in England and the Gatsby Charitable Foundation, and delivered by See Science – an independent educational consultancy based in Cardiff - STEMNET provides a STEM Clubs network, a STEM Ambassador’s Programme and a Schools STEM Advisory Network; and,
- **The Association for Science Education.** This is a membership organisation for teachers, technicians and other professionals supporting STEM that provides resources, publications and local teacher networks, and that organises annual conferences and teacher visits to industry and science centres.

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<sup>12</sup> See for example:

<http://wales.gov.uk/newsroom/businessandconomy/2012/120807stem/?status=closed&lang=en>;  
<http://wales.gov.uk/newsroom/businessandconomy/2011/110316techniquest/?status=closed&lang=en>; and <http://wales.gov.uk/topics/businessandconomy/csaw/nsa/?lang=en>.

In addition there are over 35 individual STEM support providers, including Techniquest and Techniquest Glyndŵr, which are either based in Wales or can be accessed by schools in Wales. These range from award schemes, science/visitor centres and outdoor learning programmes, to industry linked programmes, outreach activities and on-line/published resources. Some key players – in addition to TQ and TQG - include:<sup>13</sup>

- **Award schemes:** such as the British Science Association - a UK wide organisation that provides the CREST (Creativity in Science and Technology) Award - a project-based award scheme for STEM subjects. The scheme is open to primary schools (CREST Star Investigators) and to 11-19 year olds in schools and colleges across Wales.
- **Visitor Centres:** such as the Centre for Alternative Technology based in Mid Wales in Machynlleth, Powys; the Darwin Centre based in Pembrokeshire College; the National Botanic Garden of Wales and four regional Welsh Water education centres located across Wales. Other visitor centres in neighbouring English counties also offer opportunities for schools in Wales to access STEM enrichment and enhancement activities, such as the At-Bristol science centre, Chester Zoo and the Blue Planet aquarium in Ellesmere Port.
- **Outdoor learning programmes:** such as Natural Resources Wales (which brings together the former Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales, as well as some functions of Welsh Government) which delivers woodland-based learning experiences throughout Wales, supports the development and delivery of Forest School and facilitates the Forest Education Initiative on behalf of its partners.
- **Industry linked programmes:** such as Engineering UK, which organises industry visits, workshops and careers resources; the Institute of Civil Engineers which includes experiments and competitions for primary and secondary schools; and the Engineering

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<sup>13</sup> For an extensive list of STEM support providers, see WG (2012) *STEM Guidance for schools and colleges in Wales* pp. 57-76.

Education Scheme Wales which through its STEM Cymru project aims to inspire and motivate young people to choose a career in STEM.

- **Outreach activities:** delivered by providers such as Science Made Simple, and which provide a range of shows to primary and secondary schools.
- **On-line/published resources and CPD:** such as the National STEM Centre, the National Centre for Excellence in the Teaching of Mathematics (NTCEM), the Design and Technology Association; Fascinating Maths; Maths Careers; the Institution of Engineering and Technology; The Royal Society for Chemistry, the Society of Biology and the Institute of Physics.

## **2.4 What Works in Engaging Schools in STEM Enhancement and Enrichment Activities**

Interest in science among the general public is regarded as high. Data from the most recent Public Attitudes to Science Survey (PASS) <sup>14</sup> for example show that: 82 per cent of respondents considered that science is an important part of our everyday lives; 43 per cent considered they were well or fairly well informed about science; and 51 per cent reported wanting to know more about science. However we also know from the wider research literature that a number of challenges exist to engaging young peoples' interest in STEM subjects at school, with findings from a number of studies suggesting that:

- Science is afforded a relatively low priority among most pupils, particularly Physics;
- Males are more likely to be attracted to science and technology than females;
- There is a perceived lack of practical/investigation sessions in school science, and,

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<sup>14</sup> IPSOS MORI (2011) *Public Attitudes to Science Survey 2011*, Department for Business Innovation and Skills

- Most school students' interest in science declines from the final year of primary schooling.<sup>15</sup>

There is also a wealth of evidence, both in the UK and internationally, on what works in supporting schools and education professionals to more effectively engage pupils in STEM enhancement and enrichment activities. Some of these research papers are summarised below in order to provide context for the findings and recommendations presented in this report.

#### 2.4.1 *Resources that are interactive, easy to use, inquiry led, and tailored to the curriculum and interests and experiences of the audience*

Evaluations of two major Wellcome Trust UK-wide initiatives designed to support teachers in the provision of STEM education highlighted the importance of well-designed, interactive and easy to use resources, which are tailored to the curriculum.<sup>16</sup> This chimes with the wider research evidence on the role of enhancement and enrichment activities. Research into the role and impact of extra curricula activities/school trips for example has established that pupils are more likely to remember and to learn from activities that are interactive and where the teacher has built explicit curriculum links.<sup>17</sup> One piece of research, for example, found that museum programmes that used interactive ‘Inquiry Games’ were significantly more effective in enhancing pupil skills than other more traditional activities.<sup>18</sup> The 2012 UK-wide study on

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<sup>15</sup> Bevins, S, E Byrne and M Brodies (2011) English Secondary school students' perceptions of school science and science and engineering, *Science Education International*, Vol.22, No.4, December 2011 (Special Issue), pp. 255-265. The authors refer to a range of research publications to support these points.

<sup>16</sup> GHK (2011) *Evaluation of the Darwin Education Initiative*, Wellcome Trust; GHK (forthcoming) *Evaluation of In the Zone*, Wellcome Trust.

<sup>17</sup> For example: Bitgood, Stephen (1993). What do we know about school field trips? In R. J. Hannapel (Ed.), *What research says about learning in science museums* (Vol. 2, pp. 12-16). Washington, DC: Association of Science Technology Centers. This argues that a field trip event is more effective if it is experience-driven rather than information driven. Similarly, Wolins, Inez S., Jensen, N. & Ulzheimer, R. (1992). Children's memories of museum field trips: A qualitative study. *Journal of Museum Education*, 17 (2), pp. 17-27 found that high personal involvement (positive or negative) for an individual child; links with the curriculum (accompanied by teacher classroom activities); and multiple field trips to the institution were key success factors.

<sup>18</sup> Gutwill, Joshua and Allen, Sue (2012), Deepening Students' Scientific Inquiry Skills During a Science Museum Field Trip. *Journal of the Learning Sciences*. Jan/Feb2012, Vol. 21 Issue 1, p130-181 describes the creation and study of two programmes designed to significantly enhance students' inquiry skills at an interactive science museum exhibit. Using a randomized

the informal science learning sector further suggested that in addition to ensuring that experiences were stimulating, interactive and engaging, it is also important that they are tailored to audiences' interest, experiences and background and that they draw on audience research and community outreach methods.<sup>19</sup>

#### 2.4.2 *STEM support providers that engage with pupils from an early age*

Research has shown that early exposure to STEM initiatives and activities positively impacts on primary pupils' views of and dispositions to STEM subjects. Various research studies of undergraduate student experiences in choosing STEM professions have noted that the best time to create a connection, awareness and interest in STEM fields is during the primary school years.<sup>20</sup>

#### 2.4.3 *STEM activities that link to the real world*

In the UK, engineering is commonly described as “the forgotten discipline”.<sup>21</sup> However research on engineer-focused STEM activities shows that when linked to real world examples they can have a real impact on pupil engagement and learning. For example, one US study showed how the collaborative efforts of university engineers, teacher educators and middle school teachers to engage 11-14 year old pupils in a series of project-based engineering activities led to significant impacts in terms of students' confidence in and efforts towards science and mathematics, awareness of engineering and interest in engineering as a potential career.<sup>22</sup>

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experimental design approach it was found that the groups that learned the Inquiry Games significantly outperformed the control groups in the duration and quality of several inquiry skills. The highest gains came from an Inquiry Game that was structured and collaborative rather than spontaneous and individualized.

<sup>19</sup> Wellcome Trust (2012) *Review of Informal Science Learning*, November 2012.

<sup>20</sup> Dejarnette, N K (2012) America's Children: Providing Early Exposure To STEM (Science, Technology, Engineering And Math) Initiatives, *Education* Vol. 133 No. 1.

<sup>21</sup> Robin Clark and Jane Andrews (2010) Researching primary engineering education: UK perspectives, an exploratory study, *European Journal of Engineering Education*, Vol. 35, No. 5, October 2010, pp. 585–595

<sup>22</sup> Redmond, A, J. Thomas, K. High, M. Scott, P. Jordan, and J. Dockers (2012) Enriching Science and Math Through Engineering, *School Science and Mathematics*, Volume 111 (8)

#### 2.4.4 *Informal STEM support providers that proactively engage with schools and teachers to communicate the full extent of their offer*

We know from the research that schools can perceive informal venues and outside visits as a 'reward' or a 'treat', where the principal goal of the experience is affective rather than a resource to enhance student learning.<sup>23</sup> This emphasises the importance of science centres pro-actively engaging with teachers and schools to challenge this perception. Indeed, where science centres do take on a pro-active role it can be effective. For example one study in the US showed how investment in supporting trainee teachers in this respect paid off in terms of participants beginning to view and use such institutions as a main resource for classroom based science teaching.<sup>24</sup>

#### 2.4.5 *Interactive science centres that capitalise on the role they can play in developing positive attitudes towards science*

While STEM support providers in the UK tend to conduct audience satisfaction exercises to capture immediate feedback, evidence of the medium to long term impacts of informal STEM provision is limited.<sup>25</sup> However there are some examples in the literature that have attempted to explore more tangible outcomes. One study, for example, examined the role of a school-based 'mini-museum' - designed to mimic an interactive science centre - in young children's science education. The research investigated children's interactions with the exhibits and each other in such a 'centre', and suggested that although children did appear to make some gains in their learning of scientific knowledge, skills and processes, the largest gains were made in the development of positive attitudes towards science.<sup>26</sup> Similarly, a study on the attitude changes of 300 children, aged 10 or 11 years, from four schools, who visited the UK National Space Centre found that they showed more interest in space and a moderate increase in the perceived value of science in society,

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<sup>23</sup> Wellcome Trust (2012) *Analysing the UK Science Education Community: The contribution of informal providers*. November.

<sup>24</sup> Kiesel, James (2013), Introducing Future Teachers to Science Beyond the Classroom, *Journal of Science Teacher Education*, February, Vol. 24 Issue 1, p67-91

<sup>25</sup> Wellcome Trust (2012) *Review of Informal Science Learning*, November.

<sup>26</sup> Rix, Chris and Mcsorley, Jacqueline (1999) An investigation into the role that school-based interactive science centres may play in the education of primary-aged children, *International Journal of Science Education*. July, Vol. 21 Issue 6, p577-593.

with nearly 20% of the pupils showing an increased desire to become scientists in the future. Two months later, they continued to be more positive about being future scientists, but only the girls' scores remained significantly raised.<sup>27</sup>

Finally, as part of the Wellcome Trust's Review of Informal Science Learning, we explored how different providers approached evaluation. The Dundee Science Centre presented an example of a science and discovery centre that adopted an ambitious approach to monitoring and capturing impacts for pupils and teachers.

### **Science Centres: Capturing impacts**

Dundee Science Centre has embedded a culture of evaluation throughout their organisation. A range of evaluation methods are tailored to different activities and projects. Examples include:

- Visi-Track. This is a survey which tracks centre users one week after their visit with the intention of monitoring the longer term impact of the centre. While recognising that this is a self-selecting sample, it is considered the most cost-effective means to gathering some evidence about the longer term outcomes of the centre. The purpose of the survey is to collect basic demographic data and to measure whether or not outcomes have been achieved. This survey is conducted by an external company, and the centre staff have full access to the raw data. They monitor the survey on a weekly basis, and communicate and action immediate/operational findings to staff, as well as looking at quarterly and annual trends. The centre commissions the survey in partnership with a number of other science centres in Scotland to allow comparative information to be collected and analysed. The centre typically achieves a 31% response rate.
- Festivals feedback form. The festival engages around 10,000 people in Dundee and typically achieves a 5% response rate to feedback surveys. The feedback form collects basic demographic and impact data which is collated into a database for on-going review and planning.
- Baseline and follow up data collection for particular projects. One of their projects, Germs Wars, for example, was a science literacy project. A formative evaluation was conducted by the Centre where it collected baseline information from teachers and young people at the beginning of the project, and then collected follow-up data on completion to capture immediate outcomes. This was then followed-up by a survey to monitor longer term outcomes.

## **2.5 The Techniquet and Techniquet Glyndŵr School Offer: An Introduction**

Techniquet (TQ) and Techniquet Glyndŵr (TQG) are registered educational charities that aim to engage and motivate the general public and school pupils

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<sup>27</sup> Jarvis, T and A Pell (2005) Factors influencing elementary school children's attitudes toward science before, during, and after a visit to the UK National Space Centre, *Journal of Research in Science Teaching*, Volume 42, Issue 1, pages 53–83, January.

to learn more about science, technology, engineering and mathematics (STEM) across Wales. Working as separate entities and in partnership, they deploy a range of funding streams, including but not exclusively from Welsh Government, to each host a science and discovery centre and deliver learning and teaching support to primary and secondary schools. Their support to schools caters for pupils from the Foundation Phase up to Post 16. For both, school services are designed to complement the national curriculum, and are provided both through workshop activities at the centres and via outreach activities delivered directly in schools. The long term strategic vision for TQ as set out within their All Wales Strategy, is to expand provision to reach all school pupils in Wales at least once per year. TQ leads the strategy and aims to achieve the all Wales coverage in partnership with TQG and other organisations acting as regional ‘hubs.’ As will be explained in more detail below, TQG in this capacity acts as a hub for the North East of Wales but also has a role and remit that extends beyond this.

As highlighted in the previous section, TQ and TQG form part of a rich landscape of STEM support providers accessible to schools in Wales. In contrast to many providers however, both TQ and TQG deliver across the STEM agenda and cater for the whole school spectrum from the Foundation Phase to post 16. Between them and the TQ hub network they also deliver outreach to schools across Wales.

The investment in TQ and TQG is seen by Welsh Government as a key part of the Science for Wales agenda. In 2012 the Minister for Education and Skills, as part of the funding announcement for the two centres, stated that:

*"One of the key aims of our Science for Wales strategy is to foster a passion for the STEM subjects from an early age. The funding I'm announcing today will allow both Techniquest and Techniquest Glyndŵr to go that one step further in engaging pupils with STEM subjects. By stimulating pupils' interest early, we can ensure that more of our young people go on to excel in this area and consider*

*science, maths, technology or engineering as the basis for future careers.*<sup>28</sup>

The rest of this section now looks at each of the centres in turn, examining their individual aims and objectives, structures and staffing, funding sources, activities and services for schools, approaches to marketing, key delivery partnerships and future plans.

### 2.5.1 *Techniquet in Cardiff*

Techniquet (TQ) is an independent educational charity, which, established in 1986, was one of the first science centres to be opened in the UK. It currently has a main site at Cardiff Bay and also supports exhibits at other locations in Wales.

#### *TQ aim and objectives*

TQ aims to promote engagement with science, technology, engineering and mathematics (STEM) amongst the general public, and specifically with schools, across Wales. Indeed, TQ's strategic long-term vision – *The All Wales Strategy*, is to widen access and to reach all pupils in Wales once per year, and all Key Stage 2 pupils (7-11 year olds) three times per year. As part of this, and as set out in their quarterly monitoring reports to Welsh Government, their three-year strategic goals are:

- The development of All-Wales education services including, for example, developing further the outreach offer, continuing to provide Mathcymru<sup>29</sup> outreach and improving access for disadvantaged pupils;
- To invest in Techniquet on-site activity including, for example, seeking new funds to ensure greater level of exhibit refreshment;

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<sup>28</sup> See the Welsh Government press release dated April 2012:

<http://wales.gov.uk/newsroom/educationandskills/2012/120405techniquet/?lang=en>

<sup>29</sup> Mathcymru is a Wales-wide initiative to promote the teaching of mathematics in schools, funded by the Welsh Government and delivered by Techniquet. Mathcymru focuses mainly on pupils at Foundation Phase, Key Stage 2 and Key Stage 3, and includes the provision of resources to help schools deliver the Curriculum for Wales, interactive workshops and roadshows, and other engagement activities.

- To maximise income generation, including the exploration of alternative income streams and of operational changes to increase revenue from public visitors.

More specifically, the TQ Plan for 2012/13 sets out the following annual strategic goals:

- To operate large scale schools outreach services via regional hubs including Reach the Heights<sup>30</sup> and Mathcymru;
- To develop on-site school services, including a full on-site programme for primary schools and a targeted programme for secondary schools.
- To operate many community outreach events, including roadshows and a presence at the National Eisteddfod;
- To operate regular high quality engagement events on contemporary science around Wales;
- To cater for Welsh speakers in the Welsh language whenever necessary;
- To achieve benefits for public visitors to the Cardiff Bay site including the development of new shows and targeted discounted entry prices;
- To maintain a high international profile and participate in prestigious international projects, including conference attendance and support to science centres overseas; and
- To increase income generation from sales of educational materials including from overseas.

Additional points raised in our interviews with key delivery staff were that:

- The focus of TQ is on affective rather than cognitive learning i.e. supporting teachers “*to help them inspire learners and to think differently.*”
- The primary function of TQ is to motivate, inspire and excite pupils rather than teach the curriculum *per se*. As one interviewee explained

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<sup>30</sup> Reach the Heights was a £28 million initiative part-funded between 2008 and 2013 through Priority 1 of the European Structural Fund (ESF) Convergence Operational Programme for West Wales and the Valleys, which aimed to prepare young people for future employment by raising their aspirations and increasing their participation in learning.

*“TQ plays more of a nudging role; the priority is breadth rather than depth.”*

- In the context of this ‘nudging’ role, and acknowledging that learner contact time with TQ was often of short duration, TQ was seen as part of a wider range of influencing factors that encourage learners to: pay more attention to STEM subjects in school; aspire to science careers; select science subjects in post-compulsory education; and to appreciate and understand the natural world through science.

### *TQ structures and staffing*

Techniquest has a governing Council of seven members including those with senior experience in school and higher level education, Welsh Government, finance and law. This Council is supported by an Audit Committee and Finance Committee.

TQ currently has 66 full-time equivalent (FTE) posts including a dedicated Education Team and which is supplemented by a pool of front of house staff, some of whom are on zero hours contracts. There are approximately nine FTE posts under the Head of Education, who have a role in developing the school service offer as well as the wider public engagement programmes. These include a team of Presenters whose role is to lead and deliver the science shows and workshops. Presenters each receive a one day induction in theatre and performance skills and an introduction to science communication. Following this presenters are supported to develop their skills at their own pace. Presenters work in pairs and are matched carefully to play to individual strengths and observed regularly as part of performance management.

The Partnerships Manager and the two half-time posts for Marketing also contribute to the schools offer. Additionally there are thirteen FTE staff who deal with bookings and front of house / operational issues. These staff members all deal with schools and the public, except 1.5 customer service advisers who focus specifically on school bookings. There is also a team of approximately 12.5 FTE posts, headed up by a Creative Director, who design

and supply the exhibits and resources used by schools, other science centres and the public as part of Techniquest's wider income generation activity.

### *The TQ All Wales Strategy Hub Network*

The TQ Strategy aims to reach all pupils across Wales. As part of this, a pilot phase of primary outreach hubs were commissioned and delivered in 2012-13, with a new round of primary and secondary hubs being currently out for tender (at the time of writing). To date, there have been 8 hubs including:

- Five secondary focused hubs which were run by Careers Wales and funded through the ESF-supported Reach the Heights project. These have now come to an end.
- Two primary focused hubs, funded by Welsh Government through an additional grant of £20,000 to cover two school terms between summer 2012 and April 2013. Although three regional hubs were put out to tender, TQ were only able to contract two: for the North West (*Think, Learn Challenge! - TLC!*) and South West of Wales (*Superstars*). There was not a hub for Mid-Wales in this pilot phase – so TQ and others sought to meet schools' needs in this area using the cluster booking method.
- The North East hub which is delivered by TQG on an on-going basis.

### *TQ Funding Sources*

TQ is funded from a variety of sources including grant funding, admission charges and other earned income. The Welsh Government has been a steady source of grant funding to TQ since 1992. Following an initial capital investment of £10 million, the Welsh Government from 1992 provided an annual revenue grant of around £560,000. From 1999-2000, the WG has provided 'core' grant funding specifically for the purpose of supporting the provision of education services to schools with the level of funding reflecting TQ's aims to deliver an All Wales Strategy. Since 2008-9 this funding has amounted to £1.09m per year, with additional grant funding of £125,000 annually for the delivery of the Mathcymru initiative on an all Wales basis. During this time, Welsh Government has also provided additional in-year grant funding for specific projects. See Table 2.1 below for an overview.

**Table 2.1 WG Funding for TQ<sup>31</sup>**

Type of funding	2010-11	2011-12	2012-2013
WG Core Grant	£1,090,000	£1,090,000	£1,090,000
Mathcymru	£125,000	£125,000	£125,000
Additional WG grant funding for specific in-year project work	£10,990*	-	£50,000***
Additional WG grant funding agreed at year start as part of the annual plan	-	£100,000**	£85,600****
<b>Total</b>	<b>£1,225,990</b>	<b>1,315,000</b>	<b>£1,350,600</b>

Source: Appendix 6 of TQ 2012-13 Qu 4 Report plus additional information provided by TQ.

In addition to the grant funding received from WG, other sources of income include:

- **Admission fees for the Cardiff Bay site.** These are £7 for adults and £5 for children / concessions – including a voluntary donation to Techniquest of 10%. School visitors pay a discounted fee of £3.95 per child,<sup>32</sup> and supervisory adults are admitted free of charge.
- **Charges for outreach workshops.** Currently these are £130 for half a day and £195 for a full day per show.<sup>33</sup> (£150/£265 for Starlab)
- **Other grant income** such as from the European Social Fund (via Reach the Heights), National Science Learning Centre, Science

<sup>31</sup> \* Match funding to adapt EADS Lego Challenge Workshop; \*\* Match funding of new exhibits to support the education programmes, development and updating of Foundation Phase onsite programmes, development of Foundation Phase outreach programmes, subsidy for schools' outreach delivery and repairs for the outreach programmes. \*\*\* Delivery support for outreach to schools in SE Wales and non-SE Wales areas; TQ support to hubs operating outside SE Wales; and Travel grants to schools to visit TQ. Plus match finding for: new programmes for the schools outreach programme; improvements to on-site school programmes; and the development of six new exhibits. \*\*\*\* Funding for the delivery of a 4-week numeracy celebration for primary schools in Wales to support teaching and learning within the National Literacy and Numeracy Framework including additional exhibition activities and travel grants to selected schools.

<sup>32</sup> For onsite, they do not tend to use the WG grant to offer further discounts, except to a small number of local primary schools who are offered free admission.

<sup>33</sup> The WG core grant is used to subsidise the outreach charges to offer reduced rates which cover approximately half the actual cost of delivering.

Technology Facilities Council, Royal Astronomical Society, Royal Academy of Engineering, and Cardiff University (See Annex 3 for a detailed overview); and,

- **Other earned income** such as; the manufacture and sale/hiring of exhibits/kits; services to TQG (SLA); revenue from shop and café facilities. Kit hire charges are £100 per day.

CPD is fully funded by the National Science Learning Centres so fees are not charged for this strand of activity.

### *TQ School Activities and Services*

TQ offer a range of curriculum linked enhancement and enrichment activities and services to schools from the Foundation Phase through to post-16 learners, including school visits to the centre and outreach workshops, science shows and dome shows delivered at the centre or in schools, the hiring of kits, fully funded maths education services and teacher CPD. In the development of these activities TQ consults with the education advisory board and conducts a piloting phase which captures immediate feedback from teachers and pupils to inform the final design. Specific school activity examples are provided in Annex 4.

#### **TQ School Service Offer**

- **School Visits to the TQ Centre** – with the exhibition centre at TQ covering 1800sq metres and including over 120 hands-on exhibits, a Science Theatre, a digital Planetarium and a laboratory for KS2 and secondary pupils to allow pupils to gain hands-on practical experience. All programmes are linked to the Curriculum for Wales, and teachers receive pre- and post-visit materials to help prepare and extend the learning back in the classroom. In 2012-13 TQ engaged 39,634 pupils across Wales and England through their onsite activities - 86% of which were from schools in Wales and 89% were with Primary school pupils.
- **TQ Outreach Work with Schools** - a portfolio of outreach activities for pupils of different ages has been developed, which link into different areas of the curriculum and designed to be easy to replicate at a relatively low cost. An example of their outreach offer is StarLab, a mobile inflatable Planetarium that brings the night sky to the school hall. TQ also offer a series of 'challenge workshops' delivered in schools. In 2012-13, TQ engaged 68,362 pupils through their outreach activities, the vast majority of which (98%) were with schools in Wales and 95 per cent were with Primary school pupils.
- **TQ Maths Education Services** - Mathcymru funding has been used to develop resources to assist teachers in the teaching of mathematics, with support mainly focused on the Foundation Phase and at KS2 and KS3 and delivered both on-site and through fully-funded outreach workshops. A grant scheme (£400 per school) is also funded for schools to develop their own maths projects, and a series of competitions. All shows and workshops are presenter-led, while kits may be hired for use in schools

for one to four days, and all are accompanied by pre- and post- visit materials. In 2012-13 TQ engaged 20,394 pupils through their Mathcymru outreach activities, all of which were with Primary school pupils.

- **TQ Continuing Professional Development (CPD) for Teachers** - Techniquest manages opportunities for teachers in Wales to access CPD through funding from the National Science Learning Centre (NSLC). This allows TQ to provide CPD sessions at no charge to schools, with additional financial assistance being provided to pay for teacher cover. TQ are contracted by NSLC to deliver 450 days of training to approximately 100 teachers through two courses, and provision is overseen by representatives of Welsh Government, the All Wales Science Advisers Group, science teachers and the WJEC. TQ manages the advisory group and the recruitment of trainers and participants. Currently there is a waiting list in operation to teachers to access this provision. Data for 2012-13 show that 221 teachers received CPD and that 529 teacher days were delivered in that year.
- **TQ Delivery in Welsh** – finally, staff interviews indicated that the demand for Welsh Language provision is greatest among schools in the North of Wales. TQ currently has four Welsh speaking presenters on their staff, with one of the pilot hubs (TLC!) also having a Welsh speaking presenter. All marketing and resource materials are available bilingually, as is the TQ website (<http://www.techniquest.org/cy/>). According to their MI for 2012-13, TQ delivered services in the medium of Welsh to 5,791 pupils, 6% of all engagements with schools in Wales.

### *TQ Marketing*

Effectively communicating the TQ school offer to teachers and schools is recognised as a major challenge. TQ therefore deploys a range of tactics, including:

- **The production and dissemination of a range of marketing materials** such as an annual prospectus in June each year; termly updates and a shorter update in the summer term (a 2-pager promoting remaining activities for the year); a teacher e-newsletter; and the TQ website. Materials are disseminated on-line, through direct mailing, via adverts in educational publications, by presenters themselves on school visits and through key national and regional fora such as the All Wales Maths Advisors group, WJEC meetings and South Wales primary head teacher meetings.
- **The TQ website.** This has recently been re-designed. Provided bilingually it offers a comprehensive overview of all the TQ, including school, services. All printed materials are provided on-line, including pre and post visit materials.
- **The use of ‘soft’ market intelligence** such as: monthly analysis of audience trends; lunchtime teacher focus groups in 10 schools where

previous TQ engagement had been limited; an annual 'teacher weekend', during which teachers in South Wales are invited to attend the TQ centre free of charge with friends and families and complete a short questionnaire; the ad-hoc sharing of information by booking staff about schools with which they have been in contact; and the proactive identification of STEM leads within schools in order to target particular schools and provide a more individualised approach to marketing. Booking staff also attend shows and observe school outreach visits in order to be able to more effectively communicate the range of activities on offer.

- **Development of special offer promotions.** For example: the offer of travel grants to schools of £100 in more remote areas to overcome the barrier of travel costs; and the offer of free visits to TQ to those schools that had only visited once.
- As with TQG, another tactic has been **the promotion of 'cluster bookings'** pitched to groups of small schools in rural areas where coordinated joint bookings lead to reduced costs and enables small schools to access the TQG offer.
- **The promotion of TQ via education providers**, such as links with Initial Teacher Training providers in South Wales, where trainees are invited to visit TQ (Cardiff) during their training to gain an early awareness of and engagement with TQ.

### *Partnerships*

TQ cited a range of partners who support the development of their education provision:

- Maths advisers in LEAs to support the development of their Maths provision (through twice-yearly meetings);
- Industry representatives, who fund specific activities and may also provide staff to take part in work-related education activities;
- Welsh Government, which provides grant funding and also sits on their Advisory Group;

- Universities: they have links with most Welsh universities and have worked with them in developing and delivering programmes, accessing funding, research, supporting outreach, and supporting the employability of graduates.
- The Nuffield Foundation: TQ runs a Nuffield Bursary Scheme that offers Year 12 students the opportunity to undertake a placement in industry or research institutions.

In addition, WJEC are seen as an important partner, with the topic of TQ being a regular agenda item at their meetings, and allows them to promote their work to key educational stakeholders.

Finally, they engage with providers through a sub-contracted hub delivery model as part of the All-Wales Strategy – details of which are provided in the example below.

#### **The TQ Hub Network: Early Lessons**

As described above a number of primary outreach hubs were commissioned and delivered in 2012-13. These included: five secondary hubs run by Careers Wales and funded through the ESF-supported Reach The Heights project, which have now come to an end; and two primary hubs run by Think, Learn Challenge! (TLC!) in the North West and by Superstars in the South West, both funded by Welsh Government. Interviews with Career Wales and Superstars highlighted how the bringing together of different organisations with different areas of expertise served to enhance the STEM offer to schools:

- For Superstars, while not a STEM specialist organisation, the primary hub role presented them with an opportunity to build on their core offer of providing high quality subject specialists to schools. Superstar staff were trained by TQ to deliver six pre-designed TQ workshops and to deliver one of the TQ kits. Following limited success with initial attempts at generic marketing to schools, Superstars took a more tailored approach with phone calls and face to face meetings. Although more resource intensive, Superstars had the capacity to deliver this and it proved effective in terms of engaging a wide range of schools including those in deprived areas. Finally, the use of interactive practical experiments in the workshops proved effective in terms of engaging pupils further enhanced by Superstar's use of drama and performance specialists to deliver STEM content.
- For Careers Wales the secondary hub role provided them with an opportunity to build on their existing links to schools and in particular Heads of Science established through their role in running Big Bang Wales allowing for swift and effective marketing routes to schools. TQ trained CW staff in the delivery of pre-designed workshops. Although some concerns have been raised about the 2-hour workshop delivery model (a requirement of ESF funding), in terms of it not fitting into a typical school timetable, the workshops were generally found to be interactive and engaging. CW staff felt they were able to enhance the STEM offer given their expertise in working with secondary schools and their wider role in the Careers in World of Work framework.

### *TQ Future Plans*

Welsh Government has agreed grant funding to support TQ's core education work programme for 2013-14; in December 2012, the Minister for Education and Skills announced grant funding of up to £1.315m for 2013-14.<sup>34</sup>

TQ wishes to continue using the WG core funding to support the indirect costs of their outreach offer to primary and secondary schools. They are also currently developing further their secondary outreach offer, refining the workshops designed as part of the RTH programme. They secured funding from the NSA to continue this work to June 2013. Finally, they are currently developing a new concept called the 'Learning Lab', which while designed to enable open-ended exploration by children and young people allows for a greater input from a TQ facilitator than for any of their other exhibits. The approach will provide for another practical link between the exhibition and TQ's education programme.

### *2.5.2 Techniquest Glyndŵr*

Established in 2003 by North Wales Science<sup>35</sup>, TQG is an independent educational charity consisting of a science discovery centre situated on the Glyndŵr University site in Wrexham.

In line with the ethos behind the creation of Glyndŵr University, TQG is focused on supporting young people and the wider community into STEM to help fill skill gaps and to boost the local economy. Indeed, TQG was established with support from Glyndŵr University specifically to provide a mechanism for bringing together primary, secondary and FE pupils/teachers with STEM employers. The University is very closely linked to the running of TQG, and has overall management and operational responsibility. TQG also has a wider role in its capacity as the North East Wales 'hub' for the TQ All Wales Strategy (with their catchment area covering: Wrexham, Flintshire,

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<sup>34</sup> Grant funding for 2013-14 and additional grant funding for Techniquest in 2012-13: <http://wales.gov.uk/about/cabinet/decisions/dr2013/janmar/addysg/la4074/?lang=en>

<sup>35</sup> North Wales Science was set up in 2003 to promote the public understanding of science and technology, with an initial focus on the establishment and operation of a science discovery centre.

Denbighshire, Northeast Powys and East Conwy) and as a hub for the National Science Academy.

Their licensed use of the Techniquiest brand and their role as a hub for the TQ All Wales Strategy requires an annual Service Level Agreement (SLA) with TQ. The most recent SLA (2012/13) sets out a number of services provided by TQ to TQG and clarifies a number of obligations for each organisation, particularly in relation to brand and reputation<sup>36</sup>, including:

- Strategic support and general services - including the use by TQG of the Techniquiest name and brand, support with the planning of core services as part of All Wales Strategy, provision of strategic/management advice, support with marketing and staff training;
- Exhibits - including on-site technical maintenance, exhibit support, and the refreshment of exhibits; and
- Education programmes - including access to education resources and materials for use on-site and as part of outreach activities, and support with the development of new programmes.

#### *TQG Aims and Objectives*

Techniquiest Glyndŵr (TQG) aims to promote engagement with science, technology, engineering and mathematics (STEM) amongst the general public, and specifically with schools, across North East, North and Mid Wales. More specifically, and as set out in their November 2012 report *Inspiring, Challenging and Engaging*<sup>37</sup>, TQG's strategic objectives are to provide:

- A valuable year-round hands-on STEM education facility for north Wales and surrounding counties;
- A significant offer to schools for their 'Learning Outside the Classroom' remit;

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<sup>36</sup> TQG in total pay £100,400 to TQ for the services set out in the SLA 2012/13.

<sup>37</sup> TQG (2012) *Inspiring, Challenging and Engaging*, November, p.p. 4-5.

- A diverse and adaptable education programme, ranging from Foundation Phase to KS5, delivered in the centre and by outreach in schools, that supports teachers with the delivery of the National Curriculum for STEM subjects;
- Products and services through the medium of Welsh;
- An employer- and sector-relevant education programme that supports skills needs of the region, working alongside STEM industries to help them to meet the requirements of their corporate social responsibility policies;
- Strengthened links between schools and local industries to encourage take-up of STEM subjects;
- A public programme of events to engage leisure visitors and community groups in STEM issues;
- All-year-round support for and promotion of Wrexham Science Festival;
- Links between schools, colleges, STEM industry and further and higher education, augmenting the skills supply chain, raising aspirations, and ensuring that employers receive enthusiastic and qualified STEM professionals;
- Science and technology-related workshops and shows to students outside of conventional education streams, for examples home educators and toddlers;
- Assistance to Welsh Government's Department for Education and Skills, and Department for Business, Enterprise, Technology and Science, to meet their objectives by helping to create a society that views science, technology, engineering, and maths as of paramount importance for the future workforce and economy of Wales.

Interviews with delivery staff further highlighted the following points:

- That there is a distinction between the aims for primary and secondary provision i.e. for the former, TQG aims to get pupils excited by and engaged in STEM; whereas for secondary pupils it is more about getting them to think about careers in STEM. Linked to this, the

support they give to teachers varies. For primary teachers it is about sharing STEM subject knowledge with teachers who are non-STEM experts; for secondary teachers it is about supporting STEM teachers to make practical links with employers.

- In light of the links to Glyndŵr University, a key aim of TQG is about developing the skills of young people and also raising awareness among school teachers of the career opportunities that exist in engineering, maths, design and technology – “*we are giving [teachers] a STEM language*” and encouraging teachers to “*provide a richer context in the classroom.*”

### *TQG Structures and Staffing*

TQG employs a total of 8.1 FTE staff supported by a pool of 25 zero hour contractors. This includes a dedicated Education Team, managed by an Education Manager, consisting of education officers, developers/deliverers and project managers. Other staff that contribute to school work include a Partnerships Coordinator, the Operations Manager, sales/marketing and explainers/Presenters.

A team of Presenters deliver the workshops both on-site and in schools. Although not necessarily having a formal science background, Presenters receive general training on presentation skills and behaviour management, and tailored training on any new kit and how to integrate into a workshop. Presenters also have a role in designing new workshops, which includes reviewing the syllabus and taking into account teacher feedback.

In terms of delivery, they typically have two Presenters per session, who are formally observed on a regular basis as part of their performance review. There is also a peer review process, particularly when trialling a new workshop where a third presenter attends, observes and provides feedback.

### *TQG Funding Sources*

Following the establishment of TQG in 2003, TQ initially used an element of the grant funding from WG to provide services/support to TQG. Revised

funding arrangements were introduced in 2006/7, following which WG provided separate grant funding direct to TQG to support the delivery of its education services. In 2008/9 'core' grant funding to TQG was £285,000, rising in 2010-11 to £308,000 per year. In the context of this new arrangement, TQG pay TQ £100,400 per year from the grant to cover the services described in the SLA above. In 2012-13 WG also provided additional project specific grant funding to TQG. See Table 2.2 below.

**Table 2.2 WG funding for TQG**

Type of funding	2010-11	2011-12	2012-2013
WG Core Grant	£308,000	£308,000	£308,000
Additional WG grant funding for specific in-year project work	£23,145 CPD and Outreach <sup>38</sup>	0	£24,239 MAT* and 14-16 <sup>39</sup>
<b>Total</b>	<b>£331,145</b>	<b>£308,000</b>	<b>£332,239</b>

\* *More Able and Talented Project*

In addition to the grant funding received from WG, other sources of income include:

- **Glyndŵr University funding**, which is £146,832 per year;
- **Admission fees**, which for the Wrexham site are £5.95 for adults and £5.50 for children – including a voluntary donation to Techniquest of 10%. School visitors pay a discounted fee of £3 per pupil which includes one activity – extra activities are £1 per child. Accompanying teachers are free.
- **Charges for outreach workshops** and science shows are £200 per show for a full day and £150 for half a day, with a current offer of receiving a second booked activity for half the price. The Dome Show is £250 for a full day and £175 for half a day.<sup>40</sup>

<sup>38</sup> WAG CPD (Aug 10) £12,701.00 Development and delivery of teacher CPD activities; WAG Outreach (Aug 10) £10,444.00 Funded outreach delivery to schools in Wales

<sup>39</sup> WG MAT £13,950.00 More Able & Talented and WG 14-16 £10,280.00 Employer Engagement Project

<sup>40</sup> There is a surcharge of £25 for outreach visits to schools outside of TQ catchment area. Generally, the catchment area covers most schools within 90 minutes travelling time of the centre.

- **Other grant income**, such as from the National Science Academy and the Royal Academy of Engineering. See Annex 3 for a detailed overview, and,
- **Other earned income**, such as revenue from shop and café facilities and kit hire (£75 for a full day and £50 for half a day).

Income from English schools has been important to TQG in terms of “pump-priming” their work in Wales as they are charged a higher rate.

### *TQG School Activities and Services*

TQG offers a range of curriculum linked enhancement and enrichment activities and services to schools and FE colleges from the Foundation Phase through to post 16. This includes centre visits and outreach workshops, science shows and dome shows delivered at the centre or in schools, university tours, the hiring of kits and teacher CPD. In the development of these activities TQG utilises its knowledge of the wider curriculum and consults with teachers, science advisers and industry partners.

Since 2001 there has been an increased focus on STEM education engagements delivered to schools in Wales. In agreement with the Welsh Government, TQG have adopted a target school engagement ratio of 60:40 (Wales: England). Below is a summary of the school offer with further details of activities provided in Annex 5.

#### **TQG School Service Offer**

- **School Visits to the TQG Centre** – with the exhibition centre at Wrexham housing 70 hands-on exhibits, a theatre, a LEGO® Education INNOVATION STUDIO (LEIS), a laboratory, a lunchroom and workshop areas. Situated at Glyndŵr University, on-site visits can also include university department tours for older pupils often incorporated as part of workshop activities. All programmes are linked to the Curriculum for Wales, and teachers receive pre- and post-visit materials to help prepare and extend the learning back in the classroom. Activities include engineering, design technology, science and maths. In 2012-13, TQG engaged 8,617 pupils through their onsite activities, 63 per cent of which were with Primary school pupils and 70% were with pupils from schools in Wales.
- **TQG Outreach Work with Schools** – As the North East hub within the All Wales Strategy, TQG is contracted to deliver outreach to schools in Wrexham, Flintshire, Denbighshire, North Powys and East Conwy. In their capacity as a hub for the National Science Academy of Wales they also deliver school engagements in conjunction with

STEM industry across the whole of North and Mid Wales. Many science shows and workshops in their programme are offered both onsite and as outreach for schools. There are also a number of additional activities available only as an outreach option. One of their most popular activities is the dome show which is delivered as out-reach only. In 2012-13, TQG engaged 16,533 pupils through their outreach activities, 74 per cent of which were with Primary school pupils and 68% were with pupils from Wales.

- **TQG Continuing Professional Development (CPD) for Teachers** - TQG offers a range of CPD activities for teachers that include: industry visits i.e. teacher only tours/visits of local employers such as Toyota; providing training to teachers on the use of the school kits; and co-hosting activities with newly-qualified teachers in a supported way and in partnership with WJEC exam board. In 2012-13, TQG delivered CPD to 63 teachers.
- **TQG Delivery in Welsh** –Finally, the website and all their key published documents are produced bilingually and they have three full time Welsh speaking staff as trained Presenters. Other Presenters are also learning Welsh through the University, so are able to meet and greet in Welsh and use incidental Welsh. They recently held a Welsh Language Appreciation Day and have plans to repeat this on a quarterly basis. Six primary schools attended this first event, with one of the science shows being delivered in Welsh for KS1 and KS2 pupils. Participating schools were offered subsidised travel for this event. For 2012-13, TQG delivered onsite and outreach provision in the medium of Welsh to 1,307 pupils, 8% of all of their engagements with schools in Wales.

Interviewees further noted that what they offer or deliver largely depends on what schools are interested in. Some schools particularly like the maths workshops and come back year after year for this. Other popular workshops include Crime Scene Investigation (CSI), robotics and the Planetarium Dome. TQG secured a contract to deliver a Wellcome Trust funded workshop on Bacterial Evolution, which has proved very popular among secondary schools. Delivery and strategic staff were keen to emphasise the importance of having Glyndŵr University as a partner in terms of being able to offer a broader STEM offer.

### 2.5.3 TQG Marketing

There is a dedicated sales and marketing team that deploy a range of marketing tactics:

- **The production and dissemination of marketing materials.** They publish and disseminate primary and secondary booklets in English/Welsh to all schools in NE Wales at the end of the summer term, to allow time for planning for the new September term onwards. TQG follows this up with a letter/email in September. They re-send the booklets in January or, if updated, send out new versions.

- **The TQG website:** this has been re-designed so it is easier to navigate and teachers “*can now drill down to what they want*”. All information in the printed materials is also provided on-line, and curriculum links and pre- and post-materials are also provided.
- TQG also markets its services to schools through **direct sales phone calls**. A part-time sales coordinator was recruited to contact and build relations with local schools, allowing named contacts to be identified, the TQG offer explained, and any offers promoted. This includes a focus on Welsh medium schools.
- The establishment of **a contact database**, which records school contacts and activity dates which allows them to map against “pupil premium” schools and so target schools in deprived areas.
- **Face to face visits** by the Education and Operation Managers with either primary science coordinators/ head teachers or heads of maths/science in secondary schools.
- As with TQ, another tactic has been the promotion of ‘**cluster bookings**’ pitched to groups of small schools in rural areas where coordinated joint bookings lead to reduced costs and enables small schools to access the TQG offer.
- TQG has also developed **special offer promotions including subsidised travel costs**. TQG has found that travel costs are one of the main barriers for schools attending centre provision, and they offer £50 per school on average, but up to £150 in the more extreme cases.

#### 2.5.4 TQG Partnerships

Alongside the Welsh Government, TQG has a range of strategic partners, including: Glyndŵr University, TQ, industry partners such as Toyota UK Engine Plant in Deeside, LEGO® Education, the Engineering Development Trust (EDT), Business in the Community and a number of local education authorities and non-governmental organisations.

Through their links with Glyndŵr University they are also linked into various HEI networks that include other universities, such as Bangor University, Chester University, Deeside College, Yale College and Grŵp Llandrillo Menai. Additionally, TQG has developed partnerships with a number of professional bodies such as the Institution of Mechanical Engineers, Institute of Physics, Royal Society of Chemistry, Royal Academy of Engineering, and the Institution of Civil Engineers and educational organisations such as CREST Awards and Association for Science Education.

A full time Partnership Coordinator is employed to facilitate work with a range of local industry partners, all of whom are key to TQG's school work delivery. These include Toyota, Airbus, and Kraft Foods. See Figure 2.1 below for a detailed example. They are also currently in the early stages of establishing a partnership with Kellogg's with a view to securing funding to deliver in-reach/outreach activities. These links provide useful information to inform the design and delivery of TQG's wider education programme, as well as offering opportunities for visits by pupil groups. Delivery staff felt this engagement helped provide a richer engagement for pupils and teachers.<sup>41</sup> Toyota and the Engineering Development Trust (EDT) for example are key partners in their TQG STEM provision. The Toyota Engine Plant at Deeside is a large employer of STEM professionals in the region, and provides factory tours and careers talks for students alongside an interactive workshop from Techniquest Glyndŵr.

TQG is also one of the main providers for Wrexham Science Festival, which is an annual event funded through Careers Wales for primary and secondary schools. As part of its support to NEET young people TQG also works with Wrexham Information and Technology Centre (ITeC). As part of their 8-10 week engagement with ITeC NEET young people visit TQG every other week and engage in a series of interactive workshops.

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<sup>41</sup> There are challenges engaging employers in outreach activity. Where employers are engaged in visits to schools, only schools which have proved to be reliable in the past are involved, following previous experiences where schools' cancelled employer visits at the last minute.

## TQG Partnership Working: Toyota

Toyota values their partnership with TQG and GU in terms of leveraging community engagement, and helping to promote manufacturing. They made initial contact with TQG three years ago through a general programme of open days (which included seminars and Plant tours); TQG was one of the organisations who responded to this and came along. A year later, Vince Cable's initiative encouraging the motor-industry to more pro-actively link with communities pushed Toyota to approach TQG about joint working particularly given that in parallel to this, Toyota were also running regular school visits to their site (as part of raising awareness and encouraging recruitment among the local community) – an area where it was TQG could really input on. They established a joint aim of both strengthening Toyota and extending the STEM agenda in Wales. In the last two years, their three way partnership with TQ and University Glyndŵr has strengthened: *“making that bridge between industry and the classroom is invaluable.”*

In terms of the delivery model, and in agreement with TQG, they decided to build on Toyota's existing school programme and build TQG activities into this. Their main activity is the “See Inside Manufacturing” workshops for schools, targeted towards Yrs 9 and 11.<sup>42</sup> Over a two week window (in June-July every year), schools visit the plant for a one day visit each. This includes:

- A presentation from Toyota about what they do and a tour of the Plant;
- A linked interactive session led by TQG presenters using Lego ® programming, solar technology and/or hybrid vehicles; and,
- A follow up event November with teachers only (in 2012, 26 teachers attended). This session allows teachers to do the activities themselves i.e. Lego ® programming and also allows Toyota to raise awareness around the range of STEM career opportunities for all abilities.

In 2011, for the school on-site activities they had 150 participants; in 2012 for the same period they had 300 participants. The demand is high, and they operate a waiting list. If demand continues to rise, they will have to consider how best to manage this. Currently they are discussing options for this:

- a new delivery model with TQG, where time spent at the Plant is reduced, with more of an emphasis on the TQG led interactive sessions - they were planning to trial a new approach at the Big Bang fair in Llandudno in March 2013 and will then roll out as part of the June-July activities.
- work to support TQG in encouraging other industry employers in the region to take on similar role so spreading the load and giving schools a wider choice

The feedback they receive from these workshops is *“phenomenal”*; and *“overwhelmingly positive.”* – *“I don't think anyone in the local area is doing the same.”* The Toyota lead produces an internal report after each two week school session providing an overview of the feedback forms completed by every pupil and teacher. For 2012, there were 326 respondents of which 296 were pupils – 47% of schools were from England (Cheshire) and 53% from North Wales. 100% of the respondents felt they knew more about manufacturing as a result of the workshop; and 70% will choose to continue to study STEM. He also highlighted how teachers have fed back to him of the higher numbers of girls choosing manufacturing as a career option. Other feedback suggested that teachers would appreciate more opportunities for problem solving, which they will factor into the design of future workshops.

They also deliver activities at the TQG centre, for example, they take hybrid vehicles to the TQG centre and co-deliver the “Toyota Robot Challenge” workshop. TQG Presenters lead on the educational aspects, with Toyota taking questions on the employer/manufacturing side. Overall, the three way partnership between Toyota, TQG and GU offers a unique resource that can build on their Plant tours. With TQG they can show *“what an industrial robot does and then go back and play within one. Without TQG we would struggle to do this.”* They have donated a range of resources to TQG as part of their partnership. While the donation of cars is something they offer to all FE colleges across Wales, the robot

<sup>42</sup> In practice, they have catered for pupils from ages 6-7 years up to technical college level.

equipment, the cut away engine and the individual robot are 'special and indicative of how much we value their partnership.'

### 2.5.5 TQG Future plans

Welsh Government has agreed grant funding for TQG's core education work programme for 2013-14; in December 2012, the Minister for Education and Skills announced grant funding of up to £350,000 for TQG for 2013-14.<sup>43</sup>

TQG's report *Inspiring, Challenging and Engaging* (2012) described future plans as including:

- Strengthening TQG's position as a centre of excellence in the region for high quality industry-linked Robotics and Control Systems activities;
- Developing a range of enrichment and enhancement activities supporting the UK wide "Computing at School' initiative;
- Increasing the quantity, quality and scope of engineering projects developed and delivered to schools;
- Introducing public engagement and science communication training for university students, STEM industry representatives and education professionals;
- Exploring opportunities in new and digital media in order to remain relevant and at the forefront of technology;
- Developing further an appropriate and exciting environment for 14-19 year olds visiting TQG
- Providing out of school science and technology clubs to engage community visitors;
- Broadening the range of provision of cross-curricula workshops to support the whole curriculum; and,
- Developing links with other local centres of excellence to enhance student experience.

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<sup>43</sup> Grant funding for 2013-14 and additional grant funding for Techniquest in 2012-13: <http://wales.gov.uk/about/cabinet/decisions/dr2013/janmar/addysg/la4074/?lang=en>

Interviewees further noted that they were optimistic about the future for TQG, with staff partners acknowledging the important role played by Glyndŵr University in supporting TQG. However it was emphasised that the main challenge going forward is the changing market and associated issues around generating income directly from schools. Plans for expanding the onsite school offer, such as the development of an eco-garden with funding being sought from Tidy Towns, are being considered. This would allow for the development of a new set of outdoor workshops and activities such as pond dipping and data logging.

## **2.6 Stakeholder views**

Having described the school offers for each of the two centres, this final section presents further context by outlining how the two centres are viewed by a range of national STEM stakeholders interviewed as part of the study. Details of the number of individuals interviewed are provided in Annex 2, which included representatives of Welsh Government, Local Authority Advisers and wider STEM stakeholders, including members of the TQ and TQG Advisory Boards and other providers of STEM enhancement and enrichment services to schools.

The vast majority of the stakeholders interviewed were aware of both TQ and TQG and their respective school offers. However some of the interviewees expressed more familiarity with TQ in Cardiff, while some who were aware of the wider role of the centres reported having less of a detailed understanding of their offer to schools (particularly regarding their outreach provision). This suggests a need for TQ and TQG to promote/remind key influencers of the breadth and depth of their respective service offers for schools.

A number of stakeholders highlighted the challenges facing TQ and TQG in terms of reduced school budgets and shifting policy priorities, and their implications for school decision making processes around enhancement and enrichment provision. For example:

*“Inreach is generally on the decline. Schools will opt for ‘curriculum area subject experts’ visiting schools to enrich the curriculum and will increasingly focus on activities that will meet the demands of the curriculum only.” (Local Authority Adviser)*

*“There are more pressures on school budgets and, where science ambassadors are cheaper, schools will use them, or perhaps simply choose not to offer any extracurricular or enrichment opportunities to their students at all.” (Welsh Government)*

Despite these external challenges, TQ and TQG were held in high regard by most of the interviewees, who commented positively on their school services and highlighted the passion and commitment of staff members. The public funding from Welsh Government, together with their commercial activities, was seen as important for supporting innovation and sustainability. Although three stakeholders (from different backgrounds) would like to see Welsh Government open up their funding to other organisations, on the whole the stakeholders did not see any need for Welsh Government to radically review its funding of the centres. In the words of one interviewee:

*“I always felt that Techniquest engaged well with schools and their services were suitably challenging for the pupils. It’s a first class facility” (STEM Stakeholder)*

Interviewees acknowledged that the Techniquest brand was widely recognised among schools and that there were generally high levels of satisfaction expressed by teachers using TQ and TQG provision. However with the exception of one (a Local Authority Science Adviser) there was little mention of provision having “the wow factor”, with questions being raised about the need to update and renew exhibits. According to one interviewee, for example: “there are no real surprises” (Welsh Government). One interviewee also felt there was the need for the centres to employ delivery staff with teaching experience to more effectively engage pupils (STEM Stakeholder). These and other points are discussed more fully below.

### 2.6.1 *The primary and secondary focus*

There was a common perception amongst the interviewees that the main focus of the centres was with primary, rather than secondary, pupils, particularly in terms of their on-site exhibits. In relation to TQ in particular there was a common perception that – aside from the Reach the Heights funding - engagement with secondary schools was on the decline. This was not always seen negatively, however:

*“TQ’s approach is more akin to broader Foundation Phase learning than pure science and therefore makes it engaging and relevant to people.” (Welsh Government)*

In contrast another interviewee, who had previously been a secondary Head of Science, spoke very positively of the secondary onsite provision available highlighting in particular the DNA and the Forensic workshops. The interviewee however in the case of the DNA workshop did question whether it could be more effectively linked to a real life problem to help make it more engaging.

It was generally thought that secondary schools were more effectively engaged through outreach services, given that they have more restrictive timetables and incurred additional teacher supply cover costs.

### 2.6.2 *The visitor centre offer*

The TQ and TQG visitor centres were seen by stakeholders as providing real added value to their STEM support offer. However, a number of specific issues were raised:

- The running of a centre was seen as incurring higher overhead costs compared with competitors, requiring the need for higher income generation targets. While this was partly offset by direct revenue streams from commercial activities and direct grant funding, and further still by a high profile brand and a good reputation, the high

overhead costs were seen as having implications for the on-going maintenance and refreshment of onsite exhibits.

- While representatives from TQ and TQG both said exhibits were routinely refreshed, this was not how all stakeholders perceived it with some questioning the extent to which exhibits/resources were regularly updated, and the implications this can have on the quality of the experience for pupils and for potentially inhibiting repeat visits. One local authority adviser interviewee, for example had canvassed teacher views ahead of the interview who were all generally “*underwhelmed by [TQG’s] on-site facilities*”. Other interviewees compared TQ with At-Bristol, highlighting that in the case of the latter there was a faster turnaround, and greater range, of exhibits.
- It was generally felt that the on-site offer had to be a sufficiently strong pull factor for schools to outweigh perceived barriers related to costs and the efforts required to take pupils out of school. Part of this was about communicating and delivering an offer that schools could not do themselves. Some of the stakeholders highlighted positive examples of where the centres had made efforts to more effectively demonstrate how onsite experiences could add value to the curriculum and learning back in the classroom. For example, the provision of digital cameras by TQ to pupils visiting for use back in the classroom was seen as an effective and attractive way to extend learning beyond the visit. However one interviewee felt more could be done to embed learning, again giving the example of At-Bristol’s Explore More approach, which included the use of wrist bands to collect data which can subsequently be reviewed online.
- Inevitably, the locality of the two centres were not seen as conducive to allowing schools from the North West and Mid Wales practical access to on-site provision – although as discussed below the outreach offer through the hub network was seen as an alternative way to engage such schools.

### 2.6.3 *The outreach offer*

The outreach element of the TQ and TQG offer was recognised as important but - with the exception of Mathcymru - not necessarily qualitatively distinct from other outreach providers. While TQ and TQG were rated highly by the majority of respondents to the teacher survey, the market for science (less so Maths) outreach provision was seen by stakeholders as much more competitive, with a larger number of providers offering in school science shows and workshops. STEM Ambassadors and local authority science and technology services were highlighted as sometimes offering more attractive and convenient offers to schools – despite recognition that with public funding TQ/TQG were able to offer services on a much larger scale and at a subsidised rate. A local authority adviser in North Wales felt that the TQG outreach workshops were very popular among teachers, and that he had received very positive feedback. For example primary schools found the outreach workshops to be fun and engaging and helped “bring STEM to life.”

Another local authority adviser interviewee felt that the lack of coordination among STEM outreach providers meant that not all schools, particularly those in remote areas, felt they had access to STEM provision. In this context, the role of the hubs was viewed as ‘a great idea’ and that increasing outreach provision – particularly in partnership with other STEM support providers - was seen as the solution to engaging schools in more remote areas. However as one interviewee noted, for the hubs to work effectively and efficiently it will be important to get the financial model right in areas where local demand may be low/may need time to become established.

### 2.6.4 *Other aspects of the school offer*

The stakeholders interviewed were also questioned on the provision of mathematics / Mathcymru and CPD for teachers by the centres.

Two interviewees spoke very highly of TQ’s maths offer, particularly the Mathcymru outreach workshops and the maths solving toolkits loaned to schools. One of the interviewees, a local authority Maths adviser, for example considered that Mathcymru provision was of good quality and was delivered effectively. They also felt that it was well designed and in most cases

appropriate to the curriculum, although suggesting there was the need for some further refinement, particularly in terms of language used, to ensure a full curriculum fit.

Few of the stakeholders interviewed were aware of the CPD offer, and those that were aware saw it as small scale. One interviewee felt that TQ's CPD offer was not particularly well known and that more could be done to promote this strand particularly among trainees and NQTs. Two others questioned the reliance on external speakers rather than making use of existing in-house expertise to deliver the CPD sessions.

TQG and its co-location with Glyndŵr University was recognised as a "real plus" by some interviewees. TQG was generally seen as having more links with universities and employers than TQ, and included visits to Glyndŵr University STEM Departments, and employer premises as part of their offer, but as having a smaller catchment area and having less of the 'big centre' draw.

#### *2.6.5 The future for TQ and TQG*

More generally, it was felt that TQ and TQG will need to evolve and adapt to negotiate the difficult economic times and trends in onsite and outreach provision. Some supported a more enhanced role for the centres in terms of pro-actively helping to shape Welsh Government strategic areas and developments in the STEM curriculum. While existing efforts were recognised, such as TQ's establishment of a workshop on the new Welsh Baccalaureate, it was felt by some that TQ and TQG were in a position to take more of a role in influencing STEM provision in schools, particularly in terms of, for example:

- More effectively capturing impacts through robust evaluation to demonstrate what works in engaging pupils with STEM;
- Working more collaboratively with a range of education agencies including exam boards – particularly in the context of current changes to local authorities and the current drive in raising standards in numeracy;

- Promoting their maths services via and in partnership with Hwb, the new virtual learning environment for teachers and learners in Wales (<https://hwb.wales.gov.uk/Home/Pages/Home.aspx?lang=en>);
- Spearheading an inter-schools competition, in partnership with local authorities and employers, to encourage wider school buy-in and to achieve more tangible positive impacts on pupils and STEM performance; and,
- Developing further services that reflect the local and regional contexts, such as engineers in the North East and nuclear in Anglesey.

Having provided the context for TQ and TQG, the following chapters present the key study findings in relation to performance, user experiences and perceived impacts of TQ and TQG, and the views of non-users.

### 3 Techniquest: Key Findings

#### Key Findings

##### Throughput

- Since 2010 TQ has engaged with over 990,000 adults and children, of which 31% have been with pupils through school engagements (just over 306,000).
- Over the last three years, TQ has consistently exceeded its targets for outreach provision, although they have fallen slightly behind target for onsite provision.
- Engagement with both onsite and outreach provision is consistently dominated by primary phase pupils, i.e. Key Stage 2 and Foundation Phase.
- In 2012-13, TQ engaged 20,394 primary school pupils in their Mathcymru activities with Welsh Government funding (secondary pupils being engaged through the Reach the Heights project).
- Pupils from schools in England accounted for 6% of all pupils engaged in 2012/13 – dominated by schools visiting the centre compared to receiving outreach (14% vs 2% of all pupils)
- Overall engagement with TQ services shows a concentration in local authorities in the South, and particularly South East, of Wales.
- For 2012-13, TQ has engaged 5,791 pupils in activities delivered in Welsh accounting for 6% of all their engagements with schools in Wales, higher than in previous years with the exception of 2011-12, where the figure was 5,895.

##### Experiences of users

- In our teacher survey, TQ users reported first hearing of TQ's offer to schools through a variety of means – most commonly through marketing materials, word of mouth and direct contacts. The majority of respondents felt they had a good understanding of the services TQ provided.
- In the last four years the most commonly reported engagement type was through a centre visit, although this was markedly less for secondary than primary schools. In the last year the spread of engagement type for primary schools has widened to concentrate less on centre based activities, with secondary schools also being more evenly spread between onsite and outreach activities. For the majority of schools Techniquest services were used once or twice a year.
- Of the 40 Welsh language schools using TQ in the survey, 80% reported awareness that learning and promotional materials were available in Welsh and 53% reported taking up services in Welsh.
- Almost half of all schools reported receiving pre-materials, and 28% post-materials. Where received, they were found to be of high quality, appropriate and easy to use.
- The vast majority of schools, 90%, rated their most recently received service as good to excellent in terms of overall quality. TQ services were also rated highly in terms of their fit with the curriculum and their suitability for the specific pupil audiences accessing them.

##### Perceived Impacts

- The vast majority of schools found their most recent service to be fun and exciting for their pupils. Teachers also reported positively on the achievement of tangible learning outcomes, with 109 (75%) rating them to be good or excellent.
- The most commonly cited pupil impacts were: increased motivation and enthusiasm for STEM learning; increased interest in STEM subjects; improved understanding of the concepts covered in the specific sessions; and improved overall understanding of STEM subjects.
- The majority of teachers also considered that they and their schools had benefited from TQ provision, most commonly in terms of providing ideas for practical and other sessions, and introducing new ways of introducing STEM concepts.

##### Added Value

- One in three (38%) schools considered that TQ provision fully met their needs, and over

half (57% or 83 schools) that it met their needs in part.

- TQ school provision compared well to teachers' experiences of similar providers, with just under half (47%, 68 schools) considering that TQ provision was better, or much better, than similar provision received elsewhere, and 30% (44 schools) considering it to be about the same.
- The vast majority of schools (85%, 123 schools) considered TQ provision represented value for money.

#### **Future use**

- Almost two thirds of schools (62%, or 90 schools) reported being highly likely to use TQ services in the next 12 months, with an additional 26% (38 schools) being likely to use them and 8% (12 schools) possibly using.
- Cost issues and in particular travel costs emerged as the most common factors limiting the likelihood of use in the next 12 months.

### **3.1 Introduction**

This section provides the key findings as they relate to TQ's school services. We first present an overview of TQ's performance over the previous three years in terms of throughput against Welsh Government targets. We then present an analysis of the user experiences and perceived impacts drawing on the Wales-wide teacher survey and follow up interviews.

For the survey we interviewed a total of 203 teachers, 145 (71%) of which were from schools using TQ services. In terms of the distribution by primary and secondary of the TQ users, 120 were from Primary schools and 25 were from Secondary schools. A small share of respondents (11 schools) had previously used both of the centres, comprising 10 primary and one secondary school. In most cases we present data using percentages except where the numbers become too small, in which case we present them as numbers only.

### **3.2 Performance**

Since 2010, TQ has engaged with over 990,000 adults and children through the provision of services to the general public as well as its specific services for schools.<sup>44</sup> Given the focus of this study, we draw on the data on throughput and engagement relating specifically to the numbers of pupils engaged via schools against annual targets set with Welsh Government. This

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<sup>44</sup> 990,208 - the sum of the figures provided for the Wales Total Techniquet Audiences (excl NE Wales) from all three Q4 Reports for: 2010-11 (315,733); 2011-12 (331,646) and 2012-13 (342,829).

data shows that TQ reported over 306,000 pupil engagements in the years 2010/11 to 2012/13, 31% of all engagement. Of these, 118,162 (39%) were through onsite and 188,542 (61%) through outreach provision.

The remainder of this section sets out engagement against target by service type (i.e. onsite and outreach) and by primary and secondary/school stage.

### 3.2.1 Overview of performance

Table 3.1 provides an overview of TQ performance against annual targets for its onsite and outreach services. For comparison purposes, the data across all three years for onsite includes provision to pupils from both Welsh and English schools and for outreach includes provision to pupils in Wales only.

**Table 3.1 TQ Throughput against targets for Onsite and Outreach School Activities 2010-2013\***

Year	2010-11		2011-2012		2012-2013	
	Target	Actual	Target	Actual	Target	Actual
Education Onsite (pupils visiting)	41,179	40,687	41,200	37,841	41,170	39,634
Education Outreach	51,150	60,502	54,000	58,388	60,002	68,362
<b>Total</b>	<b>92,329</b>	<b>101,189</b>	<b>95,200</b>	<b>96,229</b>	<b>101,172</b>	<b>107,966</b>

\* Figures include Mathcymru and exclude provision for school pupils under the Reach the Height project. Source: Q4 Reports for 2010-11, 2011-12 and 2012-13. For Q4 Report 2012-13 Table 5a and Table 7b.

The figures in Table 3.1 above include school engagements achieved via the two hubs Superstars and TLC!. Although not presented in the table, for 2012-13, Superstars delivered to 6,046 pupils in schools in Pembrokeshire and Carmarthenshire and TLC! to 3,201 pupils in schools in Anglesey, Gwynedd and West Conwy.

Although not included in the table above, TQ also report on numbers of teachers engaged in CPD, which show that for 2012-13, the total number of teachers receiving CPD was 221 against a target of 310. This was however

across a total number of 529 teacher days indicating a greater number of 2-3 day courses and therefore resulting in fewer teachers reached.

Over the last three years, TQ has consistently exceeded its targets for outreach provision (achieving 118%, 108% and 114% of target respectively), although they have fallen slightly behind target for onsite provision (achieving 99%, 92% and 96% of target respectively). This data for onsite provision reflects many of the comments from Techniquest staff and wider stakeholders regarding the increasing challenges in attracting schools, and notably secondary schools, to centre-based provision (an issue not confined to provision in Wales).<sup>45</sup> Major barriers to attracting secondary schools to the centre as identified by TQ staff for example include: costs of transport, cuts to school budgets, the more rigid implementation of the Teacher Workload Agreement in secondary schools and risk assessment requirements.

### 3.2.2 *Engagement by school stage*

The composition of pupils engaging with TQ provision in the 2010/11 to 2012/13 years is provided as Table 3.2 below. This includes data for pupils from schools in Wales and England, with the exception of 2012-13 which is for pupils from Wales only. The table shows that engagement with both onsite and outreach provision is consistently dominated by primary phase, i.e. Key Stage 2 and Foundation Phase, pupils. Indeed, overall across both onsite and outreach for 2012-13, just 7% of TQ's pupil engagements were with secondary pupils.

In terms of **onsite provision**, Key Stage 2 pupils accounted for 51% of all engagement in both the 2011/12 and 2012/13 years. When combined with Foundation Phase pupils, to represent the primary phase, this share rose to 81% in 2011/12 and 89% in 2012/13. Engagement with onsite provision among secondary and post 16 pupils was consistently concentrated at Key Stage 3, which accounted for 80% and 83% of all secondary/post 16 provision in 2011/12 and 2012/13 respectively.

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<sup>45</sup> See Wellcome Trust (2012) *Review of Informal Science Learning*, November.

**Table 3.2 TQ Throughput for Onsite and Outreach School Activities by school stage 2010-2013**

School Stage	2010-11		2011-12		2012-13	
	Onsite*	Outreach	Onsite	Outreach	Onsite	Outreach
Foundation Phase	-	3,580	11,073	3,450	13,072	20,828
KS2	-	43,770	19,459	49,995	17,441	44,040
KS3	-	8,953	5,845	2,405	3,139	2,348
KS4	-	1,188	230	1,141	68	458
Post 16	-	3,011	1234	1,397	561	688
<b>Total</b>	<b>40,687</b>	<b>60,502</b>	<b>37,841</b>	<b>58,388</b>	<b>34,281</b>	<b>68,362</b>

*All data are for schools in Wales only. Source: Qu 4 reports for 2010-11, 2011-12 and 2012-13. For 2012-13 this draws on data in Table 5a.*

*\* A breakdown of onsite figures for 2010-11 by school stage is not available.*

In terms of **outreach provision**, Key Stage 2 pupils accounted for 78%, 86% and 64% of outreach provision in 2010/11, 2011/12 and 2012/13 respectively. When combined with Foundation Stage pupils, this group accounted for 79%, 92% and 95% of all TQ outreach provision, emphasising the concentration of provision in the primary phase. Looking at the secondary phase, outreach provision is consistently concentrated at Key Stage 3, accounting for 68%, 49% and 67% of all secondary and post 16 provision in 2010/11, 2011/12 and 2012/13 respectively.

### 3.2.3 Engagement by Pupils in Mathcymru

Table 3.3 shows the number of pupils that have engaged with Mathcymru activities by school stage from 2010 to 2013. Notably all pupils in 2011-12 and 2012-13 supported with Welsh Government funding are from primary schools, with secondary provision being supported under the Reach the Heights project. Information from TQ for 2012-13 also shows that 55 schools applied for the Mathcymru grant scheme to support maths in schools of which 22 were successful.<sup>46</sup>

<sup>46</sup> TQ Qu 4 Report 2012-13.

**Table 3.3 TQ Throughput for Mathcymru Activities by school stage 2010-2013**

School Stage	2010-11	2011-12	2012-13
Foundation Phase	0	0	6,471
KS2	11,360	16,020	13,923
KS3	1,830	0	0
KS4	0	0	0
Post 16	0	0	0
<b>Total</b>	<b>13,190</b>	<b>16,020</b>	<b>20,394</b>

Source: Table 9b of TQ Q4 Report 2012-13. All figures exclude RTH

#### 3.2.4 Engagement by Pupils in Schools in Wales

As described above, monitoring data for onsite activities prior to 2012-2013 includes the number of engagements for pupils in schools in Wales and England. For outreach, numbers only include pupils from schools in Wales; however according to their latest management information TQ has delivered additional outreach to a small number of pupils (2% of all pupil engagement) in England. Table 3.4 shows the distribution of pupil engagement by provision type and by nation.

**Table 3.4 Total pupil numbers engaging by school location: Wales and England 2012-2013**

Provision type	Number of pupils in Wales	Number of pupils in England	Total
In reach	34,281 (86%)	5,353 (14%)	39,634 (100%)
Outreach*	68,362 (98%)	1,290 (2%)	69,652 (100%)
<b>Total</b>	<b>102,643 (94%)</b>	<b>6,643 (6%)</b>	<b>109,286 (100%)</b>

Source: Appendix 2 Table 7b of TQ Q4 Report 2012-13. Figures exclude RTH.

\* All outreach figures include Mathcymru but exclude RTH.

Table 3.5 below shows the distribution of pupils receiving TQ provision across the 22 local authorities in Wales, with the numbers in brackets showing their rank order in terms of pupil numbers.

**Table 3.5 Pupil numbers by provision type and local authorities in Wales 2012-2013**

Local Authority	Onsite	Outreach	Total
Cardiff	7109 (1)	6940 (3)	14049 (1)
Rhondda Cynon Taff	4791 (2)	6717(4)	11507 (2)
Bridgend	2659 (5)	7286 (2)	9945 (3)
Vale Of Glamorgan	1942 (8)	7366 (1)	9308 (4)
Newport	2287 (6)	5575 (5)	7862 (5)
Carmarthenshire	2909 (4)	4247 (7)	7156 (6)
Swansea	2264 (7)	4889 (6)	7153 (7)
Caerphilly	3038 (3)	3126(10)	6164 (8)
Pembrokeshire	819 (12)	3858 (8)	4677 (9)
Powys*	753 (13)	3497 (9)	4250 (10)
Neath Port Talbot	1053 (10)	2804 (12)	3857 (11)
Ceredigion	415 (16)	2981 (11)	3333 (12)
Gwynedd	395 (17)	2314 (13)	2709 (13)
Monmouthshire	1402 (9)	1285 (16)	2687 (14)
Blaenau Gwent	601 (14)	1971 (19)	2572 (15)
Torfaen	926 (11)	1329 (15)	2255 (16)
Merthyr Tydfil	525 (15)	1364 (14)	1889 (17)
Anglesey	86 (20)	677 (17)	763 (18)
Conwy**	107 (19)	200 (18)	307 (19)
Flintshire*	155 (18)	0 (=20)	155 (20)
Denbighshire*	45 (21)	0 (=20)	45 (21)
Wrexham*	0 (22)	0 (=20)	0 (22)
<b>Total Wales</b>	<b>34,281</b>	<b>68,362</b>	<b>102,643</b>

Source: Appendix 2 & 3 of TQ Q4 Report 2012-13. Figures include Mathcymru but not RTH.

\* TQG also delivers to schools in these areas. \*\* TQG delivers to schools in East Conwy.

As would be expected, overall engagement with TQ services shows a concentration in local authorities in South Wales, with the vast majority of the top ten authorities in terms of overall pupil numbers being in the South, and particularly South East, of the nation. However this is not always the case – for example Merthyr Tydfil is ranked 17th in terms of overall pupil engagement despite being located in the Southern region.

### 3.2.5 Delivery through the Medium of Welsh

Finally, Table 3.6 below provides the annual number of pupils from schools who selected their visit to TQ, or outreach provision, to be delivered through the medium of Welsh from 2010/11 to 2012/13.

**Table 3.6 Number of Pupils receiving TQ education services through the medium of Welsh**

Academic Year	Onsite	Outreach	Total
2010/11	1,900	2,880	4,780
2011/12	3,525	2,460	5,985
2012/13	3,136	2,655	5,791
<b>Total</b>	<b>10,406</b>	<b>9,315</b>	<b>19,721</b>

*Source: Data for 2010/11 – 2011/12 provided by TQ in a separate document. Data for 2012/13 provided in Table 7b of TQ Q4 Report 2012-13.*

Delivery through the medium of Welsh was also explored in the survey of teachers undertaken as part of this study. The findings are reported in the following sections.

### 3.3 All User Experiences

This section draws on the findings of the teacher survey and follow up interviews conducted for this evaluation to explore the experiences of teachers and pupils using TQ services. We also, where relevant, refer to TQ customer satisfaction data and delivery staff interviews. This section explores a range of issues including awareness of available services, types of use, experiences of Welsh medium delivery, use of and views on pre and post

materials and the perceived quality and appropriateness of the TQ service offer.

All but one of the teachers responding to the user survey reported that their schools were involved in a range of externally-provided STEM enhancement and enrichment activities. These included:

- Visits to science centres, zoos and museums – 95% (97% of primary and 88% of secondary schools);
- Using materials and resources from other sources – 61% (62% primary and 60% secondary);
- Using external STEM provision delivered on an outreach basis – 67% (68% primary and 60% secondary);
- Working with outside scientists – 47% (42% of primary and 72% of secondary); and
- Having science or engineering clubs – 43% (36% primary and 72% of secondary).

Two thirds of schools (66%) reported participating in these activities on a monthly or termly basis (68% for primary and 56% for secondary). Over one in five (21%) described involvement in enhancement and enrichment activities on a more frequent/weekly basis (20% primary and 24% secondary), with 12% (11% primary and 20% secondary) engaging rarely/less than once a term. Only one primary school reported never using externally provided enhancement and enrichment activities.

### *3.3.1 Awareness of TQ's School Offer*

On the whole teachers responding to the survey had experience of a range of STEM support providers in addition to TQ. They reported first becoming aware of TQ's school offer through a range of means – most commonly marketing materials (70%), followed by word of mouth (21%) and direct contact from the centres (20%). This chimes with the experience of staff at TQ, who reported that the mailing of flyers and brochures to be the most effective mechanism. Other routes included via the website and from local authority advisers. However it was clear from wider consultations that existing

levels of awareness of TQ are high from their role as a visitor centre, and the tradition of operation from the Cardiff base. The majority of respondents (92%) felt they had a good understanding of the services TQ provided – slightly higher amongst secondary schools (96%) than primary (92%). Four of the 15 schools in the follow up interviews described not receiving promotional material or other communications from TQ. One teacher explained how:

*“I do get the TQ leaflet, but at the start of the year I shelve it, then the rest of the year I don’t get reminded so I forget what’s on offer after September. One that draws most focus is a letter addressed to you.”* (Head of Science, Secondary)

### 3.3.2 Types of Use by Schools

The schools were asked to report the TQ services they had used in the four years prior to the survey, with the responses being shown as Table 3.7 below. This shows that the most commonly reported mode of engagement was a centre visit, though this was markedly less the case for secondary schools than primary. Indeed, delivery staff reported that they have found it increasingly difficult to attract secondary schools to the centre and so have had to reduce the scale of their secondary offer in this respect quite substantially.<sup>47</sup>

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<sup>47</sup> Interviews as part of site visit in Nov.

**Table 3.7 Use of Techniquet Services - Previous Four Years**

<b>Service</b>	<b>Total Used N=145</b>	<b>Primary N=118</b>	<b>Secondary N=25</b>	<b>Other* N=2</b>
Visits to TQ Centre – workshops, planetarium, use of exhibits	122 (84%)	108 (92%)	12 (48%)	2 (100%)
Outreach provision	97 (67%)	82 (69%)	14 (56%)	1 (50%)
Visit to TQ centre for Mathamagic and other maths workshops**	44 (30%)	32 (27%)	11 (44%)	1 (50%)
Outreach mathematics provision (Mathcymru)	57 (39%)	51 (43%)	5 (20%)	1 (50%)
CPD provision for teachers	31 (21%)	22 (19%)	8 (32%)	1 (50%)
Any other services	6 (4%)	2 (2%)	4 (16%)	
None of the above	2 (1%)	2 (2%)		

Source: ICF GHK/Beaufort Research Survey of Schools \* 'Other' relates to responses from special schools, which were included in subsequent analysis as secondary schools

\*\*Mathamagic workshops only available to secondary school pupils.

The schools were also asked which services they had used in the previous 12 months, as shown in Table 3.8 below. This suggests that the spread of engagement type for primary schools has broadened to be less concentrated on centre based activities, with secondary schools also being more evenly spread across onsite and outreach activities.

**Table 3.8 Use of Techniquest Services - Previous 12 months**

Service	Total Used N=145	Primary N=118	Secondary N=25	Other* N=2
Visits to TQ Centre – workshops, planetarium, use of exhibits	71 (49%)	67 (57%)	3 (12%)	1 (50%)
Outreach provision	45 (31%)	42 (36%)	3 (12%)	
Visit to TQ centre for Mathamagic or other maths workshops**	21 (14%)	17 (14%)	3 (12%)	1 (50%)
Outreach mathematics provision (Mathcymru)	26 (18%)	24 (20%)	1 (4%)	1 (50%)
CPD provision for teachers	11 (8%)	9 (8%)	2 (8%)	
Any other services	3 (2%)	1 (1%)	2 (8%)	
None of the above	40 (28%)	27 (23%)	12 (48%)	1 (50%)

Source: ICF GHK/Beaufort Research Survey of Schools. \* 'Other' relates to responses from special schools, which were included in subsequent analysis as secondary schools

\*\*Mathamagic workshops only available to secondary school pupils.

The majority of schools reported using TQ services once or more often each year, with:

- 15 schools (10%) using at least once a term;
- 95 (66%) using once or twice a year;
- 31 (22%) using less than once a year/every couple of years; and
- 3 (2%) using rarely – less than every couple of years

The tendency to go to Techniquest on a repeat basis was reflected in some of the follow up teacher interviews, with one primary teacher, for example explaining how:

*“We do think of [Techniquest] when we want to do something ... we’ve used them in many contexts. We’ve attended their shows and had them in and it excites the children. They can do things we as teachers can’t do because we don’t have the resources.”* (Primary School Teacher)

### 3.3.3 *Experiences of Welsh medium delivery*

When the 40 Welsh medium schools responding to the survey were questioned on TQ's provision and delivery of materials and services through the medium of Welsh, the findings were mixed. All TQ promotional and learning materials are available bilingually, and indeed, the vast majority of survey respondents from Welsh medium schools (80%, 32 schools) reported awareness that the promotional and learning materials they received were available in Welsh and 53% (or 21 schools) reported that in their experience TQ was able to deliver their services in the Welsh language. However 13% (5 schools) reported that they were not aware that materials or delivery were available in Welsh.

A number of teachers in the follow up interviews explained that the ability of a provider, and in this case TQ, to provide services in Welsh was a key deciding factor in their decision to take up services.

### 3.3.4 *Pre and Post-visit Materials*

Respondents were asked whether they had received any materials from TQ or TQG either in advance of their onsite/outreach visit or following it – and if so whether these materials had been used<sup>48</sup>

#### *Pre-visit Materials*

The provision of materials of relevance to any centre visit or outreach session can provide a useful introduction for teachers to use with pupils, and to help them prepare for and make best use of the service received. Almost half of all schools using TQ services (47% or 68 schools - 48% of primary and 40% of secondary) reported receiving such materials, and while 18 schools (12%) could not recall, 41% (59 schools) reported not receiving materials in advance.

Where the pre-visit materials were received, they were used by 79% of schools (54), with only 10% not using them. Although the numbers of

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<sup>48</sup> Materials are available on-line and also provided by TQ staff as relevant.

secondary respondents must be considered, there appeared to be a considerable difference in their levels of use between primary and secondary. Primary schools appeared to be over twice as likely to use the materials (86% or 49 schools) compared to 40% (4 schools) for secondary. In addition, 40% of secondary teachers (4 schools) could not recall whether they were used or not, compared to just 5% (3) primary schools.

### *Post-visit Materials*

Similarly, the provision of materials to use following service delivery can help embed learning and maintain the heightened interest and engagement resulting from it. However, just 28% of all schools (41 schools – 31% of primary and 20% of secondary) reported receiving materials from TQ following their service, with 58% stating no materials were received and 14% being unable to remember.

Overall 80% of the schools receiving post visit materials described using them with pupils, with similar rates being reported by primary and secondary schools respectively (81%/29 schools and 80%/4 schools respectively).

### *Perceptions of Quality and Effectiveness of Pre- and Post-visit Materials*

Schools receiving either the pre- or post-visit materials were asked to rate them in terms of their overall quality, appropriateness and ease of use with their intended pupil groups and their effectiveness in helping prepare for or embed learning. A five point scale was used to rate respondents' views, with 1 being very poor and 5 being excellent.

A total of 68 respondents had received materials from Techniquet, of which:

- 86% rated the **quality** of the materials as 4 or 5 (good /excellent), a mean score of 4.25, with primary schools being more positive than secondary (88% rating 4 or 5 compared to 75% – although the small number of secondary response should be considered).

- 80% rated the **appropriateness** of the materials highly (4 or 5 rating), with primary respondents being more positive than secondary (82% vs 63% respectively).
- 76% found the materials **easy to use** (rating 4 or 5) – 81% primary vs 38% secondary.

In terms of their **effectiveness**:

- 74% of schools rated the **pre-visit materials** as good/excellent (4 or 5) in preparing pupils for their service, 78% for primary but 25% for secondary (although based on just four secondary schools); and
- 63% rated the **post-visit materials** as 4 and 5 in terms of embedding the resulting learning, 64% of primary and 25% of secondary.

Finally, reasons for why pre or post-visit materials were not used were explored, although few schools (10) provided a response. It emerged that a lack of time prior to the service was the most common reason for not using the pre-visit materials, with just one respondent considering the materials were not appropriate for their intended pupil group and a second that they were not of adequate quality.

### 3.3.5 *Views on the Quality and Appropriateness of Most Recent Service Received*

Schools were asked to describe their experience of their most recent TQ service, and their experiences of TQ services more widely, as part of the teacher survey. Here we report their experience of the most recent service received, which are shown in Table 3.9.

**Table 3.9 Use of Techniquet Services – Most Recent Service**

<b>Service</b>	<b>Total Used N=145</b>	<b>Primary N=118</b>	<b>Secondary N=25</b>	<b>Other N=2</b>
Visits to TQ Centre – workshops, planetarium, use of exhibits	65 (45%)	57 (48%)	6 (24%)	2 (100%)
Outreach provision	45 (31%)	37 (31%)	8 (32%)	--
Visit to TQ centre for Mathamagic and other maths workshops	11 (8%)	7 (6%)	4 (16%)	--
Outreach maths provision (Mathcymru)	9 (6%)	9 (8%)	--	--
CPD provision for teachers	4 (3%)	1 (1%)	3 (12%)	--
Other services	7 (5%)	4 (3%)	3 (12%)	--
N/K	4 (3%)	3 (3%)	1 (4%)	--

*ICF GHK/Beaufort Research Survey of Schools*

Using a five point scale (where 1 represented very poor and 5 excellent) schools were asked to rate their most recent experience in terms of:

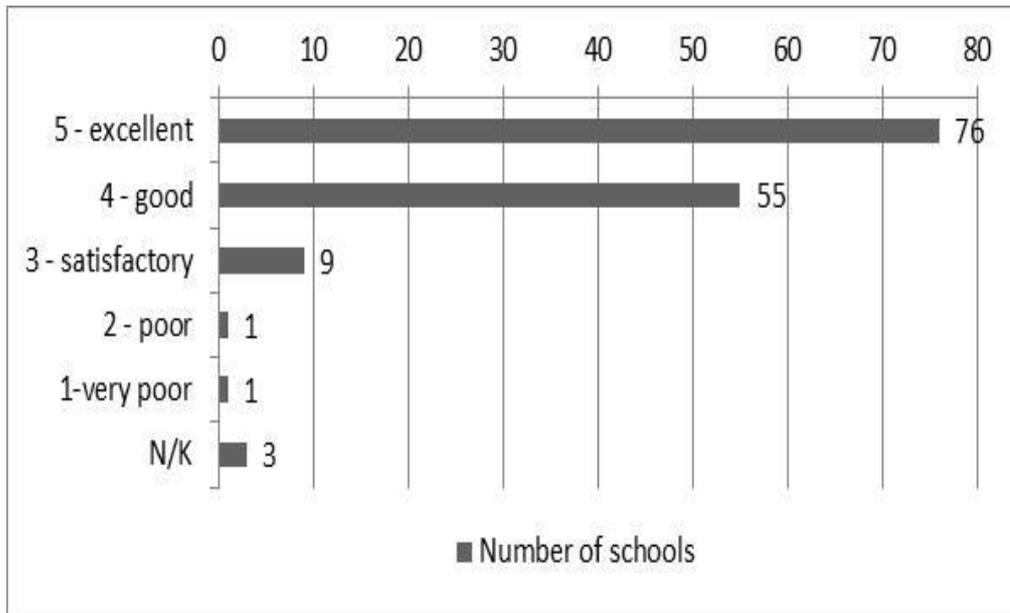
- The quality of the service provided;
- The perceived appropriateness of the service in terms of its fit with the curriculum and suitability for the specific pupil audience;
- The ease of booking/admin arrangements; and,
- The professionalism, skills and experience of the delivery staff.

They were also asked to rate the extent to which their experience provided a 'fun, exciting and engaging' experience for pupils, and had resulted in tangible learning outcomes, before being asked to rate their overall satisfaction with the service.

### Quality of the Service Provided

The vast majority of schools, 131 of the 145 using TQ services (90%), rated their overall quality as good or excellent (4 or 5), with just two schools rating below the mid-point of 3, as Figure 3.1 below shows.

**Figure 3.1 Quality of Most Recent Service**



Source: ICF GHK/Beaufort Research Survey of Schools, n=145

Both primary and secondary teachers rated service quality highly – with 89% of primary (105 of 118 schools) and 96% of secondary (26 of the 27 secondary schools) respondents rating at 4 or 5.

This overall positive feedback from the survey chimes with the views of TQ delivery staff that they are achieving their key objective of “giving the STEM curriculum the wow factor”, which was also reflected in the follow up teacher interviews. A teacher from a special school, for example, spoke very positively of their experience of taking a group of children with special needs to the TQ exhibition floor: “It gave them focus and they got to explore fun things like mirrors and optical illusions.” However, she also noted that not all TQ outreach services, such as the Planetarium, were accessible to wheelchair users, which had meant that not all of her pupils had been able to engage.

However in line with wider stakeholder views some concerns were raised about the quality of the exhibits and resources by other teachers using TQ services. For example, two primary teachers felt there was the need to refresh resources more frequently, with one saying that “*some of the equipment looks old and tired*” (Primary Teacher) and the other explaining that:

*“It would be nice if they could broaden their provision. Once you’ve used their provision once, you can’t use it again. For example, if we’re covering materials in Year 3, we can’t really have them accessing the same provision in Year 5 and 6 because they would have covered it before.”* Science Coordinator, Primary School.

#### *Appropriateness of the Service Provided*

TQ services were also rated highly in terms of both their fit with the curriculum and their suitability for the specific pupil audiences accessing them. In both cases the majority of schools considered TQ services were appropriate:

- To the curriculum – with 121 of the 145 respondents rating their fit with the curriculum as good or excellent (83%), and just one primary school rating below the midpoint; and
- To the specific pupil groups receiving them – with 127 schools rating their appropriateness to their audience as good or excellent (88%), and just two primary schools rating them below the midpoint.

Some differences emerged between the views of primary and secondary teachers regarding fit with the curriculum, and while the majority of both groups rated good or excellent more secondary teachers provided a neutral response (rating 3).

#### *Ease of Booking and Administrative Arrangements*

The majority of schools rated the ease of booking a visit/outreach session and the associated administration to be good or excellent (121 out of 145, 83%), although seven schools rated their experience as poor or very poor (5%).

Few differences emerged between the responses from primary and secondary schools in this area.

#### *Professionalism, Skills and Experience of the Delivery Staff*

The majority of schools using TQ services reported finding the professionalism, skills and experience of TQ staff to be good or excellent (90%, or 130 of the 145 respondents) – with just two primary schools providing a rating of below the midpoint of 3. Few differences emerged between primary and secondary respondents, with 105 (89%) and 23 (98%) of primary and secondary schools respectively providing a good or excellent rating.

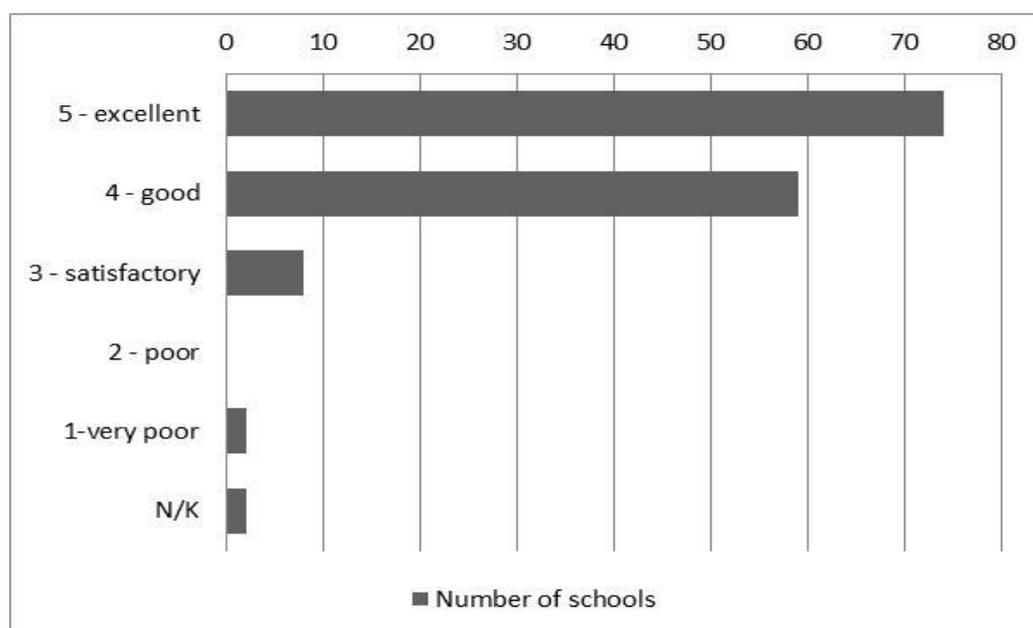
In the follow up teacher interviews, just one area of concern on this was raised. A secondary Maths teacher expressed some concerns about a maths session that his Year 7 pupils had engaged with at the Techniquiest centre. He explained that

*“TQ used different vocabulary to what they used in schools and in examinations; it would have been helpful to have specialist Maths staff who knew about the curriculum – other teachers from other schools thought the same.”* (Maths Teacher, Secondary School)

#### *Overall Satisfaction with Most Recent Service*

Given the responses to the previous questions, it is unsurprising that the majority of schools described being satisfied, or very satisfied, with their most recent TQ service. As Figure 3.2 shows, 133 of the 145 schools responding (91%) provided a rating of 4 or 5, with over half (51%) providing a rating of 5.

**Figure 3.2 Overall Satisfaction with Most Recent TQ Service**



Source: ICF GHK/Beaufort Research Survey of Schools, n=145

Primary and secondary schools varied in the strength of the positive ratings provided – with a larger share of primary schools (54%) providing a rating of 5 than secondary (36%), although more secondary schools rated 4 (52%) than primary (38%). Only two schools expressed dissatisfaction, both of which were primary schools.

### **3.4 Impacts for Pupils and Teachers**

Drawing on the teacher survey and follow up interviews, together with delivery staff interviews and TQ’s own evaluation reports,<sup>49</sup> this section explores reported impacts for pupils and teachers of the most recent service and more broadly including any perceived broader added value.

#### *3.4.1 Benefits and Impacts of Most Recent Service*

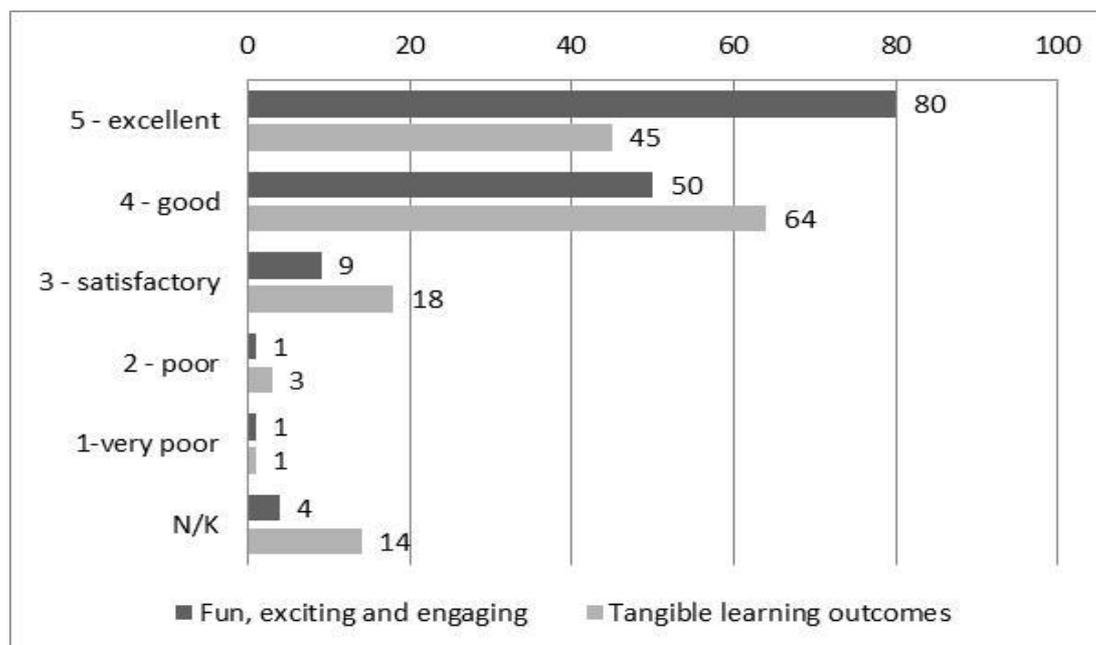
Schools were asked to rate their most recent experience of TQ provision in terms of two specific measures:

<sup>49</sup> Various formative evaluation reports of their education work; Template of their teacher questionnaire; Two studies based on follow up research to assess longer term impact; results from a number of consultation events with teachers, incl. January and June 2012; and an Evaluation Report for the Science of Me Weekend 6-7th October 2012.

- The extent to which the services was ‘fun, exciting, innovative and engaging’ for the pupils attending, and
- The extent to which the service provided tangible learning outcomes for pupils.

As Figure 3.3 shows, the survey found that the vast majority of schools using TQ services found their most recent service to be fun and exciting for their pupils - with 130 of the 145 (89%) respondents rated the provision good to excellent in this regard, and just two primary respondents rating negatively. Primary and secondary schools provided similar responses, (90% and 88% rating good/excellent respectively). We were also keen to capture views about any perceived impacts in terms of tangible outcomes beyond levels of enjoyment and interest such as increased knowledge or skills among pupils. Responses in terms of providing tangible learning outcomes were positive, with 109 or 75% of schools rating this as good to excellent – although more rated good than excellent. At the same time 14 schools (10%) were unable to comment, and four schools (three primary and one secondary) rated below the midpoint.

**Figure 3.3 Benefits and Impacts of Most Recent Service**



Source: ICF GHK/Beaufort Research Survey of Schools, n=145

Responses varied between the primary and secondary schools mainly in the degree to which learning outcomes were reported. 40 of the primary schools (34%) rated this variable excellent while 42% rated as good – compared to 4 (16%) of the secondary schools rating excellent and 14 (56%) as good.

### 3.4.2 Wider Benefits and Impacts for Pupils

In addition to perceived benefits resulting from the most recent service, the schools were asked to comment on their wider experiences of TQ provision. In each case schools were asked to rank the extent to which a series of specific benefits/impacts had resulted for their pupils on a 1 to 5 scale, with 1 being no impact at all and 5 a very high impact. The responses to the impacts questions from TQ are shown in Table 3.10 below.

**Table 3.10 Benefits and Impacts of Techniquiest Provision**

Impact Variable	Ranking – 1=no impact, 5=very high impact					N/K	Mean
	1	2	3	4	5		
Increased interest in STEM subjects (incl. computing)	5 (3%)	6 (4%)	31 (21%)	69 (48%)	28 (19%)	6 (4%)	3.78
Improved overall understanding of STEM subjects	7 (5%)	8 (6%)	39 (27%)	69 (48%)	19 (13%)	3 (2%)	3.6
Improved understanding of concepts covered in session	4 (3%)	3 (2%)	31 (21%)	77 (53%)	27 (19%)	3 (2%)	3.85
Increased motivation and enthusiasm for STEM learning	5 (3%)	6 (4%)	24 (17%)	66 (46%)	42 (29%)	2 (1%)	3.94
Improved behaviour/attitude to learning	17 (12%)	12 (8%)	56 (39%)	43 (30%)	10 (7%)	7 (5%)	3.12
Tangible improvement in academic performance	23 (16%)	22 (15%)	43 (30%)	18 (12%)	2 (1%)	37 (26%)	2.57
Increased interest in STEM subjects for future study	11 (8%)	10 (7%)	47 (32%)	48 (33%)	12 (8%)	17 (12%)	3.31
Increased interest in STEM subjects as career options	17 (12%)	15 (10%)	47 (32%)	29 (20%)	9 (6%)	28 (19%)	2.98

Source: ICF GHK/Beaufort Research Survey of Schools, n=145

The ranking of impacts was also analysed by three groups – those where over 50% of responses rated either 4 or 5; those with a mean ranking above the mid-point of 3; and those with a ranking below the mid-point of 3.

As the table shows, **impacts ranked particularly highly** (with over half of respondents rating as either 4 or 5) included:

- Increased motivation and enthusiasm for STEM learning (rated 4 or 5 by three quarters (75%) of respondents);
- Increased interest in STEM subjects (rated 4 or 5 by 67% of respondents);
- Improved understanding of the concepts covered in specific sessions (rated 4 or 5 by 61% of respondents); and
- Improved overall understanding of STEM subjects (rated 4 or 5 by 61% of respondents).

Other impacts with **a mean ranking above the mid-point of 3** were:

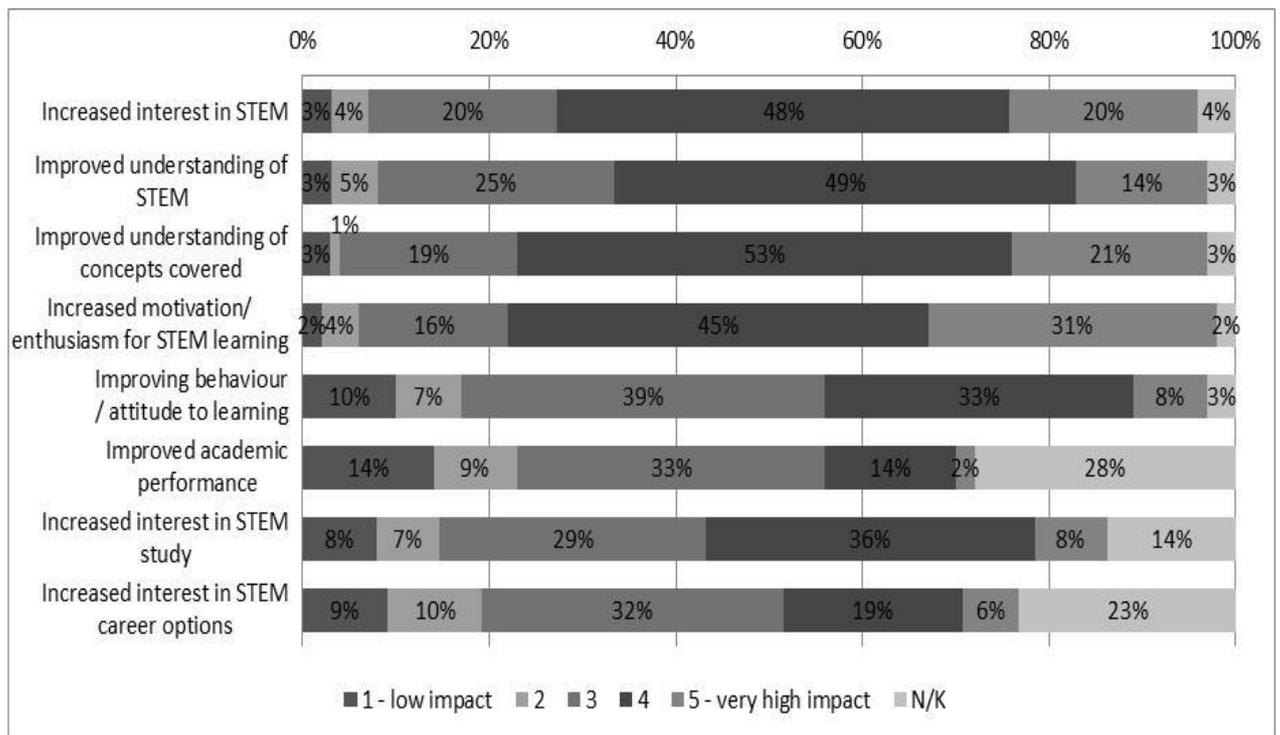
- Increased interest in STEM subjects for future study (rated 4 or 5 by 41% of respondents); and
- Improved behaviour/attitude to learning (rated 4 or 5 by 37% of respondents).

Finally two impact variables received a mean rating of **below the mid-point of 3**, namely:

- Increased interest in STEM subjects as career options (rated 4 or 5 by 26% of respondents, with almost one third (32%) rating 3); and
- Tangible improvement in academic performance (rated 4 or 5 by just 13% of respondents, with 31% rating as 1 or 2).

Differences emerged between the rankings reported by primary and secondary schools, as summarised in Figures 3.4 and 3.5 below.

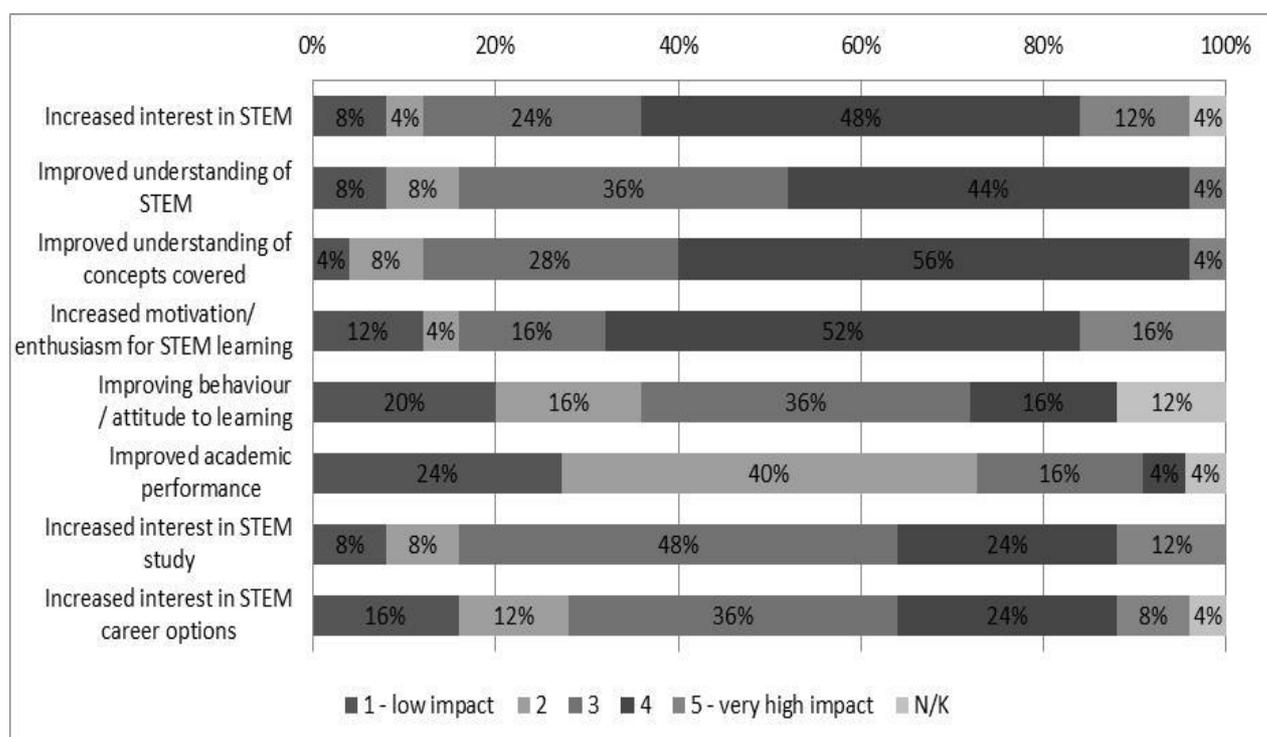
**Figure 3.4 Primary Impacts, % Ranking**



Source: ICF GHK/Beaufort Research Survey of Schools, n=118

Many primary school respondents were unable to rank the impacts of provision on the likelihood of future STEM study and future STEM careers, and on academic performance. Beyond this, the impact variables most commonly rated 4 or 5 were common for both the primary and secondary respondents, namely: improved understanding of concepts covered in session; improved understanding of STEM, increased interest in STEM; and increased motivation and enthusiasm for STEM learning.

**Figure 3.5 Secondary Impacts, % Ranking**



Source: ICF GHK/Beaufort Research Survey of Schools, n=27

However the primary respondents were consistently more likely to rate all but one of the impacts as 4 or 5 compared to their secondary equivalents.

Considerable differences emerged in terms of:

- Improving pupil behaviour and attitude to learning – where 16% of secondary schools rated 4 or 5 compared to 41% of primary;
- Improving understanding of the specific concepts covered in the session – rated 4 or 5 by 74% of primary respondents compared to 60% of secondary; and
- Improved understanding of STEM subjects – rated 4 or 5 by 63% of primary respondents vs 48% of secondary.

In addition, just 4% of secondary respondents rated improvements in academic performance as a 4 or 5, compared to 16% of primary. While more secondary than primary respondents rated increased interest in future STEM careers highly (32% vs 25%), the reverse was true of increased interest in

future STEM study, where 44% of primary respondents rated 4 or 5 compared to 36% of secondary.

The follow up teacher interviews further highlighted the role TQ provision played in stimulating pupils. Referring to TQ outreach activities provided for Year 3 primary pupils, a Science Coordinator noted that:

*“It’s different to their normal lessons, so the children are more excited”* (Science Coordinator, Primary School)

Similarly, a Primary Maths Coordinator explained in reference to their recent use of TQ Maths Kit as part of Maths Week proved very popular among the pupils:

*“They all engaged in the activity, especially those who tend to find maths boring. Everybody who came across it, wanted to use it.”* (Maths Coordinator, Primary School)

He went onto explain that the exercise served to increase pupils’ self-esteem and their social skills such as their ability to work in groups.

Another primary school teacher referred to their recent TQ outreach provision for Key Stage 2 pupils which included solving a crime scene, making a parachute for an egg and a series of sessions on tunnels and turbines, and explained how it fitted well with the curriculum and how much the pupils enjoyed it:

*“It’s a different atmosphere to your normal classroom and they don’t realise that they are learning.”* (Teacher, Primary School)

A secondary Head of Science that had used TQ outreach services with Year 9 pupils previously which involved a session on wind turbines, explained that these pupils now in Year 10 could still recall what they had learned - “it shows that they absorbed the information well.”

Another secondary Head of Science emphasised how the engagement of Year 12 pupils in onsite TQ DNA workshops had

*“made them more interested in careers that relate to science; in the school lab they don’t see science in a workday setting. When they put lab coats on in the [TQ lab], they see it as more interesting [...] it gets them thinking about a career science.”* (Head of Science, Secondary School)

Finally, although TQ does not systematically collect impact data across all their school services, some discrete research studies exploring longer term impacts for pupils showed that:

- In relation to the Key Stage 2 Maths Kit outreach initiative, pupils demonstrated a range of immediate impacts but fewer ‘longer term’ impacts. Referring to the General Learning Outcomes (GLOs) framework, data collected immediately following the intervention showed that nearly all the pupils enjoyed the activities in the Kit and 82% could understand most of what they did. 69% indicated that they had learnt some new maths skills and 63% now felt more confident with maths. When surveyed two months later, while 84% of the pupils stated that they would like to learn more maths using a similar kit, 50% of pupils were not sure whether or not ‘they had learnt some new maths skills’ from the original intervention, suggesting a diminishing effect which according to the researchers could be counteracted by multiple rather than single use of the kit.<sup>50</sup>
- More broadly, an ambitious study drawing on TQ secondary school data and publically available statistics reported a positive correlation between the number of visits a group of secondary schools in Cardiff made to Techniquest and the percentage of students taking science, technology, engineering and math (STEM) subjects at AS Level (i.e.

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<sup>50</sup> Leicester University (2008) *Report on the Key Stage 2 Maths Kit* – unpublished. For the immediate feedback, the number of pupils surveyed was 390; for the 2 month follow up the number of pupil responses was 49.

in Year 12 at age 17). However, it is worth noting that this was based on data from just 18 state schools and that it did not consider other variables such as the socio-economic status of the surrounding community or the potential positive influence of good teachers. Indeed, to substantiate these findings, the report authors highlighted the need for a longitudinal case control study to track the progress of individual students from the commencement of secondary school through to AS Level. This would be a major study over a number of years, and would require considerable funding.<sup>51</sup>

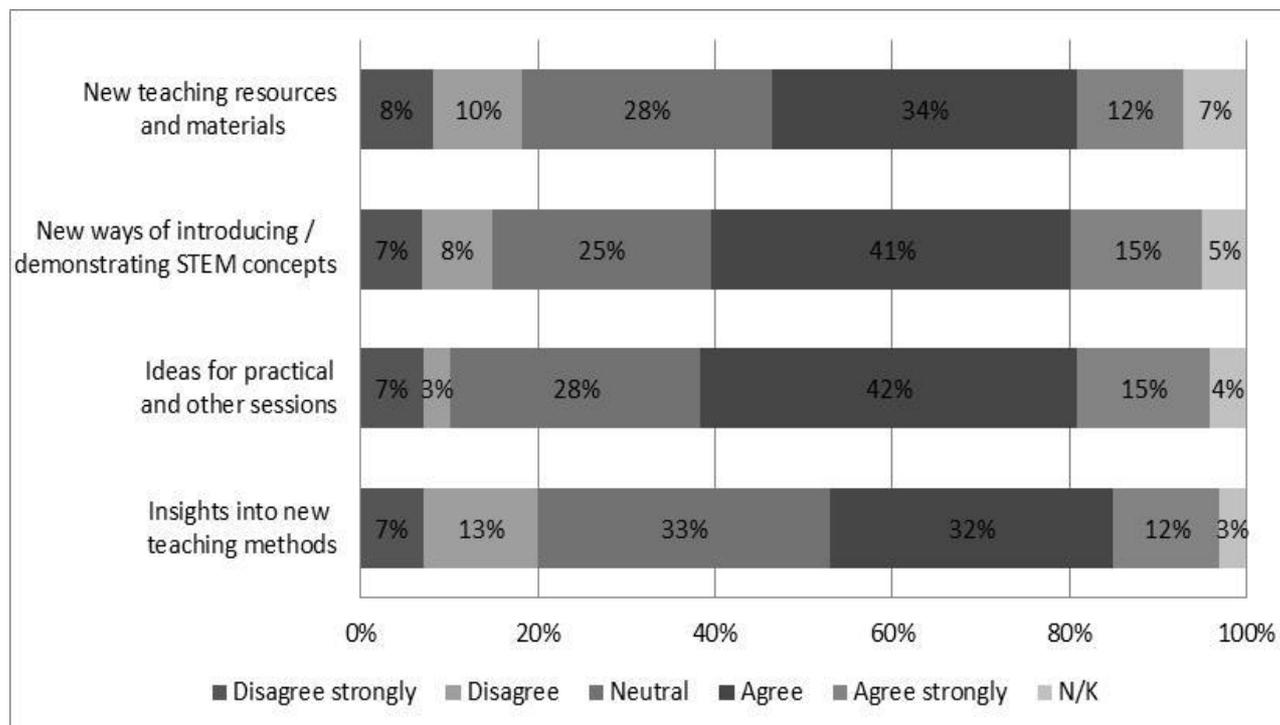
### 3.4.3 *Benefits and Impacts for Teachers*

In addition to the benefits/impacts for pupils, teachers were asked whether they had received any benefit from the school's involvement in TQ provision for pupils. Using a 1 to 5 scale (1 disagree strongly and 5 agree strongly), teachers were asked to rank the extent to which services had provided: insights into new teaching methods; ideas for practical sessions; new ways of demonstrating STEM concepts; and teaching resources for classroom use. Figure 3.6 shows the level of agreement with the four statements provided for TQ users of both onsite and outreach provision.

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<sup>51</sup> Sue Cavell and Harry White (2010) The Value of a Visit: Does Visiting a Science Centre Motivate Students to Study More Science? January/February 2010, *ASTC Dimensions*.

**Figure 3.6 Teacher Benefits, Agreement Ranking**



Source: ICF GHK/Beaufort Research Survey of Schools, n=145

As the chart shows, the majority of teachers considered that they and their schools had benefited from TQ provision in all four areas – most commonly/strongly in terms of:

- Providing ideas for practical and other sessions – 83 schools (57%) agreeing/agreeing strongly; and
- Introducing new ways of introducing STEM concepts – 81 schools (56%) agreeing or agreeing strongly.

Elsewhere 67 schools (46%) agreed/agreed strongly that TQ provision had provided them with new resources and materials for use in the classroom, and 65 schools (45%) insights into new teaching methods.

The follow up teacher interviews highlighted how the use of TQ services exposed them to new ways of teaching STEM with particular examples including:

- *“It gives you ideas like how they use water to produce a picture using the ripple effect.” (Science Coordinator, Special School)*
- *“TQ are able to bring into school a piece of equipment that the school cannot afford such as the infra-red camera and liquid nitrogen. (Deputy Head of Science, Secondary School)*
- *“Having access to kits such as spinning centrifuges and micro-pipettes [as part of the DNA workshop] and [a member of staff] was on hand to give us ethical issues and scenarios I wouldn’t have access to. It also updates my skills and knowledge.” (Head of Science, Secondary School)*

Research commissioned by TQ on the impacts on teachers of the Key Stage 2 Maths Kit further showed that:

- The teachers’ expectations were generally being met by their experience of the Maths Kit. A pre-questionnaire however also highlighted that teachers required specific support when it came to teaching fractions, and that they particularly wanted to see that the Kit was suitable for mixed-ability classes.
- After use, the teachers expressed a high degree of satisfaction with the Maths Kit. Teachers specifically highlighted the fact that the Kit gave a ‘hands-on’ dimension to the teaching of maths, and over half (57%) stated that the experience had given them more confidence in their teaching. 100% stated that they would recommend the Kit to a colleague and 91% felt that it provided them with new ideas.<sup>52</sup>

#### 3.4.4 *Experience of Teacher CPD*

Although not a primary focus for the study, the survey explored the extent to which the teachers interviewed had participated in TQ CPD provision. In total just 11 teachers described receiving TQ CPD provision - nine primary and two secondary. While the small numbers prohibit detailed analysis, the responses were positive and showed that, for TQ:

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<sup>52</sup> Leicester University (2008) *Report on the Key Stage 2 Maths Kit* – unpublished. There were 23 teacher respondents.

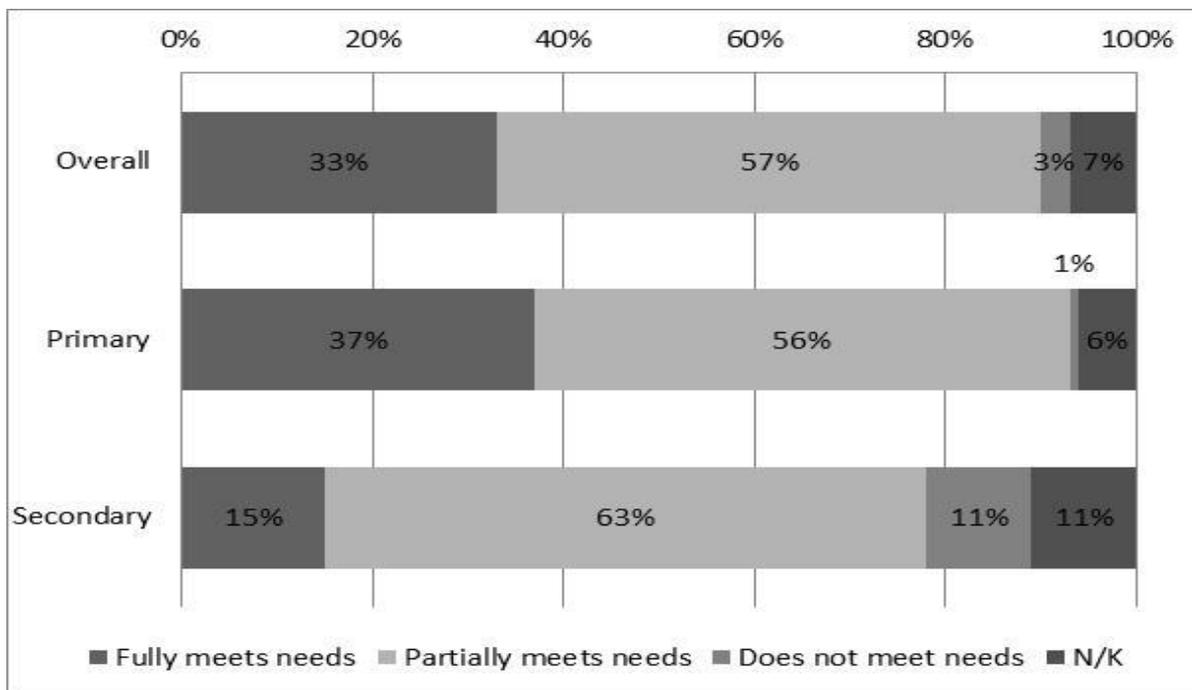
- Of the 11 schools receiving TQ provision three had received one day, five two days, one three days, one four days and one could not recall;
- The majority considered that the CPD provision received was of good or very good quality (8 of the 11 receiving TQ CPD provision); and
- That the CPD received compared well against experiences of other providers – with 7 of the 11 schools receiving TQ provision considering it was better or much better than other provision, and 2 that it was about the same.

### 3.4.5 Added Value

Teachers were also asked to reflect on the extent to which TQ and TQG services meet their needs in terms of supporting the delivery of the STEM curriculum, their satisfaction with TQ provision compared to other providers, and the extent to which TQ/TQG provision represented value for money.

#### Meeting needs

**Figure 3.7 Extent to which TQ Meets Needs**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=145, Primary n=118, Secondary n=27

Figure 3.7 above shows that one in three of all schools considered that TQ provision fully met their needs; over half (57%) that it met their needs in part; and just 3% of respondents that TQ provision did not meet their needs at all. Looking at the responses from primary and secondary schools, the primary responses closely reflected the overall responses, with over one third (37%) describing needs being met completely and 56% being met in part. While still reporting positively, with 78% of secondary schools describing their needs being met in full or in part, the secondary schools were more likely to report needs being met in part (63%) than in full (15%).

The follow up teacher interviews provided examples of how teachers described TQ services as beneficial but not essential to the delivery of the STEM curriculum. The added value of TQ onsite and outreach provision was described as enhancing their curriculum teaching through the use of practical activities but not necessarily going much beyond this. According to one interviewee:

*“TQ seem to cover the same things as we do in school. They need to go further and do something with the wow factor. Otherwise it doesn’t keep the interest of the pupils because they’ve already covered a subject in school.”* (Deputy Head of Science, Secondary School).

The same interviewee however also saw the potential for TQ to develop a service offer that meets the needs of the changing ‘science framework’ which they explained now includes research and investigative skills: *“The pupils are not prepared for that and TQ provision can do something on how to do good science, focusing on these skills.”*

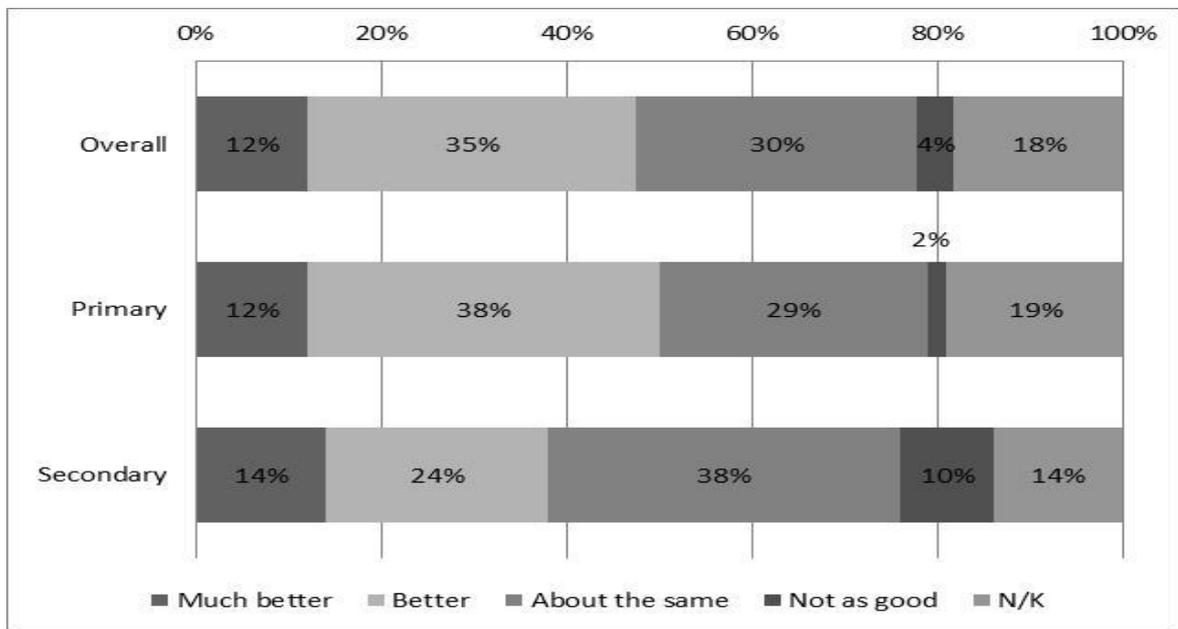
Another secondary school teacher, while extremely positive about her experience of using TQ services, explained that their offer does not match the full range of STEM needs within the school, highlighting that the more specific the offer, the better:

*“General topics we would not use. In Key Stage 4, we wouldn’t bother with anything of broader educational value. It’s cutthroat.” (Head of Science, Secondary School)*

*Satisfaction with TQ Provision Compared to Different Providers*

TQ provision for schools also compared well to schools’ experiences of similar providers. When asked how well TQ provision compares to provision from other sources in terms of quality and appropriateness, overall responses were positive as shown in the figure below.

**Figure 3.8 TQ Provision Compared to Other Providers**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=145, Primary n=118, Secondary n=27

While 18% of respondents were unable to make a comparison, just under half of all the respondents (47%) considered that TQ provision was better, or much better, than similar provision received elsewhere, while 30% considered it to be about the same. Primary respondents were more likely than secondary to rate TQ provision as better or much better than elsewhere (50% vs 38% respectively), with proportionately more secondary schools rating TQ provision as not as good as elsewhere (10% of responses).

Follow up teacher interviews expressed a range of views on how TQ and TQG compared with other providers with many referring to their use of a range of other providers such as STTEM Ambassadors, local authority services, and Education Business Partnerships.

A Science Coordinator in a primary school, for example, explained that TQ was one of a range of STEM support providers they used “*there are so many other providers that we can use, such as STEM ambassador*” and that while offering “*something that teachers can’t*” in terms of the resources, TQ was not seen as substantially enhancing their STEM provision. Another primary teacher – a Maths Coordinator – explained that “*Our first point of call is the Local Authority or the local secondary school because it is free.*”

A secondary Head of Science did not see TQ as one of their main STEM support providers, and that in his view other providers, such as STEMNET and Engineering Wales provided a better service. He explained how STEMNET resources are more geared to the classroom over the longer term, and cited STEMNET providing the school with 14 boxes of wind turbine and teaching materials to use in class for the whole Spring term.

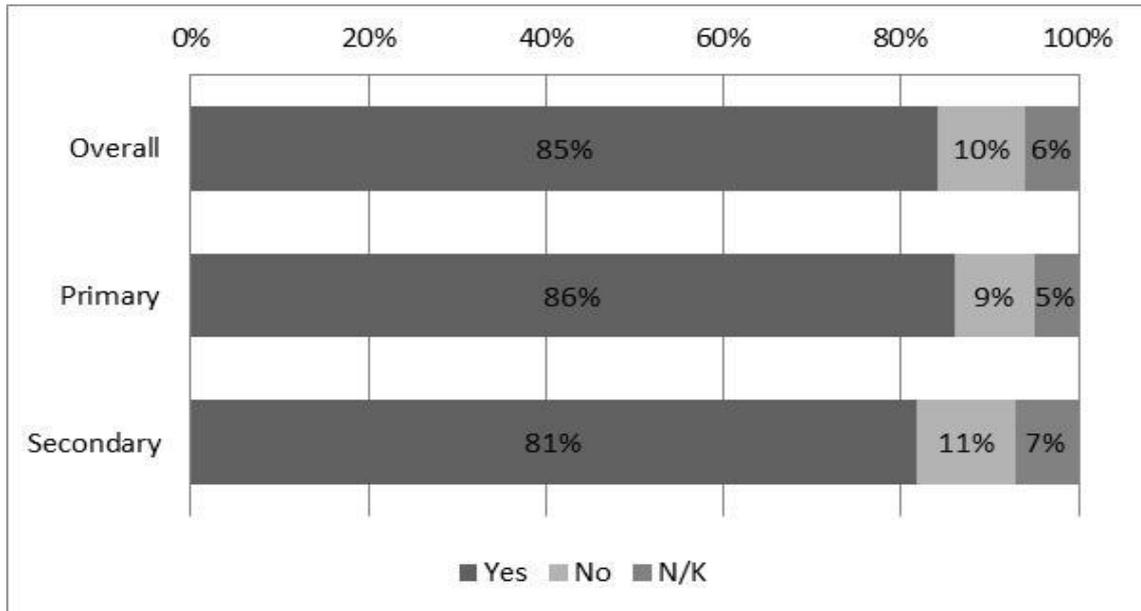
Others spoke of competitors offering services at a lower or no cost. For example, a secondary Head of Science in another school explained that they opted to use outreach STEM services from Education Business Partnerships – rather than TQ – that included an astronomical dome, and science of sound and soap making workshops as they “*came to us at no cost.*” She also noted that At-Bristol does compete with TQ for pupils in or near to Cardiff: “*the price for a visit is similar to TQ, but when you ask kids to pay, they would want to go to At Bristol as they are more local to TQ and so are more likely to have been there.*”

#### *Value for Money*

Finally teachers were asked whether or not they considered TQ provision to offer good value for money. Care was taken when introducing this question to ensure that respondents considered the overall cost to the school of

accessing TQ provision, not just the direct costs of provision (such as entry fees or transport costs in isolation). For TQ, the vast majority of schools (85%, with little difference between primary and secondary respondents) considered the provision received represented value for money, as shown on the figure below.

**Figure 3.9 Value for Money of TQ Provision**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=145, Primary n=118, Secondary n=27

This was also reflected in the follow-up teacher interviews, where the vast majority - with the exception of the example provided in the previous section - felt that the cost of TQ was lower than many other providers and that it offered good value for money. A secondary teacher for example had used another external provider to deliver a Forensic session, which had proved to be “*very expensive in comparison to TQ*”. Indeed, many of the interviewees recognised the importance of investment from Welsh Government in terms of allowing TQ to offer subsidised travel costs and lower service fees.

### 3.5 Areas for Improvement

Schools were asked, on the basis of their previous experience of TQ services, if there were any areas where TQ services could be improved. Asked as an open question, the responses were coded and are summarised in Table 3.11

below. Notably, as for TQG the most common responses to this question were positive in that no improvements were required. The areas for improvement identified in the TQ interviews are provided below.

**Table 3.11 Areas for Improvement - TQ**

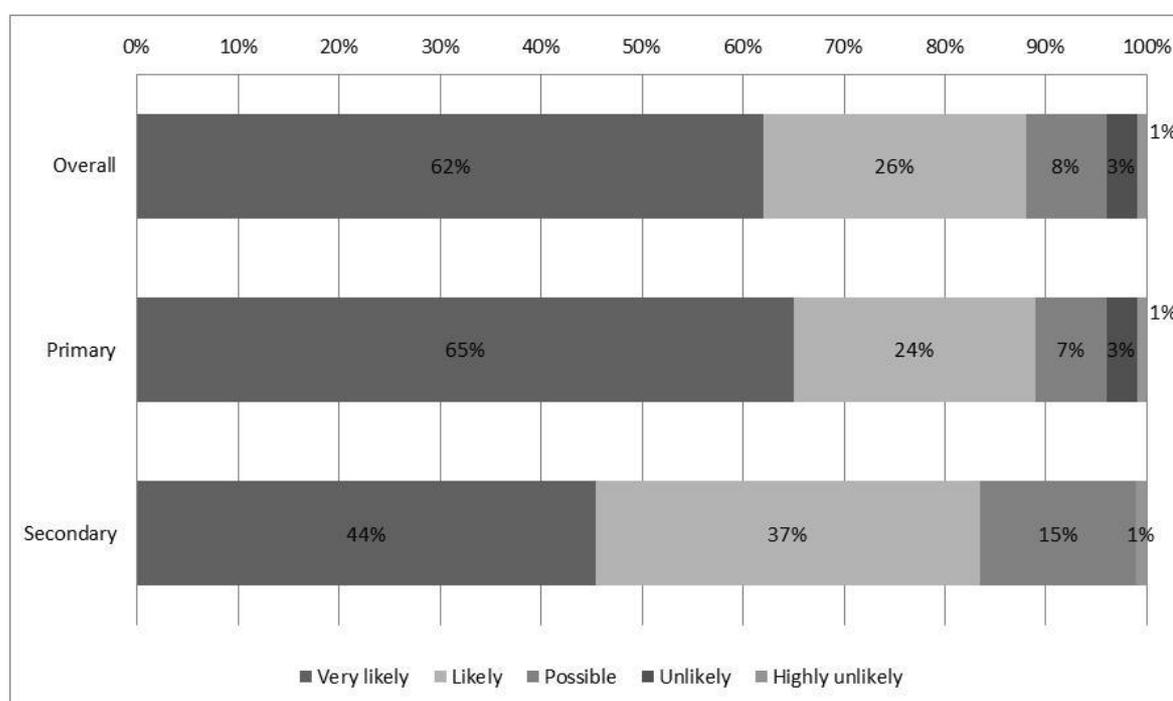
<b>Improvement</b>	<b>TQ Overall</b>	<b>Primary</b>	<b>Secondary</b>
N/K – positive comments only	36	30	5
Improved marketing / promotion / materials	20	15	5
Improved links to curriculum	18	13	5
References to distance – e.g. travel costs	17	16	1
Cost of services	14	13	1
Increased outreach provision	13	11	2
More Welsh language provision	7	7	--
Staff experience / skills / ability to enthuse	6	5	1
More involvement of teachers in provision development	6	3	3
Delivering at right level / not too difficult	6	5	1
Post-visit materials	5	5	--
New materials / exhibits	5	4	--
Smaller groups / fewer children on same day	4	4	--
Availability of sessions	4	4	--
More variety / range of activities	4	3	1
Allow schools to borrow more equipment	4	3	1
More for more able – gifted and talented pupils	3	2	1
More guided activities for children	2	1	1
Other	7	5	2
Not answered	3	3	--

(n=145)

### 3.6 Plans for Future Use

Finally, schools were questioned on the likelihood of using TQ services in the coming 12 months, with the responses for TQ being shown on the figure below.

**Figure 3.10 Likelihood of Use of TQ Services in the Next 12 Months**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=145, Primary n=118, Secondary n=27

Almost two thirds (62%) of schools reported being highly likely to use TQ services in the next 12 months, with an additional 26% being likely to use them and 8% possibly using. Just six schools (4%) reported being unlikely or highly unlikely to use TQ services. Primary respondents were the most likely to use TQ services in the next year – two thirds (77 schools, 65%) being highly likely and 24% being likely to use.

Five primary schools and one secondary school reported being either unlikely or highly unlikely to use TQ services over the next 12 months, and 12 (8 primary and 4 secondary) that their use was ‘possible’. Cost issues emerged as the most common factors limiting the likelihood of use in the next 12 months. The most commonly mentioned single reason was the cost of transport (7 schools, 39%), followed by, where appropriate, the cost of

provision (5 schools, 28%) and the cost of teacher cover (2 schools, 11%). As one primary school teacher explained:

*“It is the cost implication which prevents visits to the site, given the cost of transport to get there. Coaches to Cardiff cost £375 and you can only take one class. Outreach is more manageable. Outreach for the day is £250 and you can have three classes involved.”* (Head Teacher, Primary School.)

Beyond these cost issues, a range of other issues were reported by one or two schools, including the logistics of arranging visits/outreach; being engaged with another provider, negative previous experiences, provision not being available through the medium of Welsh and being unsure of the benefits for pupils.

## 4 Techniquet Glyndŵr: Key Findings

### Key Findings

#### Throughput

- Overall since 2010, TQG has engaged with almost 150,000 adults and children, of which just under half have been pupils through school engagements (just over 73,000).
- While TQG has experienced a steady increase in the numbers of pupils engaging with their outreach provision, they have achieved their outreach target in just one of the last three years. In terms of onsite provision, TQG has failed to achieve their targets in each of the last three years, achieving 84%, 88% and 68% of target respectively.
- In common with TQ, the majority of pupils engaging with TQG services were from the Foundation and Primary stages.
- TQG is now exceeding its target of a 60:40 ratio for engagements with pupils from schools in Wales and England. This follows a steady increase in the numbers of pupils from schools in Wales and their share of overall provision.
- TQG reports an increase in the number of pupils engaging in activities delivered through the medium of Welsh, with 565 total onsite engagements (9% of all in-reach Wales engagements) and 742 outreach engagements delivered in Welsh (6% of all out reach engagements).

#### Experiences of users

- TQG users reported hearing of TQG through a range of means – mostly by marketing materials and word of mouth, with the majority reporting a good understanding of available TQG services.
- In the last four years the types of reported engagement types were equally shared between onsite and outreach and overall, for the majority of schools, TQG services were used once or twice a year.
- Of the 26 Welsh language schools using TQG provision in the survey, 81% reported receiving promotional and learning materials in Welsh, and 62% reported receiving services in Welsh.
- 50% of all schools using TQG services reported receiving pre-materials and 22% post-materials, with the majority of these reporting them to be of high quality, appropriate and easy to use.
- The vast majority of schools (93%) rated the quality of their most recent service as good or excellent, and their fit with the curriculum and suitability for pupil audiences also rated highly.

#### Impacts

- The vast majority of schools using TQG services found their most recent service to be fun and exciting for their pupils. The responses in terms of providing tangible learning outcomes were also strongly positive, with 86% of schools (50 schools) rating this as good or excellent.
- The most commonly cited pupil impacts were: increased interest in STEM subjects (incl. computing), improved understanding of concepts covered in session, increased motivation and enthusiasm for STEM learning, improved overall understanding of STEM subjects and increased interest in STEM subjects for future study.
- The majority of teachers also considered that they and their schools had benefited from TQG provision, most commonly in terms of providing ideas for practical and other sessions, and introducing new ways of introducing STEM concepts.

#### Added Value

- In line with TQ, one in three schools considered that TQG provision fully met their needs and 62% that it met their needs in part.
- TQG provision for schools also compared well to schools' experiences of similar providers: with 28% of all the respondents considering that TQG provision was better, or much better, than similar provision received elsewhere, while 18% considered it to be about the same.

- The vast majority of schools (84%) considered the provision received represented good value for money.

#### **Future use**

- Almost two thirds (60%) of schools reported being highly likely to use TQG services in the next 12 months, with an additional 28% being likely to use them and 10% possibly using.
- Only one school considered they were unlikely to use TQG services in the next year, for a combination of financial and awareness/scheduling reasons.

## **4.1 Introduction**

This section provides the key findings as they relate to TQG's school services. We first present an overview of how well TQG has performed in terms of throughput against Welsh Government targets. We then present an analysis of the user experiences and perceived impacts drawing on the Wales-wide teacher survey and follow up interviews.

For the survey we interviewed a total of 203 teachers, 58 (29%) of which were from schools using TQG services. In terms of the distribution by primary and secondary of the TQG users, 40 were from Primary schools and 18 were from Secondary schools. A small share of respondents (11 schools) had previously used both of the centres, comprising 10 primary and one secondary school. In most cases we present data using percentages except where the numbers become too small, in which case we present them as numbers only.

## **4.2 Performance**

Overall since 2010, TQG has engaged with nearly 150,000 adults and children through the provision of services to the general public as well as its specific services for schools.<sup>53</sup> Given the focus of this study, we draw on the data on throughput and engagement that relates specifically to pupils engaged through schools against annual targets set with Welsh Government. For TQG, this also includes the numbers of pupils engaged from schools in Wales and England against a target ratio of 60:40 respectively.

Across the previous three years TQG reported a total of over 73,000 pupil engagements by pupils from Wales and England through its onsite (38% or

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<sup>53</sup> The actual figure is 149,429, the sum of the total engagement figure provided in Q4 Report 2012-13 (56,329) and figures provided for 2010 (41,100) and 2011 (52,000) in: TQG, *Inspiring, Challenging and Engaging*, p. 9.

27,628 engagements) and outreach (62% or 45,396) provision, with services for schools accounting for almost half of their total number of engagements. Of this over 44,353 pupils were from schools in Wales (16,384 for onsite and 27,969 for outreach), representing 61% of all pupils engaged.

In this section we report engagement against target by service type (onsite and outreach), by primary and secondary/school stage and by pupils from schools in Wales and England.

#### 4.2.1 Overview of performance

Table 4.1 provides an overview of TQG performance against annual targets for onsite and outreach provision, and includes pupils from both Wales and England.

**Table 4.1 TQG Throughput against targets for Onsite and Outreach Activities 2010-2013**

Year	2010-11		2011-2012		2012-2013	
	Target	Actual	Target	Actual	Target	Actual
Education Onsite*	10,500	8,839	11,590	10,172	12,580	8,617
Education Outreach*	16,000	13,668	14,351	15,195	22,200	16,533
<b>Total</b>	<b>26,500</b>	<b>22,507</b>	<b>25,941</b>	<b>25,367</b>	<b>34,780</b>	<b>25,150</b>

\* Targets and figures include schools from England and Wales.

Source: Q4 Reports for 2010-11, 2011-12 and 2012-13

Although not included in the table above, TQG also report on numbers of teachers engaged in CPD, which show that for 2012-13, the total number of teachers receiving CPD was 63 against a target of 24.

While the table above shows that TQG has experienced a steady increase in the overall numbers of pupils engaging with their outreach provision, they have achieved their target for outreach services in just one of the last three years (2011/12, 106% of target), and achieving 85% and 74% of target for the 2010/11 and 2012/13 years respectively. In terms of onsite provision, TQG has failed to achieve its targets in each of the three years, achieving 84%, 88% and 68% respectively.

Some questions were raised by Welsh Government and other stakeholders about the levels at which the targets were set, notably the 2012/13 outreach target which represented a considerable increase over previous years. This aside, the data for onsite provision reflects the experiences and comments from many of the TQG and wider stakeholders on the increasing challenges in attracting schools, and notably secondary schools, to centre-based provision (an issue - as described in the previous chapter – that is not confined to provision in Wales)<sup>54</sup>.

Major barriers to attracting schools, and in particular secondary schools, to the centre identified by TQG staff include: costs of transport and supply cover; more restrictive timetables for secondary making it difficult for teachers to release pupils for a whole day; and a perception by older pupils that the exhibition is for younger children. TQG are attempting to attract more on-site provision through the offer of subsidised travel costs, and for secondary schools through the greater promotion of their university tour offer. This also brings added benefits to the University, one of the interviewees from the University, for example, spoke very highly of their partnership with TQG in that it helped facilitate links to schools and industry and specifically access to potential students who otherwise may not have considered attending the university.

#### *4.2.2 Engagement by school stage*

The composition of pupils engaging with TQG provision by school stage for the 2012/13 year is provided in Table 4.2, for pupils from schools in Wales and England. The table shows that, in common with TQ, the majority of pupils engaging with TQG services were from the Foundation and Primary stages, accounting for 70% of all engagement in the 2012/13 year (63% of all onsite and 74% of all outreach provision). However, TQG have engaged a larger share of secondary school pupils as a proportion of all their provision in 2012/13 than TQ – 29% compared to 7% respectively.

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<sup>54</sup> See Wellcome Trust (2012) *Review of Informal Science Learning*, November.

**Table 4.2 TQG Throughput for Onsite and Outreach Activities by School Stage 2012-2013\***

<b>School Stage</b>	<b>Onsite</b>	<b>Outreach</b>	<b>Total</b>
Foundation Phase	2,529	3,563	6,092
KS2	2,925	8,736	11,661
KS3	1,115	3,468	4,583
KS4+	2,048	766	2,814
<b>Total</b>	<b>8,617</b>	<b>16,533</b>	<b>25,150</b>

\* Data for schools in England and Wales. Source: TQG Qtr4 Report 2013.

Although it is not possible to integrate figures for the 2010/11 and 2011/12 years into a common table, as the variables against which pupil numbers are reported for previous quarters are presented differently, data from previous reports has been analysed to provide a breakdown by primary and secondary phases. This shows that the 2012/13 data follows a similar trend to previous years, with 82% of onsite and 66% of outreach engagements being with primary pupils in 2010/11, with primary pupils also making up 63% of onsite and 74% of outreach engagements in 2011/12.

#### *4.2.3 Engagement by pupils in schools in Wales*

Table 4.3 below provides data on pupil engagement from schools in Wales for the previous three years, and as a proportion of all services delivered (i.e. to pupils in Wales and England). TQG are now exceeding their target of a 60:40 ratio between pupils from schools in Wales and England. This follows a steady increase in the numbers of pupils from schools in Wales receiving provision, and their proportion of overall provision.

**Table 4.3 Total number of pupil engagements from schools in Wales 2010-2013**

Provision type	Number of pupils in Wales			% of all education engagements		
	Onsite	Outreach	Total	Onsite	Outreach	Total
2010-11	4,012	7,412	11,424	45%	54%	51%
2011-12	6,375	9,386	15,761	63%	62%	62%
2012-13	5,997	11,171	17,168	70%	68%	68%
<b>Total</b>	<b>16,384</b>	<b>27,969</b>	<b>44,353</b>	<b>59%</b>	<b>62%</b>	<b>61%</b>

Source: Individual TQG Qtrly reports

Table 4.4 below shows the distribution of pupils receiving TQG provision from their catchment local authorities, and is based on the latest available data (for the period April 2011 and September 2012). It indicates that pupil engagements are concentrated in the Wrexham and Flintshire local authorities.

**Table 4.4 Pupil numbers by local authorities in Wales April 2011-September 2012**

Local Authority	Educational Engagements
Wrexham	8,151
Flintshire	5,682
Denbighshire	2,163
Conwy	1,679
Gwynedd	1,153
Isle of Anglesey	1,013
Powys	487
<b>Total</b>	<b>20,328</b>

Source: TQG (2012) *Inspiring, Challenging and Engaging*.

#### 4.2.4 *Delivery through the medium of Welsh*

Finally, TQG report an increase in both the number and proportion of pupils engaging in activities delivered through the medium of Welsh in 2012/13. A total of 565 onsite engagements were delivered in Welsh (9% of all onsite engagements with pupils in Wales) and 742 outreach engagements (accounting for 7% of all outreach engagements with pupils in Wales).<sup>55</sup>

### 4.3 **User Experiences**

This section draws on the findings of the teacher survey and follow up interviews conducted for this evaluation to explore the experiences of pupils and pupils using TQG services. We also, where relevant, refer to TQG own evaluation reports and delivery staff interviews. This section explores a range of issues including awareness of available services, types of use, experiences of Welsh medium delivery, use of and views on pre and post materials and the perceived quality and appropriateness of the TQG service offer.

All but three of the respondents to the user survey reported that their schools were involved in a range of externally-provided STEM enhancement and enrichment activities of which TQG was one. These included:

- Visits to science centres, zoos and museums – 88% (87% of primary and 94% of secondary schools);
- Using materials and resources from other sources – 55% (58% primary and 50% secondary);
- Using external STEM provision delivered on an outreach basis – 62% (58% primary and 72% secondary);
- Working with outside scientists – 50% (39% of primary and 72% of secondary); and
- Having science or engineering clubs – 47% (37% primary and 67% of secondary).

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<sup>55</sup> TQG Qtr 4 Report 2013.

Over seven out of 10 schools (71%) reported participating in these activities on a monthly or termly basis (69% for primary and 72% for secondary). One in four (25%) described involvement in enhancement and enrichment activities on a more frequent/weekly basis (25% primary and 28% secondary), with just two primary schools reporting engaging rarely/less than once a term.

#### *4.3.1 Awareness of the TQG school offer*

As with TQ, TQG users reported hearing of TQG's school services through a range of means – the most common of which matched those of the TQ respondents – with 62% hearing via marketing materials (71% primary and 50% secondary), 19% by word of mouth, and 19% via direct contact from the centre. The majority of TQG users felt they had a good understanding of the services provided (86%) – with primary respondents being considerably more likely to report this than secondary (97% vs. 61%; 37 vs. 11 schools respectively).

Delivery staff interviewees reported that in their experience direct sales calls by telephone, face to face contact with/visits to schools and their 'cluster booking' approach were effective in generating bookings. Recognising the competitiveness of their market, staff considered that direct sales calls provided a 'personal touch', as do face to face visits (although there is limited capacity to do this on a large scale). While the cluster bookings approach may be logistically complicated to set up, as multiple schools must agree to the same workshop and to be flexible around timings, it was felt to have worked well. Views were mixed on the effectiveness of subsidised travel costs, with some feeling this had been "a tremendous help" while others were unsure of its impact on recruiting secondary schools.

#### *4.3.2 Types of Use by Schools*

The schools were asked to report the TQG services they had used in the previous four years, with the responses being shown as Table 4.5 below. Overall reported TQG service use over the previous four years showed an even balance between onsite and outreach provision – although primary schools were more likely to report visiting the centre (87% vs. 66%), while the

reverse was true for secondary schools (56% vs. 94%).

**Table 4.5 Use of Techniquest Glyndŵr Services - Previous Four Years**

<b>Service</b>	<b>Total Used N=58</b>	<b>Primary N=38</b>	<b>Secondary N=18</b>	<b>Other* N=2</b>
Visits to TQG Centre – workshops and use of exhibits	44 (76%)	33 (87%)	10 (56%)	1 (50%)
Outreach provision	44 (76%)	25 (66%)	17 (94%)	2 (100%)
Visit to TQG centre for maths workshops	12 (21%)	10 (26%)	2 (11%)	--
Tour of University Glyndŵr STEM departments	9 (16%)	3 (8%)	6 (33%)	--
CPD provision for teachers	11 (19%)	6 (16%)	5 (28%)	--

*Source: ICF GHK/Beaufort Research Survey of Schools. \*Other schools relate to responses from special schools, which were included in subsequent analysis as secondary schools*

The schools were also asked which services they had used in the previous 12 months, to establish a picture of more recent use. The responses are shown in Table 4.6 below. The majority of respondents reported using TQG services once or twice during a year, with:

- 10 schools (18%) using at least once a term;
- 38 (66%) using once or twice a year;
- 7 (12%) using less than once a year/every couple of years; and
- 3 (5%) using rarely – less than every couple of years.

**Table 4.6 Use of Techniquet Glyndŵr Services – Previous 12 months**

<b>Service</b>	<b>Total Used N=58</b>	<b>Primary N=38</b>	<b>Secondary N=18</b>	<b>Other* N=2</b>
Visits to TQG Centre – workshops and use of exhibits	30 (52%)	23 (61%)	7 (39%)	--
Outreach provision	33 (57%)	17 (45%)	16 (89%)	--
Visit to TQG centre for maths workshops	7 (12%)	5 (13%)	2 (11%)	--
Tour of University Glyndŵr STEM departments	4 (7%)	2 (5%)	2 (11%)	--
CPD provision for teachers	4 (7%)	4 (11%)	--	--
None of the above	7 (12%)	4 (11%)	1 (6%)	2 (100%)

*ICF GHK/Beaufort Research Survey of Schools \*Other' here refers to special schools.*

#### *4.3.3 Experience of Welsh Medium Delivery*

Teachers in 26 of the schools using TQG services described working through the medium of Welsh. Of these, the vast majority (21 schools, 81%) reported that all TQG materials were provided in Welsh and 8% (just two schools) that they were not – a similar distribution to TQ. However a slightly higher share (62%, or 16 schools) reported that TQG were able to deliver their services through the medium of Welsh, with 23% (6 schools) reporting otherwise. Just one of the teachers in the follow up interviews raised provision in the Welsh language as an issue, and suggested that TQG could use more incidental Welsh even with English speaking schools to expose pupils to the use of Welsh outside of school. (Head Teacher, Primary School)

#### *4.3.4 Pre and Post-visit Materials*

Respondents were asked whether they had received any materials from TQG either in advance of their visit or following it – and if so whether these materials had been used.

### *Pre-visit materials*

The provision of materials of relevance to any Centre visit or outreach session can provide a useful introduction for teachers to use with pupils, and to help them prepare for and make best use of the service received. Half of the all respondents (50%, 29 schools – comprising 56% of primary/10 schools and 50% of secondary/19 schools) reported receiving pre-visit materials, with 38% (22 schools) reporting that they did not – a similar distribution to TQ.

Overall a slightly lower proportion of schools receiving pre-visit materials from TQG than TQ reported using them – 72% or 21 schools. Although the numbers of respondents must be considered, use appeared highest amongst secondary schools – 80% (8 schools) vs. 68% of primary (13 schools) – the reverse of the TQ findings.

### *Post-visit materials*

Similarly, the provision of materials to use following service delivery can help embed learning and help maintain the heightened interest and engagement resulting from it. As with TQ, a far lower proportion of schools reported receiving post-visit than pre-visit materials, 22% or 13 schools, comprising 8% of primary/7 schools and 33% of secondary/6 schools.

A lower proportion of schools reported using TQG post-visit materials than for TQ – 69% overall (9 schools). However a notable difference emerged (although caution over sample size) between use by primary and secondary schools. All 7 primary schools receiving materials reported using them, compared to just one in three secondary schools (2 schools).

### *Perceptions of Quality and Effectiveness of Pre- and Post-visit Materials*

Schools who had used either the pre or post-visit materials were asked to rate them in terms of their overall quality, appropriateness for use with the intended pupil groups, their ease of use and their effectiveness in helping prepare for or embed resulting learning. A five point scale was used to rate respondents' views, with 1 being very poor and 5 being excellent.

While the numbers responding are low when broken down by primary and secondary schools, of the 27 schools receiving either pre or post-visit materials from TQG:

- 85% (23 schools) rated their **quality** as 4 or 5, a mean score of 4.11, and broadly the same as TQ. Primary schools were more positive about the quality of materials than secondary (89% [16 schools] rating 4 or 5 compared to 78% [7 schools] respectively).
- 85% of respondents also rated the **appropriateness** of the materials for their intended audience highly (4 or 5 rating), but here secondary respondents were slightly more positive than primary (89% of secondary rating 4 or 5 vs 83% of primary [15 schools]).
- 78% (16 schools) found the materials **easy to use** (4 or 5 rating) – although a notable difference emerged between primary (83% or 15 schools) and secondary (66% or 6 schools) respondents.
- In terms of **effectiveness**:
  - 72% of respondents **using the pre-visit materials** (15 schools) rated them as good/excellent (4 and 5) in preparing pupils for their service, 77% (10 schools) for primary and 63% (5 schools) for secondary; and
  - 77% of respondents **using the post-visit materials** (9 schools) rated them as good or excellent in terms of embedding the resulting learning, 72% (5 schools) for primary and 100% (2 schools) for secondary.

As with the TQ respondents, insufficient time emerged as the most common reason why pre and post-visit materials had not been used by TQG users (3 of the 10 schools providing a response). Just two schools considered that the materials were not appropriate for their intended pupil group, and one that the materials were not of adequate quality.

Three teachers in the follow up teacher interviews emphasised the high quality of the pre and post-visit materials provided by TQG. A primary school headteacher explained that:

*“They include resources and lesson plans. The quality is good and importantly they are provided in Welsh. The materials help to embed and continue learning. They are prepared by experts in the field so you know the information is right.”*  
(Head Teacher, Primary School)

A secondary Head of Science highlighted how the pre-visit materials “*allow us to prepare and ties in (provision) well with the curriculum – they are very good.*” Finally, the head teacher of a primary school valued the role of post-materials in ensuring that the activity “*was not a one-off and that children can continue to advance and consolidate their learning.*”

#### *4.3.5 Views on the Quality and Appropriateness of the Most Recent Service Received*

Schools were asked to describe their experience of their most recent TQG service and their experience of TQG services more widely. Here we report their experiences of the most recent services received, which are shown in Table 4.7.

Schools were asked to comment on their most recent experience of TQG services in terms of the most recent service received and their experiences overall. Using a five point scale (1=very poor and 5=excellent) schools were asked to rate their experience in terms of:

- The quality of the service provided;
- The perceived appropriateness of the service in terms of its fit with the curriculum and suitability for the specific pupil audience;
- The ease of booking/admin arrangements; and
- The professionalism, skills and experience of the delivery staff.

They were also asked to rate the extent to which their most recent service experience provided a ‘fun, exciting and engaging’ experience for pupils, and

had resulted in tangible learning outcomes, before being asked to rate their overall satisfaction with the service.

**Table 4.7 Use of Techniquet Glyndŵr Services – Most Recent Service**

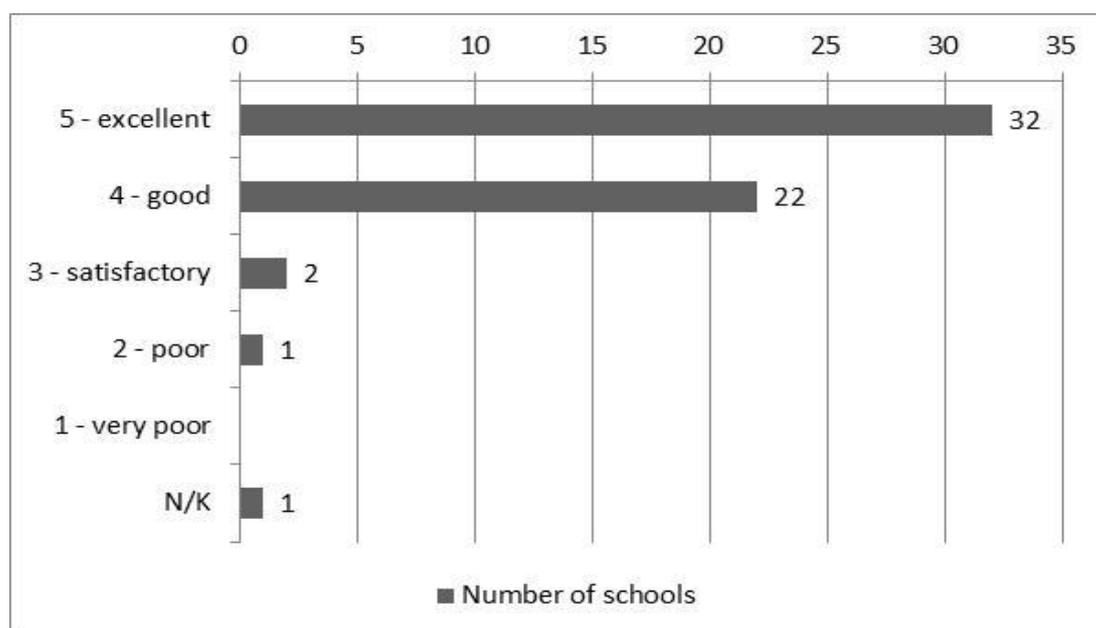
<b>Service</b>	<b>Total Used N=58</b>	<b>Primary N=38</b>	<b>Secondary N=18</b>	<b>Other N=2</b>
Visits to TQG Centre – workshops and use of exhibits	20 (34%)	17 (45%)	2 (11%)	1 (50%)
Outreach provision	29 (50%)	19 (50%)	9 (50%)	1 (50%)
Visit to TQG centre for maths workshops	--	--	--	--
Tour of University Glyndŵr STEM departments	1 (2%)	1 (3%)	--	--
CPD provision for teachers	1 (2%)	1 (3%)	--	--
N/K	7 (12%)	--	7 (39%)	--

*Source: ICF GHK/Beaufort Research Survey of Schools*

#### *Quality of the Service Provided*

The vast majority of schools using TQG services rated the quality of the most recent service received highly. As the Figure below shows, 93% (54 schools) rated the provision as good or excellent, and just one school rated them below the mid-point of 3.

**Figure 4.1 Quality of Most Recent Service**



Source: ICF GHK/Beaufort Research Survey of Schools, n=58

Primary schools were slightly more likely to rate the provision good/excellent than secondary – 95% of the primary schools (36 out of 38) compared to 88% of secondary (16 of the 18 schools responding).

This was also reflected in TQG’s own teacher surveys, which reported high levels of satisfaction across onsite and outreach <sup>56</sup>, and in our follow up teacher interviewees, where a quote from a secondary Head of Science was typical:

*“It is always a good service, quality is good, they are nice to deal with, the resources and what they do is good.”* (Head of Science, Secondary School)

In terms of onsite experiences, TQG’s own satisfaction surveys report that teachers valued the hands-on and group work approach to delivery, with comments on the LEGO workshops being particularly positive. Some

<sup>56</sup> Aled Wyatt and Scot Owen (2013) Techniquet Glyndŵr Inreach Education Report, September 2011-July 2012. The number of evaluation forms returned was 301 – 97% of all onsite activities; and Aled Wyatt and Scot Owen (2013) Techniquet Glyndŵr Outreach Education Report, September 2011-July 2012. The number of evaluation forms returned was 96– 72% of all outreach activities.

suggestions were made about pitching technical language at the right age/ability, and also allowing more time for pupils to absorb information.<sup>57</sup>

Although not articulated as a particular issue by the teachers in TQG's internal evaluation reports nor in our follow up interviews, some delivery staff in TQG echoed the views of national stakeholders that there was the need for an 'upgrade' at the centre such as the theatre, and more generally that fresh exhibits were needed.

In terms of outreach services, TQG's evaluation reports show that while overall satisfaction was high there was some room for improvement, with points highlighted including:

- Pupils enjoyed the activities, with the Stardome proving most popular - *"It brought concepts to life.... put the ideas about the universe into context"*, and *"Children loved the Stardome as in introduction to space"*;
- Hands on activities were most valued – *"The practical hands on challenge part really stimulated the children"*, although in some cases teachers felt there was the need for more of this: *"too much talking in parts, the children were restless"*; and,
- Some teachers requested more differentiation in the facilitation of activities, to allow for different ability groups to fully participate.<sup>58</sup>

#### *Appropriateness of the Service Provided*

Schools using TQG provision rated their most recent experience highly in terms of its fit with the curriculum and appropriateness for specific pupil groups:

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<sup>57</sup> Aled Wyatt and Scot Owen (2013) Techniquest Glyndŵr Inreach Education Report, September 2011-July 2012.

<sup>58</sup> Aled Wyatt and Scot Owen (2013) Techniquest Glyndŵr Outreach Education Report, September 2011-July 2012. The number of evaluation forms returned was 96– 72% of all outreach activities. TQG sets out action points for future delivery in relation to all the areas for improvement highlighted by teachers.

- The vast majority (88% or 51 schools) rated provision highly in terms of its fit with the curriculum; while
- A similarly high share (84%, or 49 schools) rated appropriateness for specific pupil groups as good / excellent, with just three schools rating below the mid-point of 3.

Some differences emerged in the responses between primary and secondary schools, with 95% of primary schools (36) rating curriculum fit as excellent or good, compared to 72% of secondary schools (13). This distribution was repeated in the responses for appropriateness for specific pupil groups, where primary schools were more positive (89% or 34 schools rating good/excellent, compared to 72% for secondary [13 schools]).

TQG plan to include a specific question on fit with the curriculum in the on-going satisfaction surveys, in light of some teacher comments received concerning “shows being slightly off the latest curriculum.”<sup>59</sup>

#### *Ease of Booking and administrative Arrangements*

TQG respondents rated the ease of booking and associated administration highly, with 91% (53 schools) rating it as good or excellent, and none rating it below the midpoint of 3. As with the TQ findings, few differences emerged between the experiences of the primary and secondary schools.

In the follow up teacher interviews, a primary teacher highlighted that TQG was particularly attractive due to their ease of access: “*they are easy to book and arrange.*”

#### *Professionalism, Skills and Experience of the Delivery Staff*

The vast majority of respondents using TQG services, 91% or 53 schools, described the professionalism, skills and experience of TQG staff as good or excellent, with just one primary school rating them below the mid-point of 3.

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<sup>59</sup> See Aled Wyatt and Scot Owen (2013) Techniquest Glyndŵr Outreach Education Report, September 2011-July 2012. The number of evaluation forms returned was 96– 72% of all outreach activities.

95% of the primary respondents (36 schools) rated staff professionalism and experience as good or excellent, slightly higher than the secondary respondents (where 83%, or 15 schools, rated good/excellent).

In the teacher follow up interviews, one primary head teacher described how he valued the expertise of the TQG staff:

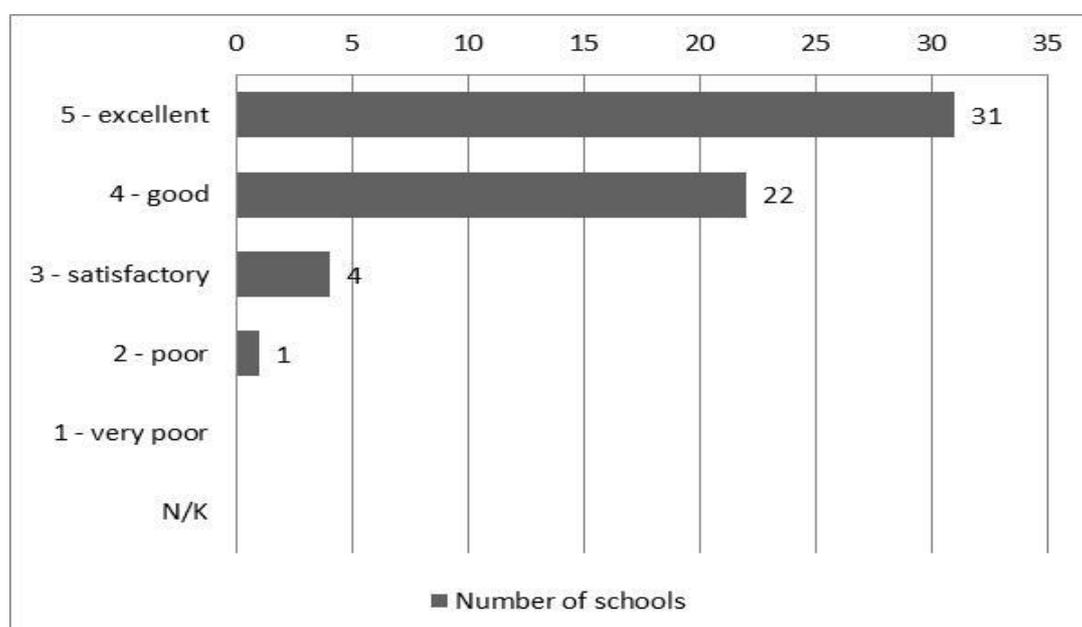
*“TQG have the expertise to introduce the topic [Forces] in a different way which was a factor in choosing the service. Using external knowledge provides a different approach to teaching.”* (Head Teacher, Primary School)

#### Overall Satisfaction with Most Recent Service

As Figure 4.2 shows, the vast majority of respondents, 91% or 53 of the 58 schools responding, described being satisfied or very satisfied with the most recent service received – a similar level as reported for TQ – and just one primary school provided a rating below the midpoint of 3.

Few differences emerged between primary and secondary responses – 92% of primary (33 schools) and 89% of secondary schools (16 schools) reported being satisfied/very satisfied.

**Figure 4.2 Overall Satisfaction with Most Recent TQG Service**



Source: ICF GHK/Beaufort Research Survey of Schools, n=58

#### **4.4 Impacts for Pupils and Teachers**

Drawing on the teacher survey and follow up interviews together with delivery staff interviews and TQG's own evaluation reports<sup>60</sup>, this section explores reported impacts for pupils and teachers of the most recent service, and more broadly for pupils and teachers accessing TQG services, together with any perceived broader added value.

##### *4.4.1 Benefits and Impacts of Most Recent Service*

Schools were asked to rate their most recent experience of TQG in terms of two measures:

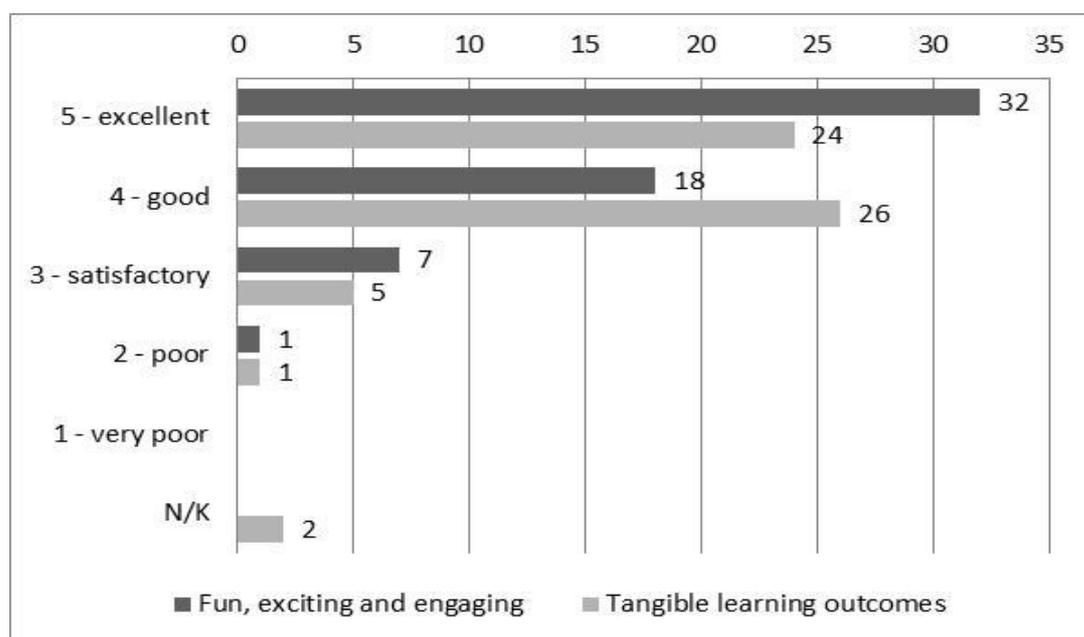
- The extent to which services were 'fun, exciting, innovative and engaging' for pupils; and
- The extent to which the service provided tangible learning outcomes for pupils.

Figure 4.3 shows that the vast majority of schools, 86% or 50 of the 58 respondents, reported their most recent service as good or excellent in terms of being fun and exciting for pupils. Primary respondents provided a higher rating than their secondary equivalents – 90% rating good/excellent (34 schools) compared to 78% of secondary (14 schools).

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<sup>60</sup> e.g. A short evaluation report of a STEM day event with Y10s June 2010; In reach and outreach feedback reports 2010-11/2011-12.

**Figure 4.3 Benefits and Impacts – Most Recent Service**



Source: ICF GHK/Beaufort Research Survey of Schools, n=58

Responses were also positive in regard to tangible learning outcomes, with 86% (50 schools) rating this of their most recent service as good/excellent – with the most common rating being 4 (good). Primary schools appeared to be more positive here (with 97% or 37 schools, rating good or excellent) and one rating as poor. In comparison 61% of secondary schools rated the achievement of tangible learning outcomes as good or excellent (11 schools), with five schools rating neutrally (3).

#### 4.4.2 Wider Benefits and Impacts for Pupils

In terms of the perceived benefits resulting from their most recent service, the schools were asked to comment on the impacts resulting from their wider use of TQG provision. In each case schools were asked to rank the extent to which specific benefits/impacts had resulted for their pupils on a 1 to 5 scale, with 1 being no impact at all and 5 a high level of impact. The responses to the TQG impact questions are shown in Table 4.8 below.

**Table 4.8 Benefits and Impacts of Techniquest Glyndŵr Provision**

Impact Variable	Ranking – 1=no impact, 5=very high impact						Mean Ranking
	1	2	3	4	5	N/K	
Increased interest in STEM subjects (incl. computing)	2 (3%)	1 (2%)	7 (12%)	31 (53%)	15 (26%)	2 (3%)	4.00
Improved overall understanding of STEM subjects	3 (5%)	1 (2%)	17 (29%)	24 (41%)	13 (22%)	--	3.74
Improved understanding of concepts covered in session	2 (3%)	--	9 (16%)	28 (48%)	18 (31%)	1 (2%)	4.05
Increased motivation and enthusiasm for STEM learning	2 (3%)	2 (3%)	9 (16%)	24 (41%)	21 (36%)	--	4.03
Improved behaviour/attitude to learning	7 (12%)	6 (10%)	17 (29%)	18 (31%)	10 (17%)	--	3.31
Tangible improvement in academic performance	8 (14%)	8 (14%)	14 (24%)	8 (14%)	5 (9%)	15 (26%)	2.86
Increased interest in STEM subjects for future study	4 (7%)	2 (3%)	15 (26%)	21 (36%)	13 (22%)	3 (5%)	3.67
Increased interest in STEM subjects as career options	5 (9%)	5 (9%)	11 (19%)	21 (36%)	8 (14%)	8 (14%)	3.44

Source: ICF GHK/Beaufort Research Survey of Schools, n=58

The ranking of TQG impacts were also analysed by the three groups of - over 50% of responses rated either 4 or 5; those with a mean ranking above the mid-point of 3; and those with a ranking below the mid-point of 3.

**Impacts ranked particularly highly** (i.e. over half of respondents rating 4 or 5) included:

- Increased interest in STEM subjects (incl. computing) – 79% rating 4 or 5 (46 schools)
- Improved understanding of concepts covered in session – 79% (46 schools)
- Increased motivation and enthusiasm for STEM learning - 77% (45 schools)

- Improved overall understanding of STEM subjects – 63% (37 schools)
- Increased interest in STEM subjects for future study – 58% (34 schools)

Other impacts with a **mean ranking above the mid-point of 3** were:

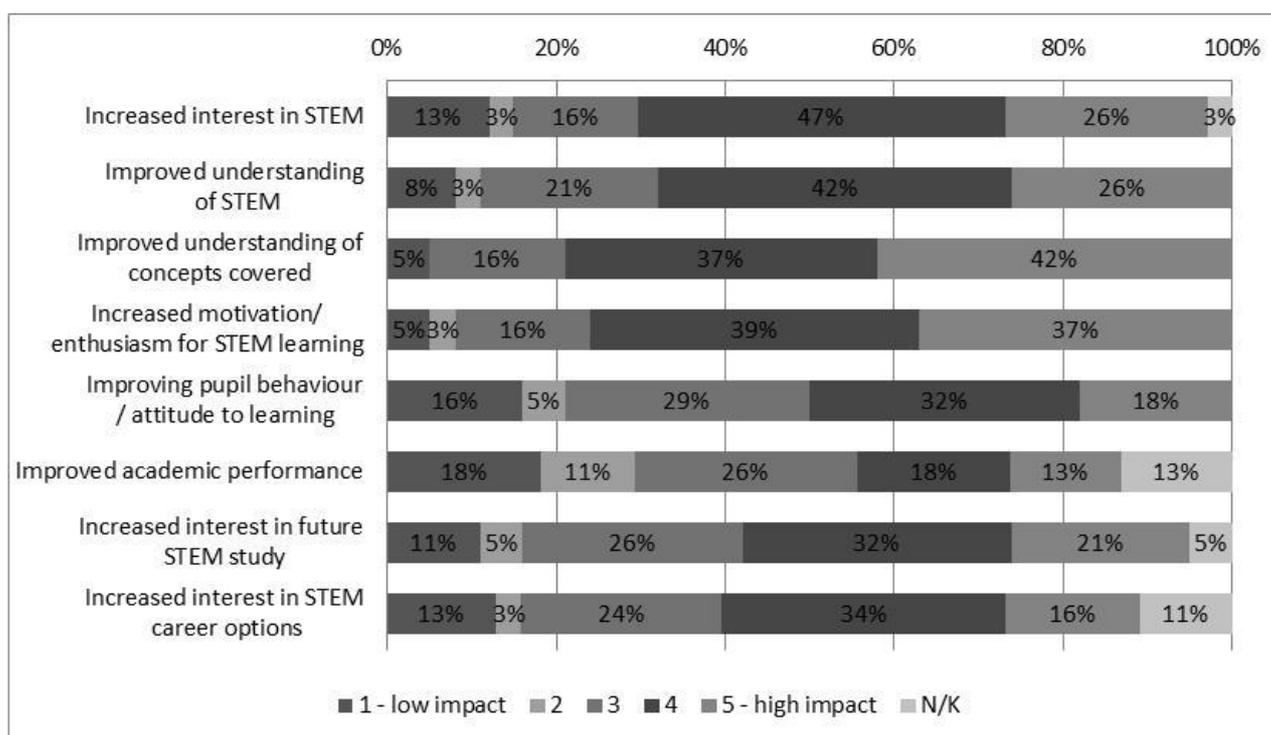
- Increased interest in STEM subjects as career options – 50% rating 4 or 5 (29 schools)
- Improved behaviour/attitude to learning – 48% rating 4 or 5 (28 schools)

Finally one variable received a **mean rating below the mid-point of 3**:

- Tangible improvement in academic performance - rated 4/5 by 23% of respondents, (13 schools), with 24% rating as 3 and 26% as N/K.

Differences emerged between rankings reported by primary and secondary schools, as shown in Figures 4.4 and 4.5 below. Primary schools rated improved understanding of the session contents most highly (79% rating 4 or 5), followed by increased motivation and enthusiasm for STEM learning and increased interest in STEM subjects.

**Figure 4.4 Primary Impacts, % Ranking**

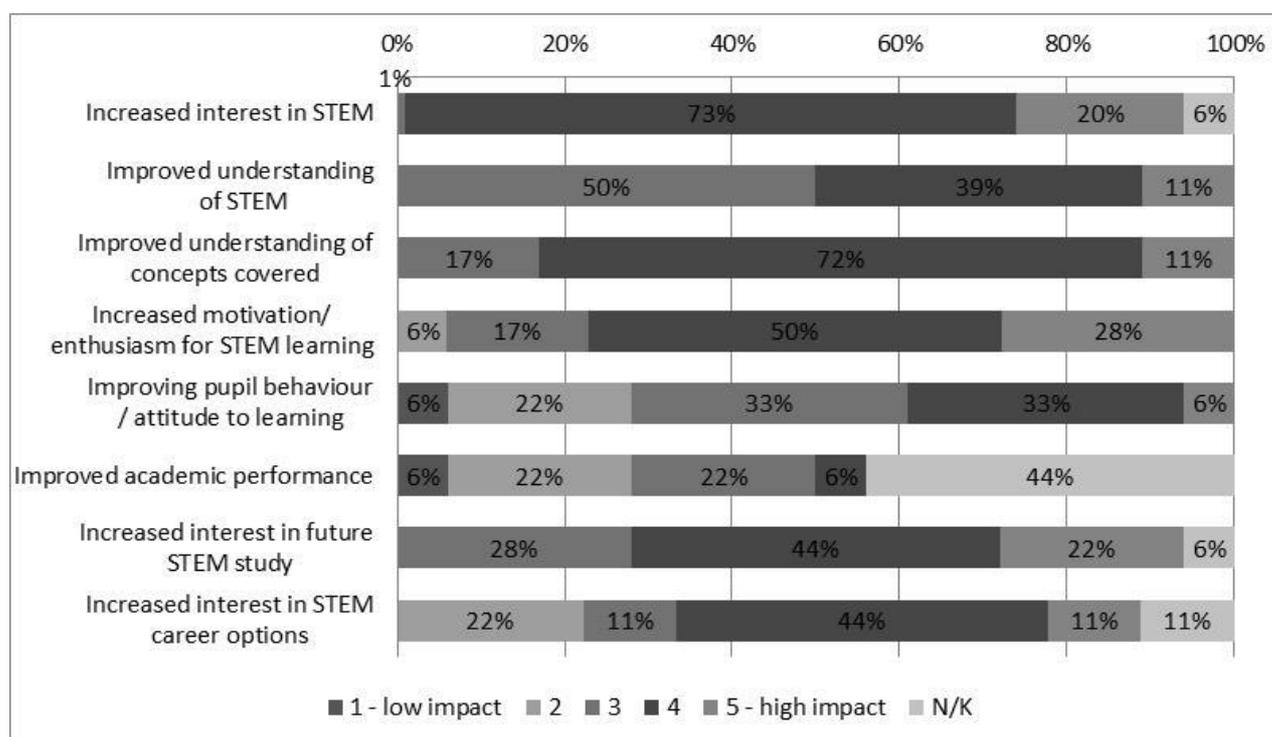


Source: ICF GHK/Beaufort Research Survey of Schools, n=38

By comparison, the secondary schools rated increased interest in STEM subjects most highly (93% rating 4 or 5), followed by specific understanding of the specific topics covered in the sessions and increased motivation and enthusiasm for STEM subjects.

In terms of the impacts rated less highly, improved academic performance was rated highly less frequently (rated 4 or 5 by 31% of primary and 28% of secondary respondents). However, in both cases schools were less able to comment on this variable than others, 13% of primary and 44% of secondary respondents.

**Figure 4.5 Secondary Impacts, % Ranking**



Source: ICF GHK/Beaufort Research Survey of Schools, n=20

Across all the variables, the largest differences between the primary and secondary respondents related to:

- Increased interest in STEM subjects – where 93% of secondary schools rated as 4 or 5 compared to 73% for primary schools;
- Improved understanding of STEM subjects – where the reverse applied, with primary schools rating more highly (68% rating 4 or 5) than secondary (50% rating 4 or 5);
- Improving pupil behaviour/attitude to learning – where 76% of primary schools rated 4 or 5 compared to 66% of secondary; and
- Increased interest in future STEM study – where 66% of secondary schools rated 4 or 5 compared to 53% of primary. While this might be expected given the age of the pupils concerned, the primary figures are encouraging. Similarly more secondary respondents also rated increased interest in future STEM careers as 4 or 5 compared to primary (55% vs 50%), although again the primary figures are encouraging.

The follow up interviews with TQG users expanded on the above points highlighting that “*TQG helps make science more fun.*” (Science Coordinator, Primary School) and provides “*hands on experience they don’t otherwise get.*” (Head Teacher, Primary School). Three of the interviewees articulated how these factors contribute to tangible outcomes, with one primary head teacher who uses TQG services regularly describing how:

*“Pupils have access to hands on resources in TQG that we don’t have in school. We have seen an increase in interest in science, and at the end of Year 2 and Year 6 we have seen an increase in the standard of science. While TQG isn’t solely responsible it contributes to it; it definitely helps. Teachers will assess at the end of the half term on the topic covered in science; if they have visited TQG you can see they have picked up the learning.”* (Head teacher, Primary School.)

Similarly a secondary Head of Science using a number of TQG outreach services described that TQG inputs, as part of their wider enhancement and enrichment offer, were beneficial:

*“Evidence from school shows that three times the number of students now take separate science and a third of our students now opt for A’ Level; the TQG outreach has helped with that. We also have a good pass rate with students getting a grade C or above.”* (Head of Science, Secondary School)

Finally, another secondary Head of Science noted the following pupil impacts: “*Aspiration raising, confidence building, team building, skill development in problem solving and thinking skills; all due to pupils getting together and the content of the session.*”

Although TQG does not collect long term impact data, it systematically collects immediate satisfaction data across all their school onsite and outreach activities through self-completion forms for teachers. Drawing on the Generic Learning Outcomes (GLO) framework, these show that for 2011-12:

- 86% of teachers providing feedback agreed or strongly agreed that TQG onsite activities helped improve pupils' understanding of science concepts, and 85% agreed or strongly agreed that they made pupils feel more positive about themselves and their ability with science.<sup>61</sup>
- 71% of teachers providing feedback agreed or strongly agreed that TQG outreach activities helped improve pupils' understanding of science concepts, and 75% agreed or strongly agreed that they made pupils feel more positive about themselves and their ability with science.<sup>62</sup>

#### 4.4.3 *Benefits and Impacts for Teachers*

In addition to the benefits/impacts for pupils, teachers were asked whether they had received any benefit from the school's involvement in TQG provision. Using a 1 to 5 scale (1=disagree strongly and 5=agree strongly), teachers were asked to rank the extent to which services had provided: insights into new teaching methods, ideas for practical sessions, new ways of demonstrating STEM concepts, and teaching resources for classroom use.

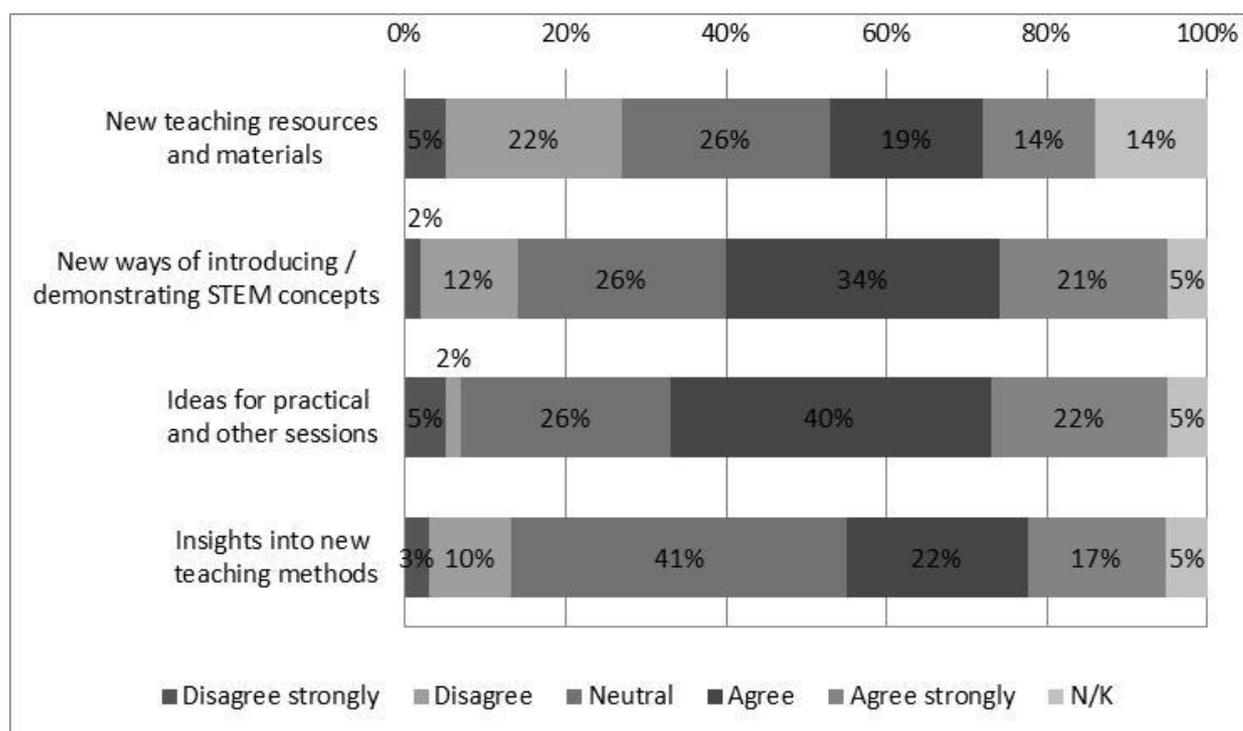
The Figure below shows the level of agreement with the four statements provided for TQG users.

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<sup>61</sup> Aled Wyatt and Scot Owen (2013) *Techniquest Glyndŵr Inreach Education Report*, September 2011-July 2012. The number of evaluation forms returned was 301 – 97% of all onsite activities.

<sup>62</sup> Aled Wyatt and Scot Owen (2013) *Techniquest Glyndŵr Outreach Education Report*, September 2011-July 2012. The number of evaluation forms returned was 96– 72% of all outreach activities.

**Figure 4.6 Teacher Benefits, Agreement Ranking**



Source: ICF GHK/Beaufort Research Survey of Schools, n=58

The majority of teachers using TQG services felt that they and their schools had benefited from TQ provision in all four impact areas, with the two most highly rated areas being:

- Providing ideas for practical and other sessions – with 36 schools (62%) agreeing / agreeing strongly; and
- Introducing new ways of introducing STEM concepts – 32 schools (55%) agreeing or agreeing strongly.

Elsewhere 19 schools (33%) agreed/agreed strongly that TQ provision had provided them with new resources and materials for use in the classroom, and 23 schools (40%) insights into new teaching methods.

The follow up teacher interviews also highlighted the benefits of TQG engagement for teachers, with many highlighting how ‘rewarding’ it was “to see the kids learning out of school.” (Head Teacher, Primary School).

Another teacher valued “seeing children work outside the classroom and seeing different approaches to teaching a topic.” (Head Teacher, Primary

School). With specific reference to outreach sessions on Light, another teacher felt they benefited from TQG which they described as acting as a “refresher” and “letting us view [the topic] from a distance and see a different way to present.” (Science Coordinator, Primary School).

A primary school Head Teacher emphasised the positive effect of exposure to TQG presenters: “next time the teacher comes to the topic, they are more knowledgeable of what they need to do with the kids.” Similarly, a secondary Head of Science noted that

*“the TQG sessions provide the teachers with ideas. You see things and think ‘I’d not thought of that.’ The outreach sometimes shows practical ideas we can do in school.”*  
(Head of Science, Secondary School)

He also valued the links that TQG provided to local industry: “*Talking to TQG staff we have been able to develop links for other topics and they know the people in industry.*”

The extent to which teachers consider TQG activities have enhanced their own teaching also features in their routine satisfaction surveys with teachers, the results of which show that:

- For onsite activities, 74% of teachers agreed or strongly agreed that the science show/workshop activities provided them with new ideas to use in their teaching.<sup>63</sup>
- For outreach activities, 53% agreed or strongly agreed that they had provided them with new ideas to use in their teaching. TQG explain

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<sup>63</sup> Aled Wyatt and Scot Owen (2013) Techniquet Glyndŵr Inreach Education Report, September 2011-July 2012. The number of evaluation forms returned was 301 – 97% of all onsite activities.

this lower rate as a reflection of teachers not having the equipment to recreate TQG activities.<sup>64</sup>

#### 4.4.4 *Experience of Teacher CPD*

Although not a primary focus for the study, the survey explored the extent to which the teachers had participated in TQG CPD provision. In total just four teachers reported receiving TQG CPD provision, each of which were primary schools.

While the small numbers prohibit more detailed analysis, the responses were positive and showed that for TQG:

- Of two of the four schools using TQG CPD provision, two had received one day and two received three days provision;
- Three of the four considered the provision to be of good or very good quality, with one providing a neutral (3) rating; and
- Two TQG CPD users considered it to be of a similar quality to that received elsewhere, and two that the TQG provision was better.

#### 4.4.5 *Added Value*

Teachers were also asked to reflect on the extent to which TQG services meet their needs in terms of supporting curriculum delivery, their satisfaction with TQG provision compared to that of other providers, and the extent to which TQG provision represented value for money.

#### *Meeting Needs*

Figure 4.7 below suggests that TQG is meeting the needs of the majority of respondents, either fully or in part.

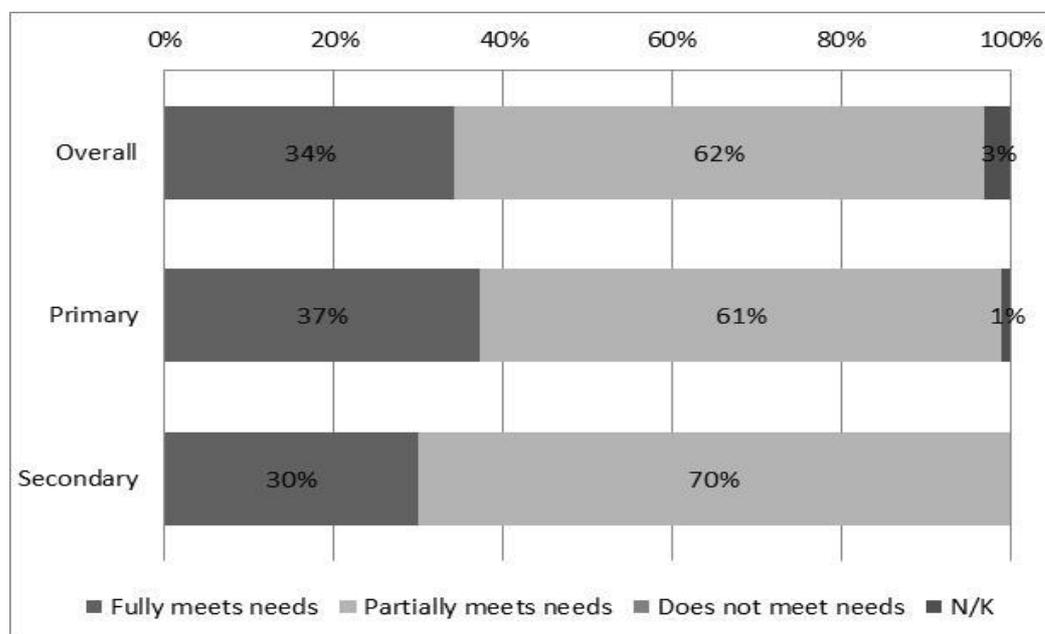
Over one third of schools reported that TQG provision fully meets their needs (34% or 20 schools), with 62% (36 schools) reporting it partially meeting their

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<sup>64</sup> Aled Wyatt and Scot Owen (2013) Techniquest Glyndŵr Outreach Education Report, September 2011-July 2012. The number of evaluation forms returned was 96– 72% of all outreach activities.

needs. No teachers reported TQG provision failing to meet needs. Of these 37% of primary respondents reported their needs being completely met compared to 30% of secondary schools (14 and 6 schools respectively).

**Figure 4.7 Extent to Which TQG Provision Meets Needs**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=58, Primary n=38 and Secondary n=20

The teachers taking part in the follow up interviews all felt that their needs had been met, with one school saying that TQG services are “*pretty important*” to their delivery of STEM and that “*we would like to have them come every half term but we cannot afford it.*” (Science Coordinator, Primary School). This contrasted with another primary school, which while extremely positive about the provision they had received did not necessarily view TQG as the main contributor to their STEM provision – “*It is only an element of our provision*” (Head Teacher, Primary School).

Three interviewees emphasised how a tailored approach helped meet their specific needs:

- In one example an onsite workshop for Foundation and Key Stage 1 pupils on space and the body as part of Science Week was tailored based on inputs from teachers prior to delivery. The teachers

discussed the provision in advance with the Science Coordinator, who then liaised with TQG to ensure the workshop met the needs of the various age groups. (Head Teacher, Primary School).

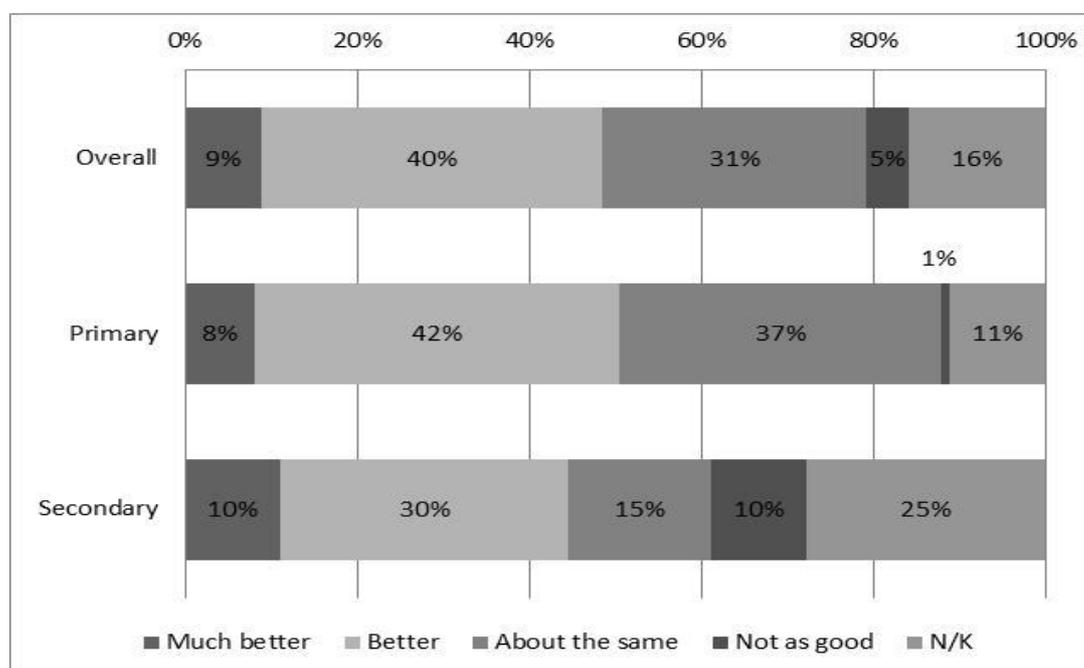
- In another example a Year 9 session on investigating science problems also benefited from discussions prior to TQG delivery: “*TQG liaise well and ask the target ability and whether for example the students are gifted and talented or mixed.*” The teacher gave an example of a Presenter who modified a session on solar cells for a lower ability class. (Head of Science, Secondary School).
- Finally, with reference to a primary onsite workshop, the teacher in question appreciated being able to discuss in advance the content of the visit to ensure that certain sessions were suitably tailored for the Foundation Phase pupils.

#### *Satisfaction with TQG Provision Compared to Different Providers*

TQG provision for schools also compared well to schools’ experiences of similar providers. Teachers were asked to compare TQG provision to other providers’ in terms of overall quality and appropriateness, and whether the TQG provision was much better; better; about the same; or not as good.

Figure 4.8 below shows the distribution of responses for TQG provision overall, and by primary and secondary school respondents.

**Figure 4.8 TQG Provision Compared to Other Providers**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=58, Primary n=38 and Secondary n=20

The teacher follow up interviews highlighted that their schools engaged in a range of broader enhancement and enrichment activities beyond solely TQG, although these were not always perceived as direct STEM competitors and included employers such as Dee Valley Water, E-On Power Station and recycling centres, universities such as Bangor University and museums. One interviewee explained that although they used some of these providers, he did not see them as an alternative to the TQG offer: *“to be honest, I have not looked elsewhere [for STEM provision] as TQG have a good name and are so close.”* One of the interviewees stressed that the reliability of a provider is really important:

*“You need people to turn up on time. Some [non STEM] providers have called on the day and said they cannot come. TQG are good in this sense and have not let the school down.”* (Head of Science, Secondary School)

Finally, another interviewee felt that TQG was very strong on Key Stage 3 and 4, compared to University provision which was more focused on Key Stage 5.

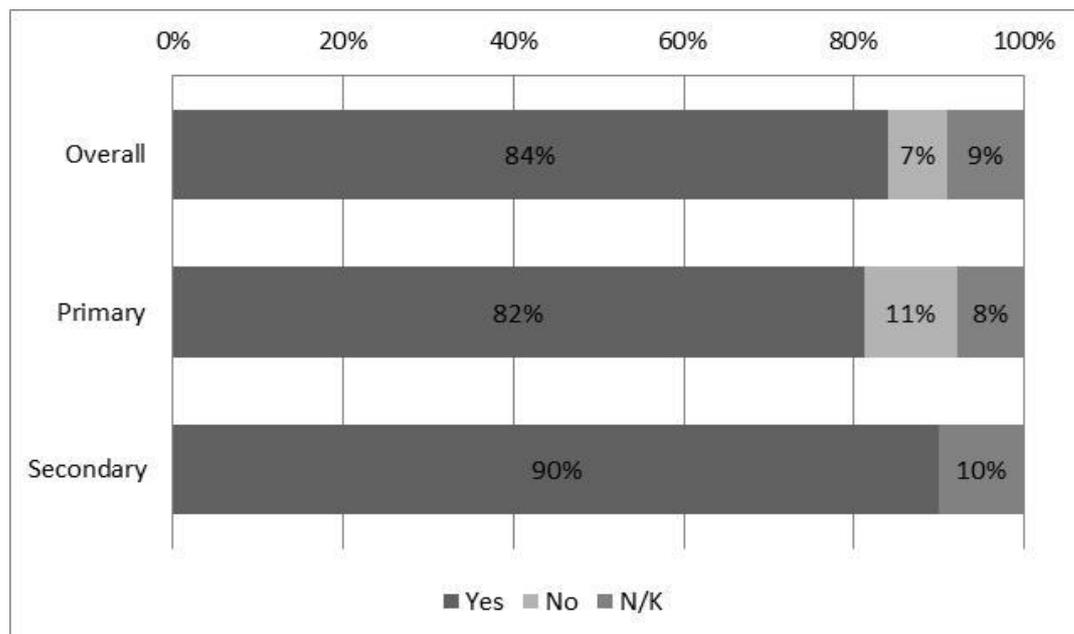
As a user of wider University STEM provision, this interviewee was aware that TQG was co-located with Glyndŵr University, but had never visited or taken advantage of this offer (Head of Science, Secondary School).

*Value for Money*

Finally teachers were asked whether or not they considered TQG provision to offer good value for money. Care was taken when introducing this question to ensure that respondents considered the overall cost to the school of accessing TQ provision, not just the direct costs of provision (such as entry fees or transport costs in isolation).

As Figure 4.9 below shows, the vast majority of respondents (84% or 49 schools) considered that the services provided by TQG represented value for money - just four schools (7%) reported otherwise.

**Figure 4.9 Value for Money of TQG Provision**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=58, Primary n=38 and Secondary n=20

A larger proportion of secondary schools (90% or 18 schools) than primary schools (82% or 31 schools) considered TQG provision was good value for money, and no secondary schools reported otherwise.

This was also reflected in the follow up teacher interviews, where it was felt that TQG offered value for money with a number of interviewees recognising the importance of Welsh Government funding. A secondary Head of Science for example that had used TQG extensively explained that *“if it was more expensive, I would have to think twice. The Welsh Government funding discounts a lot.”* Similarly, from a Head of Science in another secondary school *“if it costs more we wouldn’t do it. Its good value for money especially as our budget is tight.”*

#### 4.5 Areas for Improvement

Schools were asked, on the basis of their previous experience of TQG services, if there were any areas where services could be improved. Asked as an open question, the responses were coded and are summarised in Table 4.9 below. Notably, as for TQ, the most common responses to this question were positive in that no improvements were required.

**Table 4.9 Areas for Improvement - TQG**

Improvement	TQG Overall	Primary	Secondary
N/K – positive comments only	14	10	4
References to distance – e.g. travel costs	8	8	--
Cost of services	7	6	1
Improved links to curriculum	5	1	4
Improved marketing / promotion / materials	5	3	3
Increased outreach provision	5	4	1
Staff experience / skills / ability to enthuse	5	3	2
More for more able – gifted and talented pupils	3	1	2
More Welsh language provision	3	1	2
More involvement of teachers in provision development	3	1	2
Delivering at right level / not too difficult	2	1	1
Post-visit materials	2	2	--
Availability of sessions	1	1	--

Improvement	TQG Overall	Primary	Secondary
More variety / range of activities	1	1	--
Other	7	4	3
Not answered	1	--	1

(n=58)

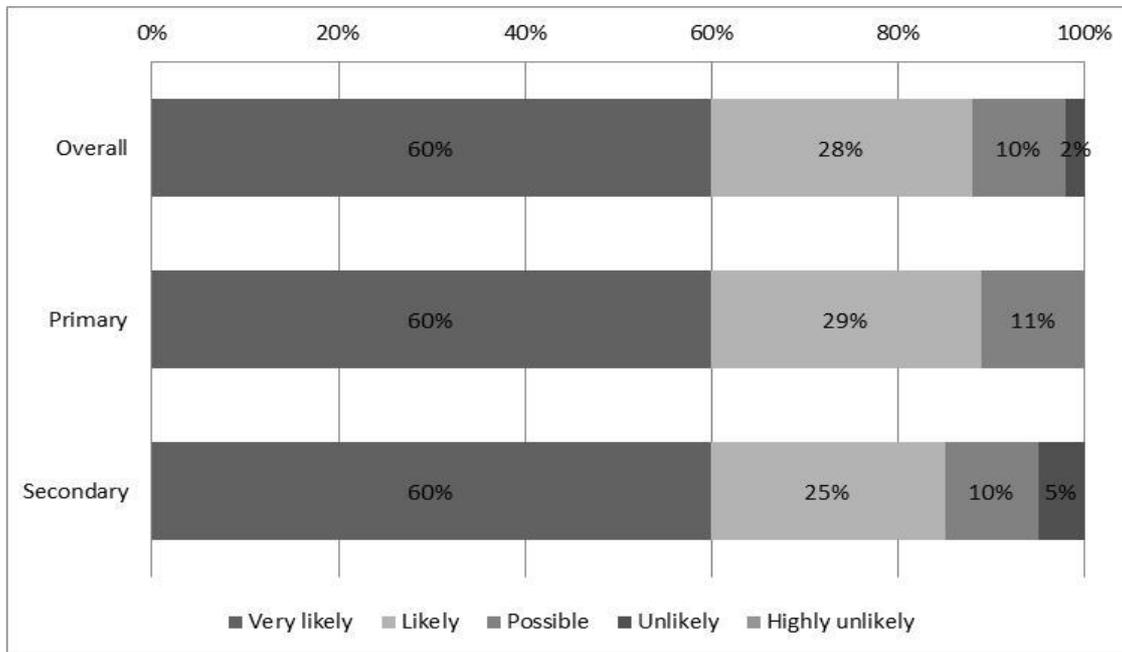
#### 4.6 Plans for Future Use

Finally schools were questioned on their likelihood of using TQG services in the coming 12 months, with the responses being shown in the chart below. The majority of teachers (60% or 35 schools) reported being highly likely to use TQG services again in the next 12 months, with an additional 28% (16 schools) being likely to use them and 10% (6 schools) possibly using them over the next year. Primary and secondary respondents reported broadly similar likelihoods of using services over the next year:

- 61% of both (23 primary and 11 secondary schools) were very likely to use;
- 29% of primary and 25% of secondary (11 and 5 schools respectively) were likely to use; and
- 11% of primary (4 schools) and 10% of secondary (2) schools felt they might possibly use TQG services.

Just one primary school considered they were unlikely to use TQG services over the next year, for a combination of financial reasons and not being aware of specific provision to fit with their learning aims for the year.

**Figure 4.10 Likelihood of Using TQG Services in the Next 12 Months**



Source: ICF GHK/Beaufort Research Survey of Schools. Overall n=58, Primary n=38 and Secondary n=20

## 5 Non-User Survey Findings – Techniquest and Techniquest Glyndŵr

### Summary

- Teachers in 50 schools not using TQ or TQG services in the last 4 years were surveyed, comprising 49 primary and 1 secondary school across the TQ and TQG catchments. Each reported accessing a range of external STEM support on an on-going basis.

### Awareness

- All the teachers were aware of TQ or TQG, with the vast majority (47 of 50) also being aware that they provided services for schools. However, while almost all respondents knew about the centres' onsite provision, fewer were aware of their outreach services. Even less were aware of the support for mathematics and of teacher CPD – while none were aware of the TQG University tour opportunity.
- This suggests that opportunities exist for both centres to promote their services/new activities introduced, to schools where recent contact has been limited. However, and seemingly contradictorily, the majority of the non-user schools described receiving information on a regular basis from TQ or TQG – highlighting the challenges of communicating effectively and raising awareness amongst the school audience.

### Previous Use

- While none had used TQ or TQG services in the previous four years, 31 of the 50 schools had used TQ or TQG services in the past – most commonly through centre visits but also through outreach. Just two reported using CPD services.
- Despite this, almost half of the schools reported planning to use TQ or TQG services in the next 12 months – including seven schools who reported not using their services previously.

### Decision Making

- Costs emerged as the most common consideration when deciding to use external enhancement and enrichment provision, followed by relevance to the curriculum, recommendations from colleagues, expected benefits for pupils, and transport/distance and quality issues. The single main factor influencing decisions appeared to be costs, followed by benefits for pupils, relevance to the curriculum and delivery quality.

### Reasons for Non-use

- The vast majority of teachers aware that TQ/TQG provided services for schools reported facing barriers to using their services (89% or 42 schools), while just five reported having actively decided not to use their services:
  - Barriers most commonly cited were costs (of transport and of visits/services), followed by access/distance issues – with a lack of provision at specific times also being mentioned.
  - Reasons cited for deciding not to use TQ/TQG services included previous poor experiences, having sufficient provision already and provision being considered poor value for money.

### What Would Help?

- Unsurprisingly support to help schools with costs (admission, transport and teacher cover – reported by almost two thirds of teachers), followed by additional outreach provision and stronger curriculum links. Other factors included improving marketing/raising awareness and more Welsh language provision.

## **5.1 Introduction**

This section draws on the findings of the survey of teachers in schools who had not used TQ or TQG services in the previous four years, and TQ and TQG's own materials where relevant, to explore barriers to service use and the reasons for schools deciding not to use the centre's school services.

## **5.2 The Non-User Survey Respondents**

Teachers in a total of 50 schools not using TQ or TQG services were interviewed, comprising 34 non-using schools in the TQ catchment and 16 in the TQG catchment. The primary and secondary school split was determined by the availability of contact details for non-users at each centre. Of the 34 TQ schools, 33 were primary and one secondary; all 16 of the TQG schools were primary. All of the teachers interviewed described using a range of externally provided STEM enhancement and enrichment activities:

- 94% (47 schools) reported taking pupils on visits to science centres, zoos, and museums – 97% of TQ and 88% of TQG respondents;
- Almost two thirds (64% or 32 schools) reported using materials and resources from other sources – 68% of TQ and 56% of TQG schools;
- Over half (56% or 28 schools) described using external services delivered on an outreach basis; and
- 44% (22 schools) reported working with outside scientists – (both TQ and TQG schools).

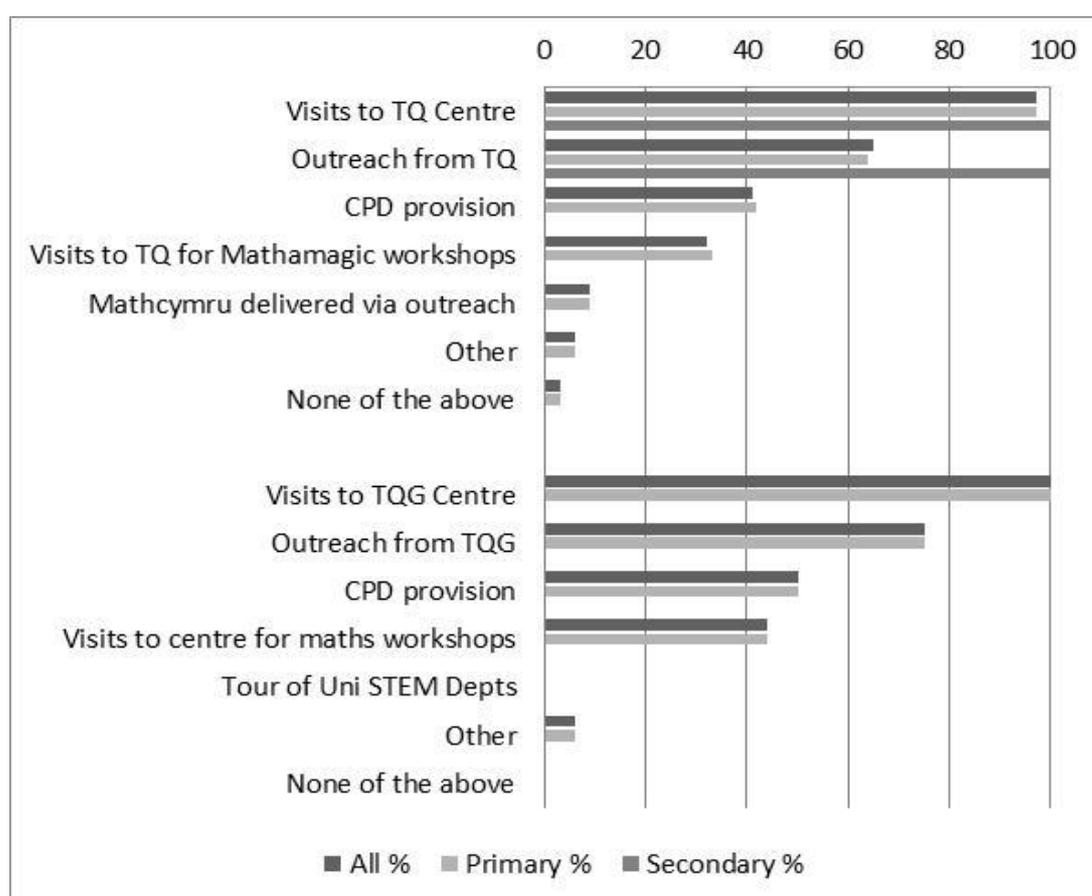
For most of the respondents, using external STEM enhancement and enrichment provision was something that happened either monthly or termly (58% or 29 schools). Around one in five (22% or 11 schools) reported involvement in such activities more regularly, some on a weekly basis, while a similar share (20% or 10 schools) reported using external services was more of a rare event, happening less than once a term.

## 5.3 Survey Findings

### 5.3.1 Prior awareness of TQ/TQG

Each of the teachers responding to the survey had heard of TQ/TQG prior to their interview, with the vast majority, 47 of the 50 respondents (31 TQ and 16 TQG), being aware that the centres provide a range of services for schools (as shown in Figure 5.1 below).

**Figure 5.1 Awareness of TQ/TQG Services**



Source: ICF GHK/Beaufort Research Survey of Schools

While all the schools were aware of TQ/TQG, and 47 of the 50 were aware that they provided services for schools, the chart shows that not all were equally aware of the range of services that were available. While the vast majority of the schools were aware of the centres' onsite provision (97% of TQ and 100% for TQG), fewer were aware of outreach opportunities (65% TQ and 75% TQG). Half or fewer of the teachers reported being aware of the TQ/TQG CPD offer - 41% of TQ and 50% of TQG respondents.

Awareness of mathematics provision by both centres was also low – although this is likely to be influenced in part by the subject focus of the teacher responding. Less than one third (32%) were aware of the option to receive Mathamagic workshops at the TQ centre, and just 9% (three schools) were aware of the Mathcymru outreach service.

Some 44% of TQG respondents (7 schools) reported being aware of the mathematics workshops delivered at the centre, and none reported being aware of the opportunity to tour the Glyndŵr University STEM departments. Although the numbers are small and predominantly confined to primary schools, the findings would suggest that awareness of the range of TQ and TQG services could be improved, especially around CPD, mathematics provision and the TQG University tour option.

However, 39 (78%) of the respondents reported receiving information from TQ/TQG on the services they provide for schools, with TQ schools appearing more likely to receive this information (82%) than TQG schools (69%). Where information was received it was most commonly in the form of written materials (36 of the 39 schools), with 11 schools saying they received email updates and four schools direct or telephone contact. This illustrates the challenges facing the centres in terms of stimulating and maintaining awareness of the range of services they provide – and suggests that communications focussing on specific products or services may be required.

### *5.3.2 Previous use of TQ and TQG services*

The survey found that the majority of the 'non-using' schools had used TQ or TQG services previously (32 of the 50 respondents), while 14 had never used their services (to the best of the teacher's knowledge) while four respondents were unsure.

Visits to the centres/onsite provision was the most commonly reported mode of previous provision (20 of the 25 previous TQ users, and five of the seven TQG), followed by outreach services (6 of the 25 TQ and 1 of the 7 TQG), and with two of the TQ schools reporting using their CPD services.

Despite not using TQ or TQG services in the previous four years, almost half (44% or 22 schools) of the schools reported planning to use their services in the next 12 months. This included the 14 schools who reported not using any TQ or TQG services previously.

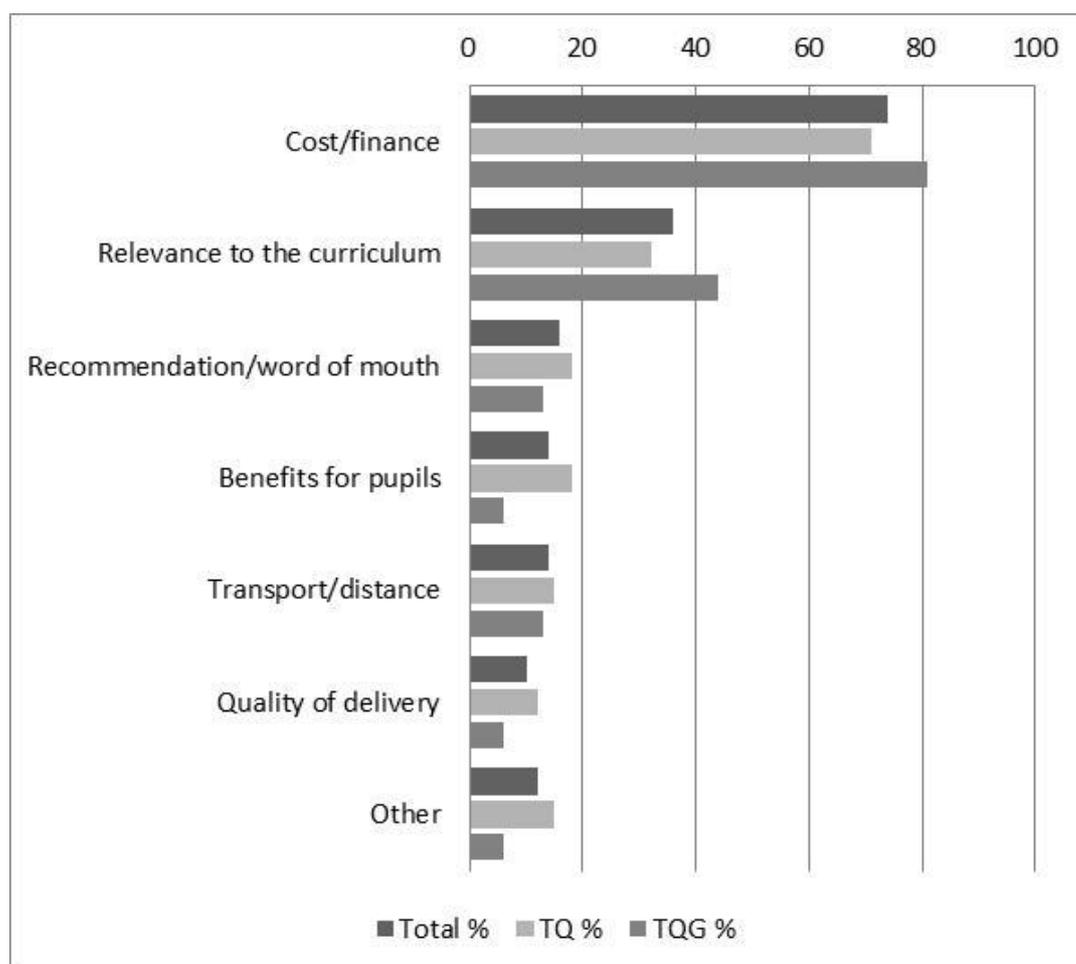
#### **5.4 School Decision Making**

The survey explored the key factors which influence schools' decision making around the use of external enhancement and enrichment services. Figure 5.2 below sets out the responses and shows that costs were the most commonly mentioned influencing factor (74%, 37 schools), followed by the provision's perceived relevance to the curriculum (36% or 18 schools). Other factors included recommendations from colleagues/word of mouth, the perceived benefits for pupils, transport issues/distance from the centres and perceptions of the quality of delivery – which were cited by between five and eight schools (10-16% respectively). One school referred to the availability of provision through the medium of Welsh.

Figure 5.2 below also shows responses for schools in the TQ and TQG catchments – which shows that the ranking of the key factors are broadly similar (although costs and curriculum links appear more of an issue for TQG catchment).

When asked to describe the single most important single factor in deciding to use specific services or providers, costs were the most commonly mentioned (by 36% of all schools), followed by benefits for pupils (28%), relevance to the curriculum (18%) and the quality of delivery (16%).

**Figure 5.2 Factors Influencing Decision to use External Services**



Source: ICF GHK/Beaufort Research Survey of Schools

The follow up interviews with teachers using TQ and TQG services highlighted a number of factors that were influential in determining their decision to engage a STEM provider. These reflected the factors above, with key influences including:

- Cost and value for money – while some competing services are available for free, travel costs again emerged a key factor, and teachers explained that they were often unable to cover the costs from school budgets or to pass on the financial burden to parents.
- Quality provision, explicitly linked to the curriculum and available at the right time – many teachers spoke of the need for any investment in extra curricula activities to fit directly with the school curriculum and learning plans, particularly for older pupils in Key Stage 4 and above.

- Offering something that the school could not do themselves – as one secondary teacher described “*we want it to have the wow factor and for students to come away mesmerised.*” Indeed, this was the expectation expressed by many teachers as part of TQ’s review of non-engagement.<sup>65</sup>
- Being proactively targeted by a provider – a typical response among teachers is that they do not have time to “*go out actively looking for*” providers.
- Recommendations from fellow teachers – “*colleague recommendations go a long way.*”
- For onsite provision the location of the centre is crucial - if it is easy and inexpensive to get to, then schools are more likely to use.
- For outreach provision a key factor is the availability of space within the school - especially for primary schools, where the use of the main school hall may be restricted due to PE lessons and lunchtimes.

## 5.5 Reasons for Not Using TQ/TQG Services

To identify the reasons why schools which were aware of the centres’ school services but had not used them recently, teachers were asked whether they:

- Would like to use TQ or TQG services more but faced barriers in doing so; or
- Had actively taken the decision not to use TQ/TQG services, and if so for what reason.

The majority of respondents (89% or 42 teachers) reported facing barriers to accessing provision, while five (three TQ and two TQG) reported deciding not to use their services.

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<sup>65</sup> Sally McGregor (2012) “Exploring why teachers do not visit Techniquet or access its Outreach Service: a Report on a Focus Group Discussion conducted with Secondary School Teachers, March;

### 5.5.1 *Barriers to TQ/TQG use*

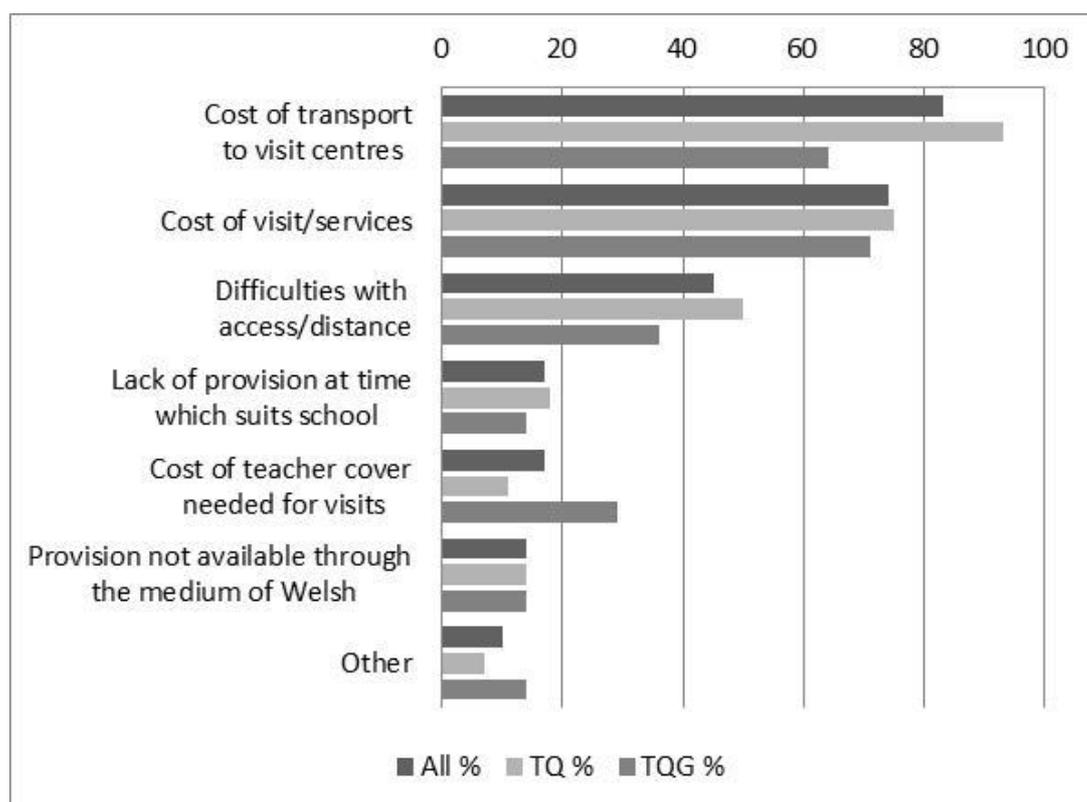
The barriers reported to the use of TQ and TQG services are shown on Figure 5.3 below, with cost issues emerging as the main reason for the non-use of services, followed by difficulties with access/distance.

The figure also shows that:

- A larger share of TQ schools found the cost of transportation to the centre, and access issues/distance, as barriers than TQG schools, while both found cost of provision itself equally challenging;
- However TQG schools reported the cost of teacher cover to be a greater barrier than that for TQ – where perhaps the reverse would be expected given distance issues; and
- The ability to provide through the medium of Welsh is important – with a small share of schools (14% or 6 schools) reported this as a specific barrier.

The one TQ secondary school reported cost of transport, cost of visits, difficulties with access/distance and cost of teacher cover to be their barriers.

**Figure 5.3 Barriers to Using TQ/TQG Provision**



Source: ICF GHK/Beaufort Research Survey of Schools

Four schools reported additional barriers, including:

- One TQG primary school who wanted additional information on CPD and Maths provision for whole school/specific year group sessions, and a second reported being unable to find the time to arrange provision; and
- One TQ school reported that their priorities were away from the STEM subjects, while another felt that the perceived minimum cohort size for a visit of 55 was too many.

TQ's own studies into non-engagement report a number of factors that constrain use among teachers:

- Costs, and in particular the cost of travel, is again often cited as a main barrier, with secondary schools also citing the cost of supply cover.

- Some teachers cited a lack of information from TQ as inhibiting their take up services; and
- In a focus group discussion, teachers highlighted that TQ had to compete with ‘free’ services and innovative attractions for their school audience.<sup>66</sup>

The follow-up interviews undertaken with teachers responding to the main user survey also highlighted that curriculum changes were a barrier. A secondary school teacher, for example, explained that *“every time the curriculum changes we have to drop these activities, because we need to catch up and be familiar with the new curriculum.”*

#### 5.5.2 *Reasons for deciding not to use TQ/TQG services*

The five schools who had actively decided not to use TQ/TQG services (3 TQ and 2 TQG schools) described a range of reasons for their decision, comprising: deciding not to use the centres’ services based on their previous experience of the quality and appropriateness of TQ and TQG provision; having sufficient provision to meet their needs; challenges in accessing provision and the distance leading them to make alternative arrangements for provision; and a perception that TQ was poor value for money.

Additional reasons for not using the centres’ services included: lack of available provision at the time wanted; the cost of transport; and lack of fit with their own school development plan.

#### 5.5.3 *What would help?*

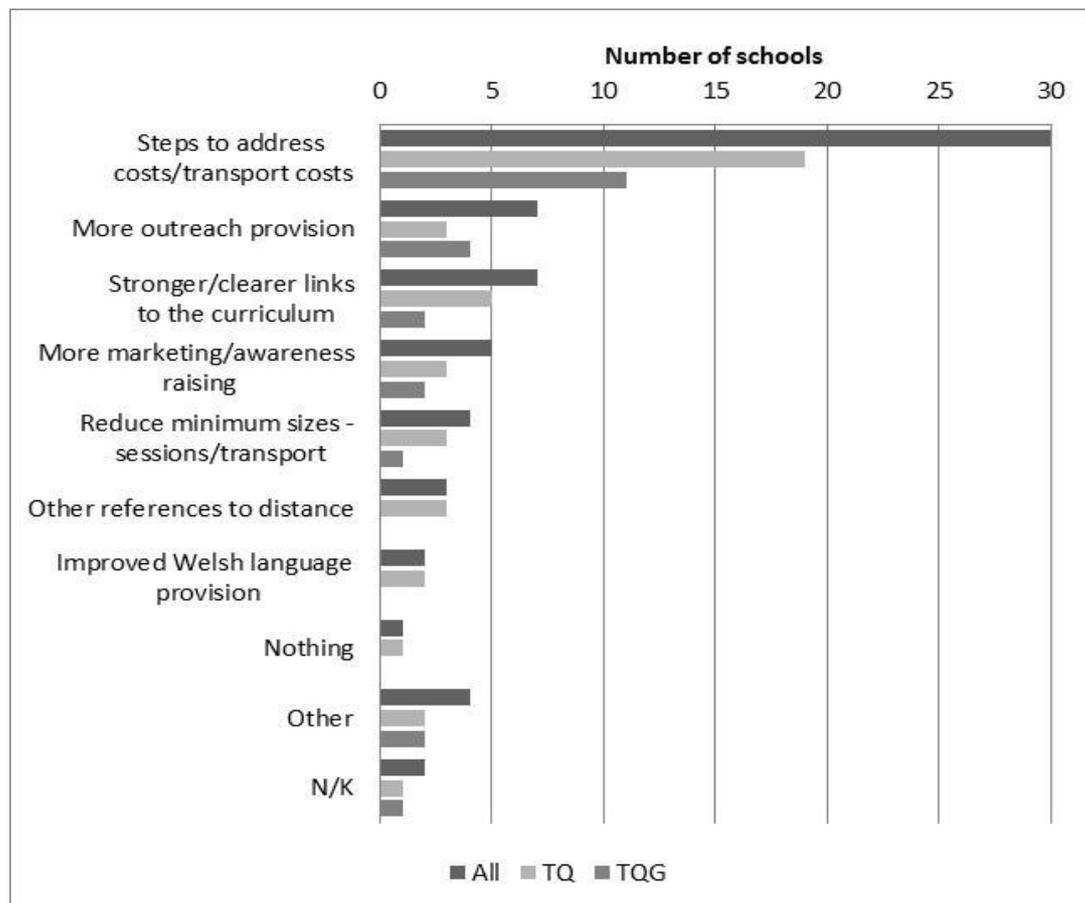
Finally, all 47 schools aware of TQ and TQG’s services for schools were asked what would make them more likely to use these services in the future. The responses are shown in Figure 5.4 below.

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<sup>66</sup> Sally McGregor (2012) “Exploring why teachers do not visit Techniquet or access its Outreach Service: a Report on a Focus Group Discussion conducted with Secondary School Teachers, March; and TQ, Results of Teacher questionnaire, July 2011.

In keeping with previous responses, supporting schools to meet the costs of provision – in terms of admission, transportation or supply cover – was most commonly mentioned, by almost two thirds of schools (30 schools, 19 of the TQ schools and 11 of TQG).

**Figure 5.4 Factors Improving Likelihood of Future Use**



Source: ICF GHK/Beaufort Research Survey of Schools

Additional outreach provision and stronger curriculum links were both mentioned by seven schools (three TQ and four TQG schools for outreach, and five TQ and two TQG schools for improved curriculum links). Other factors mentioned by five or fewer respondents included improving marketing and awareness raising (TQ and TQG), offering provision for smaller numbers (linked to minimum sizes for free transport – TQ and TQG), other references to distance (TQ), improved Welsh language provision (TQ) and more variety in the provision offered (TQG).

## **6 Conclusions and Recommendations**

This section summarises the findings of the study and presents our conclusions, structured to reflect the study aims and objectives, namely to assess:

- The extent to which TQ and TQG are achieving the aims and objectives agreed with WG for providing support to schools;
- The effectiveness and efficiency of TQ and TQG in providing centre-based and outreach services to support schools in delivery of the curriculum for 3-19 year olds, particularly in science and mathematics – including exploring teacher and stakeholder views of the quality and appropriateness of available provision, the impacts resulting for pupils, and identifying best practice and areas for improvement;
- The effectiveness of collaborative working between TQ, TQG and their key partners and stakeholders – from service planning through to delivery; and
- Whether the core grant and Mathcymru funding is being used appropriately, economically and efficiently to support and enrich curriculum delivery – and identifying the implications of any reductions in funding.

Alongside these objectives the invitation to tender also set out a series of topics to be investigated, including assessing the extent to which TQ/TQG are delivering the full STEM agenda, beyond maths and science; the extent to which TQ and TQG are providing services bilingually; why some schools do not use TQ/TQG services; and how data collection can be improved to capture impacts.

This section also provides our recommendations, structured by recommendations for Welsh Government and the individual centres.

### **6.1 Conclusions**

First we provide an overview of the study findings before addressing the specific study aims and objectives.

### 6.1.1 *Overview of Findings*

TQ and TQG work as separate entities and in partnership to deliver a range of public engagement and school services. Their school services include onsite provided through structured activities within their respective science centres, and outreach delivered through a range of interactive shows and hands-on workshops within schools delivered through the centres and the newly extended hub network. In contrast to many of the other STEM support providers available to schools in Wales, TQ and TQG deliver across the STEM agenda and cater for the whole school spectrum, from the Foundation Phase to post 16. Both centres also provide CPD for teachers, with funding from the National Science Learning Centre.

While independent organisations, both centres operate with a common understanding that their role is about enhancing and complementing the STEM and wider school curriculum, rather than directly delivering it. Both centres also face common challenges, not least in terms of the changing market where it is increasingly difficult to generate income directly from schools, especially secondary schools. This has meant that despite having a range of services on offer for all the key stages, both centres predominantly engage with primary pupils. Both centres deploy a range of marketing and recruitment strategies, and have expanded their capacity to deliver both onsite and outreach in the medium of Welsh. However both centres still acknowledge the challenge of how best to communicate their offer to teachers in a way that is timely and relevant.

There are, of course, also some important differences between the two centres, which set the context for the conclusions and recommendations, namely:

- TQ in Cardiff operates on a much larger scale, with greater overall funding (reflecting their All Wales Strategy and delivery for Welsh Government of the Mathcymru initiative on an all Wales basis), a larger venue and catchment area and a much higher public and pupil

throughput, with just under 1 million total engagements since 2010 (of which 31% were pupil engagements). A key component for TQ in delivery of its All Wales Strategy and Mathcymru (i.e. to be able to offer provision to all schools in Wales) has involved subcontracting and managing a network of hubs/outreach STEM support providers including TQG. The scale of TQ and its reach has meant a more standardised programme has evolved, and has perhaps contributed to greater challenges to communication/marketing.

- TQG operates, under licence from TQ, within a much smaller catchment area, with a smaller venue, lower levels of overall funding and achieving fewer public and pupil engagements (just under 150,000 since 2010, and with pupil engagements making up nearly half of this). Although not situated in a tourist destination, they are located very close to the English border, with an agreement with WG allowing for up to 40% of school provision to be to pupils from schools in England (in 2012/13 32% of pupil engagements were from schools in England compared with 6% for TQ). Its co-location with Glyndŵr University and links with local employers brings particular benefits, especially in terms of their secondary offer which includes access to University equipment, buildings/space and staff time. These factors allow TQG to offer tours of university STEM facilities and visits to, and development work with, local STEM employers. Their smaller scale also allows for greater capacity to offer tailored approaches to schools and teachers.

Finally, while this study has focussed on the Welsh Government's core funding to TQ and TQG for services for schools, it should be emphasised that both centres also engage with the general public, including children and young people of school age, through their wider science centre activities. As described above, pupils from both Wales and England engaging with the centres, on an onsite or outreach basis, make up one third of TQ's and almost half of TQG's total engagements with the general public, which means that substantial numbers of children and young people in Wales also benefit from their services supported outside of the core grant. However, it is clear that

without this funding the centres' ability to continue to deliver to both their school and public audiences would be severely restricted.

### 6.1.2 *Achieving Aims and Objectives*

As highlighted in Section 2 of this report, Welsh Government support for TQ and TQG sits within a wider Welsh Government commitment to STEM. As part of this, each centre has developed a series of aims and objectives which address their broader remit.

From the grant agreement, TQ's objectives of relevance to the WG core funded school provision in 2012/13, and the extent to which they have been achieved, are set out below:

- **To operate large scale school outreach services via regional hubs.** Progress has been made with a pilot phase of primary outreach being delivered and TQ reporting that both sub-contractors met their targets. However TQ failed to recruit a hub for Mid-Wales – and although they subsequently covered this themselves – this does raise the question of how an outreach hub provider can operate in areas with lower potential demand.
- **To develop on-site school services including a full programme for primary and a targeted programme for secondary schools.** TQ has made efforts to expand and deepen its programme but still struggling to attract secondary schools, with demand from these schools remaining low and barriers to engagement by schools are reported.
- **To cater for Welsh speakers in the Welsh language whenever necessary.** TQ have recruited Welsh speaking presenters and all their promotional materials and resources are produced bilingually. While still making up a relatively small proportion of their total throughput, the school survey suggests needs in this respect are being met.

From their grant agreement, TQG's objectives of relevance to the WG core funded school provision, and the extent to which they have been achieved, are described below:

- **To provide a valuable, year round and hands-on STEM education facility for both Wales and surrounding English counties.** Our research suggests that TQG are valued and used by schools in their area, with MI indicating that school engagement is clustered in authorities closest to the centre.
- **To provide a diverse and adaptable education programme from Foundation to post-16, delivered through onsite and outreach, and that supports teachers in the delivery of the curriculum.** The survey suggests that the school programme is well designed to cover all the key stages, however the majority of engagements remain with primary pupils.
- **To deliver products and services through the medium of Welsh.** TQG has recruited Welsh speaking presenters and produce promotional materials and resources bilingually. As with TQ, while still making up a relatively small proportion of their total throughput, the survey suggests needs in this respect are being met.
- **To provide an employer and sector relevant education programme that supports skills of the region.** TQG has established good strong links with a range of industry partners; delivering joint sessions to good effect.
- **To strengthen links between schools and local industries to encourage the take up of STEM subjects.** TQG emphasise the distinction between the aims of their primary and secondary provision, with the latter focussing more explicitly on stimulating pupils to consider STEM careers (including supporting teachers to make practical links to employers). Teachers responding to the survey particularly valued this aspect of TQG delivery, which was reflected in teachers' perceptions of impact in terms of increased interest in STEM as a study option and potential future career.

## *Performance*

Welsh Government monitor the performance of TQ and TQ's education services through annual targets for onsite and outreach pupil engagements agreed with each of the centres prior to each funding round. In the case of TQG, and in recognition of their location and proximity to schools in England, a target has been established of a 60:40 ratio for use by pupils in Wales and England respectively.

In summary:

- Performance against target for TQ outreach provision has been good in the previous three years, safely exceeding the target set in each year. However onsite provision has failed to meet its target in each of the three years, achieving 99%, 92% and 96% of the outreach target for each year respectively.
- TQG have struggled to reach their both their onsite and outreach targets over the last three years, for onsite achieving 84%, 88% and 68% of target respectively. For outreach, targets were exceeded in 2011/12 (106%), but missed in 2010/11 and 2012/13 (85% and 74% respectively) – although this is despite showing a year on year increase in outreach numbers. TQG have however increased the proportion of schools engaged from Wales, and have exceeded the 60:40 ratio for the last two years<sup>67</sup>.
- Both centres displayed similar rates of delivery through the medium of Welsh, with 6% of all TQ and 8% of all TQG engagements in schools in Wales having been in the Welsh language in 2012/13. The school survey responses on the provision of materials and services through the medium of Welsh indicated that for the majority their language needs were being met.
- Across both centres, recent years have seen an expansion of their offers beyond maths and science to include engineering and design and technology, with examples of these provided in the report.

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<sup>67</sup> The 2012/13 target set for onsite delivery by TQG was particularly high – representing a 50% increase on the target set for 2011/12 – and was not achieved despite the continued growth in the numbers of pupils receiving TQG outreach services across the last three years.

For both centres, achieving targets for onsite provision have been particularly challenging. It has proved increasingly difficult to attract schools, particularly secondary schools, to the TQ and TQG centres. According to the wider stakeholders, this is partly a symptom of reduced school budgets and shifting policy priorities, with secondary schools constrained further by more restrictive timetables. Delivery staff further highlighted that in-reach to secondary schools seems to be less attractive for the following reasons:

- The exhibition floor is often seen by older pupils as ‘too young’ and more suited for the younger children;
- It is more difficult for secondary schools to spare time for pupils to have day visits; and
- It appears more challenging for secondary schools to fund visits, as they need to pay for supply cover in addition to travel and admission costs.

### *6.1.3 The Effectiveness and Efficiency of TQ’s and TQG’s Education Services*

Both the stakeholders interviewed and the majority of teachers responding to the school survey considered that TQ and TQG were delivering high quality experiences for the pupils they engaged with. Although some issues and challenges were raised, as described below, stakeholders highlighted a number of key strengths such as: for both TQ and TQG having centre based provision alongside outreach; TQ’s Mathcymru offer, which was seen as adding value to the wider range of STEM outreach on offer; and the co-location of TQG with Glyndŵr University.

In summary:

- The majority of teachers described using TQ and TQG services at least once a year (76% and 84% respectively), with high levels of repeat business being reported;

- The vast majority of service users reported being satisfied or highly satisfied with their most recent TQ and TQG experiences (91% for both TQ and TQG). Contributing to this overall satisfaction rating:
  - The vast majority rated the quality of their most recently received service highly – with 90% of TQ users rating as good or excellent (50% as excellent), and 93% of TQG users (55% as excellent).
  - Services were seen as being appropriate in terms of their fit with the curriculum (rated as good or excellent by 83% of TQ and 88% of TQG users), and for their intended pupil groups (rated as good or excellent by 88% of TQ and 91% of TQG users).
  - TQ and TQG staff were also viewed highly in terms of their professionalism, skills and experience (rated good or excellent by 90% of TQ and 91% of TQG users).
- Teachers also reported a range of benefits for their pupils (and for themselves/their schools) as a result of TQ and TQG services. Impacts ranked particularly highly included increases in: pupil interest in STEM subjects; motivation and enthusiasm for STEM learning; improved understanding of STEM subjects; and an improved understanding of the concepts covered in their individual sessions.
- Fewer respondents reported impacts in terms of tangible learning outcomes - with 13% of TQ users and 23% of TQG users describing these as areas of high or very high impact – not unexpected given the nature/duration of the interventions offered. However differences emerged between the centres, notably around the share of respondents reporting increased interest in future STEM study or careers, where responses for TQG were more positive than for TQ, perhaps as a result of their industry and University links and inclusion in their service offer.
- The findings from the survey of schools not using TQ or TQG services in the previous four years showed that for the majority their lack of engagement was due to them facing barriers rather than deciding not to use their services for other reasons. Here costs, and particularly the costs of transport, emerged as the most common barriers to use –

very few of the schools reported not using the centres on the basis of previous negative (direct or anecdotal) experiences.

The survey findings therefore strongly suggested that, based on the experiences of the schools responding, both centres were providing good quality, appropriate services which were leading to identifiable impacts for the pupils participating. In addition the majority of teachers reported that:

- TQ and TQG provision was meeting their needs, either wholly or in part (90% of TQ and 96% TQG);
- TQ and TQG services compared well to those of other providers (with 47% rating TQ services better than and 30% the same as other providers, and for TQG 48% and 31% respectively); and
- TQ and TQG services offered good value for money (85% of TQ and 84% of TQG respondents)

Finally, the vast majority of teachers reported being likely or very likely to use TQ or TQG provision in the next 12 months. However cost issues also emerged as the key determining factor.

#### *What is working well*

As described above, TQ and TQG are generally held in high regard by stakeholders and teachers alike, and the TQ brand is widely recognised and associated with quality. Teachers see TQ and TQG services as relevant to and enhancing STEM curricula, and in most cases as meeting their needs at least in part. It was also recognised that TQ and TQG contribute to STEM learning as part of a wider range of STEM provision and providers within Wales that schools can, and do, draw upon. This study has shown that both centres are delivering services mostly in line with what the research evidence tells us about 'what works', although some challenges remain.

**Table 6.1 Good Practice Principles - TQ and TQG**

<b>Good Practice</b>	<b>Performance</b>
Providing resources that are interactive, easy to use, inquiry led, and tailored to the curriculum and audience interests and experiences	Both centres have developed workshops and shows that are interactive and easy to use – features noted and valued by teachers.
Engaging with pupils from an early age	Both TQ and TQG engage with primary aged pupils – and while this represents good practice it needs to be followed through by continued engagement throughout secondary schooling.
Providing STEM activities that link to the real world	Both centres recognise this as important, with TQG providing particularly good examples of links with the university and local industries to offer real life experiences – particularly linked to engineering – a priority of the 2012 WG STEM Strategy.
Proactively engaging with schools and teachers to communicate the full extent of their offer	Both centres deploy a mix of tactics in communicating with teachers, with teachers in the survey considering they had a good understanding of the TQ and TQG offer. The non-user survey however shows maintaining awareness of the range of services available is an on-going challenge, and that no single method can be relied upon. The stakeholder interviews usefully highlight that more could be done by both centres to link into and engage the support of local authority advisers in reinforcing their message.
Offering interactive science centres that capitalise on the role they can play in helping to develop positive attitudes towards science	Both centres make efforts to capture satisfaction and some level of impact. For TQ this is in relation to some but not all their activities; for TQG data is collected across all their activities but with no longer term follow up. Other science centres have prioritised this and developed more robust ways of capturing impact – partly by investing in surveys and also by partnering up and sharing costs with other science centres; a model worth exploring for TQ and TQG.

### *Key challenges and areas for improvement*

The stakeholder interviews and consultations with schools also identified areas of continued challenge and where improvements could be made. These are set out below.

#### ■ **Reaching all schools throughout Wales**

In terms of coverage, and despite the new hubs introduced to the network, engagement with schools for TQ remains concentrated in the South, and particularly South East, of Wales, and for TQG within their specific catchment area with some engagement in the adjoining local authority areas.

Highlighted as an issue by the wider stakeholders, the challenge remains of how best to engage schools in the more remote parts of Wales – with both centres seeking to better communicate their offers, providing subsidised travel costs and offering a ‘cluster booking’ approach. However the ambition in the All Wales Strategy of reaching each pupil in Wales on an annual basis continues to remain challenging.

#### ■ **Addressing barriers associated with cost**

While similar proportions of users of both centres considered that their services represented good value for money, the key issue of travel costs seems to be the main barrier to accessing TQ and TQG services, particularly onsite activities. TQ and TQG are attempting to attract more on-site provision through offering travel grants, special offers and for TQG in particular promoting the university tour to secondary pupils as well as an additional attraction to the main centre exhibition.

#### ■ **Making onsite offer more attractive particularly to secondary schools**

In common with other science centres across the UK, secondary audiences are particularly challenging to engage, particularly in terms of onsite provision. A number of stakeholders, delivery staff and partners stated that TQ and TQG are perceived by some schools as focussing on provision for primary stage pupils, and that the exhibits in each of the centres were in need of more frequent updating/refresh to maintain interest, to allow for repeat

engagements and cater to a wider range of age groups. Although this issue did not emerge as clearly in the survey of schools, the follow-up qualitative interviews did identify a similar view, and in a couple of cases drew unfavourable comparisons with the nature of exhibits offered by the At Bristol science centre. In terms of appealing to a secondary audience, the ability of TQG to offer tours of the University STEM Departments, as well as their links with local industry, were felt to offer an enhanced experience for older pupils. These features may account for the increased share of TQG schools reporting impacts regarding increased interest in future STEM study and STEM careers for both primary and secondary pupils.

#### ■ **Demonstrating impact with robust evidence**

As part of the challenge in communicating the TQ and TQG offers to teachers is the ability to robustly demonstrate how their services contribute to the curriculum, and more widely to the development of enhanced positive attitudes to science, amongst their pupil groups. Currently, impact data are mainly in the form of evaluation feedback on specific programmes or in their early stages of delivery, or from customer satisfaction surveys, neither of which are systematically collected across both centres. There is scope for enhancing the mechanisms by which both centres collect impact data, which we discuss more fully in our recommendations at section 6.2 below.

#### *6.1.4 Collaborative Working Between TQ, TQG and Key Partners*

##### *TQ and TQG collaboration*

TQ and TQG have formal partnership arrangements in place as part of their Service Level Agreement, which establishes certain obligations on the part of both centres particularly in relation to branding and reputation management. Beyond this, the extent of collaborative two-way working between the two centres has been to some extent limited, and although improving there is much to be gained from greater partnership working. As an example, while both centres recently invested in redesigning their respective websites, these were carried out in parallel rather than in partnership, preventing any opportunities for economies of scale and to reinforce common branding and messaging.

More broadly, TQG recognise the importance of and welcome their role as the North East Wales hub for the All Wales Strategy, but are keen to consider ways of expanding their catchment area particularly with respect to their secondary offer. TQ is supportive of progressing discussions about the changing role and status of TQG, and as part of this are exploring the potential and implications of TQG marketing their outreach as well as onsite offer to schools more widely across Wales. However a number of important factors must be considered if the catchment for TQG's outreach provision is to be expanded:

- First, does the centre currently have sufficient numbers of staff, with the necessary skills and experience, to provide high quality outreach provision to a larger customer group? This will require detailed consideration of potential additional user numbers, the balance between onsite and outreach provision, and their distribution by phase (i.e. primary or secondary).
- Second, TQG have not met their existing onsite or outreach targets, and although outreach numbers are increasing onsite participation is more variable. While there may be many reasons for this, not least the limitations of their existing catchment, current performance may suggest that a considerable enhancement of existing resources will be required if their catchment is to be extended.
- Third, assuming a finite amount of funding is available for school provision, any re-allocation of responsibility for provision of school services will need to be matched with a re-distribution of funding between TQ and TQG. However funding is allocated for any increased TQG coverage, its basis will need to be carefully considered, especially in light of concerns expressed by some stakeholders that the funding offered for delivery under the new hub model was insufficient.

These issues aside, we consider that expanding the formal catchment of TQG should be considered if the aims of the TQ All Wales Strategy are to be achieved.

### *Wider partnership engagement*

Both TQ and TQG have a strong network of partnerships with other STEM support providers and universities, and have been successful in attracting additional funding from a range of sources including the Welsh Government's National Science Academy.

TQ have a strong track record in securing funding from industries in Wales, such as from Wales and West Utilities to fund the Gas Detective exhibits. Their role in sub-contracting primary outreach hubs has also highlighted how the bringing together of different organisations, including non-STEM specialists, can enhance the STEM offer to schools.

In the case of TQG, their close links with Glyndŵr University and local industry employers such as the Toyota UK Engine Plant were highlighted as being mutually beneficial, enhancing the TQG offer to secondary schools while also providing access to potential new students or recruits for their partners. The building of such networks in terms of securing new funding sources, and in terms of allowing for joint delivery, signals an important direction of travel for the two centres, with opportunities available to further enhance this.

### *6.1.5 The Effectiveness of the Use of the Welsh Government Grant Funding*

The Welsh Government core funding, and for TQ the funding to deliver Mathcymru, has remained stable over recent years, but is supplemented by additional in year grant funding for specific projects. Welsh Government is keen to understand the extent to which these grants are being used appropriately, economically and efficiently across both centres to support and enrich curriculum delivery. Our conclusions are set out below:

- In terms of **appropriateness** – both centres describe their school services as complementing and supporting the curriculum rather than delivering it – with the bulk of their activities being focused on primary schools. We conclude that this is an appropriate use of the core grant funding, particularly from what is known of the benefits of enhancement and enrichment provision and of engaging pupils early.

However schools, and particularly secondary schools, increasingly want STEM support that closely matches the curriculum. While the schools surveyed considered that curriculum appropriateness was a strength for both centres, we consider that this more direct support for curriculum delivery could be more clearly articulated in the objectives of the funding agreement with WG (for example through providing examples of provision aligned to specific aspects of the curriculum for the coming year).

- In terms of **efficiency** – as the TQ and TQG MI routinely reported to WG does not report the number of schools supported via core funding (only pupil numbers), it is not possible to draw reliable conclusions on the extent to which provision represents value for money. However, in the view of the vast majority of the schools surveyed TQ and TQG represented good value for money from their perspective, and there was a unanimous view that without Welsh Government funding the centres could not maintain current services nor enhance their existing offer. Similarly at the school level teachers expressed the view that they would not be able to afford TQ services without the Welsh Government subsidy. This would suggest that the WG grant is performing an important function that would be difficult to replicate from other sources.

As these two bullet points suggest, this study provides a timely opportunity for Welsh Government to revisit the aims and objectives behind the grant. Currently its broad rationale is to pay for enhancement and enrichment activities for schools in order to enthuse pupils and engage them more in science. Within this the focus has shifted over time, and Welsh Government is also increasingly keen for the grant to fund activities that are more closely linked to the curriculum.

As part of this, we have seen a number of incremental changes to MI reporting requirements for both centres. However, a number of gaps remain, namely:

- Pupil, rather than school, engagement is the main reporting variable. While school level information may be collected internally by each of the centres, it is not included in the routine quarterly monitoring reports to Welsh Government.
- The MI data does not show whether the engagements represent unique or repeat participants.
- There are differences in how TQ and TQG report on the distribution of engagements within Wales and on the number/proportion of pupils engaged in Wales vs England.
- There is limited comparable evaluative data collection across both centres: TQG routinely collects GLO satisfaction data but TQ does not.

## 6.2 Recommendations

Following on from the conclusions, we now present our recommendations for Welsh Government, Techniquest and Techniquest Glyndŵr. A number of the recommendations for the two centres apply equally to both, and therefore we present these jointly, with centre-specific recommendations presented separately.

### 6.2.1 Recommendations for Welsh Government

Our recommendations for Welsh Government are set out below.

#### *Continued grant funding for school services*

It is clear that the Welsh Government grant funding for both centres is highly valued both by the centres themselves and by the large numbers of teachers using their services. Although it has not increased in recent years, the grant income acts as steady revenue stream and is essential to the continuation of the centres' school services and broader offer.

1. We therefore recommend that **core grant funding should continue**. However, we consider that it is timely for Welsh Government to review the strategic aims and objectives for the core funding for schools, to ensure clarity in terms of what is expected from provision. While

acknowledging that the core grant plays an important role by indirectly contributing to the wider public engagement activities of both centres, we would argue that in light of increasing demands from teachers for services that directly support the delivery of the STEM curriculum, Welsh Government should more clearly define what it wishes the core grant to be used for in terms of curriculum support.

Therefore, we also recommend that Welsh Government:

2. **Review the strategic aims and objectives for the core grant to TQ and TQG** - ensuring that they are SMART (specific, measurable, achievable, realistic and time bound), and set a clear agenda and expectations which can be shared internally and externally.
3. **Stipulate that the core grant pays for education services to schools in Wales that are explicitly linked to curriculum delivery**, and which play to the respective strengths of TQ and TQG.
4. As part of any review of the objectives for core funding, WG should **revise the performance management framework for the grant**, including the monitoring variables to be reported quarterly. For consistency and comparison both centres should follow a common set of indicators, reported on a common template, to allow reporting on:
  - (i) The number of **school** engagements in Wales – by activity type, broken down by location to show the spread of engagement (i.e. by local authority);
  - (ii) The number of **pupils** receiving services – and their composition by Key Stage;
  - (iii) Data on **pupil** outcomes – in terms of immediate learning outcomes and attitudinal change, recognising the challenges this poses (see below); and
  - (iv) The number of **unique vs. repeat engagements by school** – to give a more accurate picture of the scale of coverage.
  - (v) Any revised performance management framework should show clearly **service use by schools in Wales separately from school service users from England**. While both centres

should continue to service schools from England to generate revenue, the resulting engagements should be reported separately.

- 5. Ensure that the process for establishing targets for the core funding is robust** – and while targets should be challenging to stimulate performance, they must also be realistic, achievable and based on the robust analysis of market conditions.

### *Identifying impacts*

The revised performance management measures above provide data on throughput and immediate outcomes, but say little about longer term pupil impacts. However, for a range of methodological, financial and temporal reasons identifying the impact of provision is challenging, and for the most part UK studies have focused on these short term impacts.<sup>68</sup> At the same time, expectations must be realistic over the scale of the impacts that can be expected from single, short term intervention such as a centre visit or outreach experience, where efforts to embed learning (use of post-visit materials, repeat inputs which build upon the first, etc) are crucial to maximising benefits and impacts. However, the report provided examples of coordinated approaches to impact data collection in single or across networks of science and similar centres.

- 6. Consequently we recommend that Welsh Government seeks to work with TQ, TQG and other National Science Academy partners to develop the impact evidence base.** As part of this we recommend that Welsh Government, TQ and TQG meet to establish a realistic approach to assessing the impact of their school provision. Working jointly, an annual programme of evaluation activity should be agreed, with a view to lessons being shared to inform the development of good practice. Areas to be explored could include impacts in terms of pupils choosing STEM subjects at GCSE, A level and further/higher education (through tracking studies with a sample of pupils receiving TQ/TQG

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<sup>68</sup> See Association of Science and Discovery Centre resource page - <http://sciencecentres.org.uk/reports/>

provision at different frequencies ); as well as sustained attitudinal change (such as interest in science, and perception of science as a career). The additional funding that this and other monitoring and evaluation activities will require should be considered as part of the annual core funding agreement.

7. In parallel, **consideration should be given to undertaking an annual/biannual survey of schools** to explore their use of external STEM support (from all providers), to identify frequency/patterns of use, perceived benefits/impacts and areas of unmet need.
8. Finally, Welsh Government should consider providing **specific funding for discrete studies** to contribute to the evidence base on the contribution of science centres and associated STEM provision to the take-up of STEM among secondary pupils and beyond. In combination with enhanced internal evaluation activity at each of the centres, this would help make the case more widely for Welsh Government's continued investment in science centre provision.

#### *Progressing TQ's All Wales strategy*

In terms of supporting TQ's All Wales strategy, and progressing the objective of providing services to all pupils in Wales, we recommend that Welsh Government:

9. **Facilitate discussions between the two centres about a more expanded role for TQG outreach activities as part of TQ's All Wales Strategy.** We suggest that Welsh Government become included in the discussions that are currently underway between the two centres about the potential for TQG to market their outreach and onsite services more widely.
10. **Encourage TQ to continue to explore the 'hub' model of providing outreach services to the most remote parts of Wales.** The two pilot hubs appear to have been effective in terms of outreach delivery to date, it is clear that more capacity will be required if all pupils are to be reached. Even if the TQG catchment is extended it is likely that an extension of the hub model will still be necessary, so we recommend

that as part of this TQ should be encouraged to ensure that the pilot hub programme is robustly evaluated, to provide lessons on successes and challenges to inform future service expansion.

11. Aligned to extending coverage, we recommend that **Welsh Government continues to support the development of a comprehensive and coherent approach to STEM support provision for schools across Wales** through the National Science Academy, and its key partner bodies and organisations. The continued provision of Welsh Government core funding for school services should be set in this wider context, and directed towards understood and agreed priorities to maximise its contribution to the STEM agenda in Wales.
12. The development of such a comprehensive and coherent approach would include **the facilitation of closer partnership working between the various STEM support providers operating in Wales**, building upon their individual strengths and specialisms to help provide a continuum of support through the learner pathway from primary, through secondary, to higher level STEM education and careers in STEM industries. Creating more widespread and active links with higher education providers and STEM employers, for example, would raise awareness of opportunities and help inform pupils' decision making about further STEM study and future careers.

### *6.2.2 Recommendations for Techniquest and Techniquest Glyndŵr*

Our recommendations that apply both to TQ and TQG are provided below followed by additional recommendations for each centre. These are set in the context that while TQ is performing well against its pupil engagement targets and TQG has achieved continued growth in outreach engagement numbers, for both centres, onsite numbers has been challenging particularly for secondary pupils, highlighting there is the need to consider areas for further development.

For **both centres**, we recommend that:

**13. The centres explicitly link elements of their programmes directly to curriculum delivery**, and promote them as such to the schools they engage with, to allow teachers to identify where provision can have most value.

**14. The centres take steps to increase the share of secondary pupils accessing their services on an onsite or outreach basis.** As part of this:

- (i) **Consider new approaches that will be attractive to secondary schools**, such as specific events on subject choice for secondary pupils, as well as sessions for primary pupils at key transition points (to enhance familiarity);
- (ii) **Consider investing in specific exhibits or experiences which would be of particular interest to secondary pupils** visiting the centre;
- (iii) **Organise a high-profile inter-schools STEM competition for Wales**, delivered annually in partnership with local authorities and employers, which would be attractive to secondary schools.

**15.** As part of the evaluation of the pilot hub programme at Recommendation 10, **particular attention be paid to the adequacy of the level of funding provided to the pilot hubs**, and whether this was sufficient to attract providers and ensure sustainable provision.

For both centres, more broadly:

**16.** In the context of the developments regarding the WG core grant for school services, seek to **work more closely with each other and other partners to establish combined offers to schools across Wales that reflect local and regional circumstances**, such as

engineers in the North East Wales and nuclear engineering in Anglesey.

17. Although not explored specifically in the study, the common issues raised about travel costs and for some schools the long distances required to travel suggest that there may be value in the centres exploring the feasibility of **delivering on-line sessions through ICT** as an alternative or to complement more formal out-reach provision. The use of podcasts for example would allow for the provision of more flexible 'taster' or 'bite size' sessions, that may prove more attractive to schools in terms of cost implications or at least help boost awareness of and interest in the TQ/TQG school offer. This could also allow a wider set of engagements to take place at a lower cost to the centres – notably if a 'webinar' approach is followed with multiple schools participating.
18. Notwithstanding the challenges associated with delivering to large numbers of schools, consider ways to **offer more tailored approaches to delivery particularly for outreach activities** – this is particularly valued and helps teachers to link activities more closely to their own curriculum teaching. Importantly continue to ensure that outreach provision is designed to be as inclusive as possible, to allow pupils of all abilities to participate.
19. Continue and build upon current efforts to **ensure all schools are aware of the availability of Welsh medium provision**; this is valued by schools across Wales.
20. **Continue to make efforts to engage schools with post-visit materials and potential follow-up activities**, helping to embed learning and building upon the initial enthusiasm and interest generated. As part of this, we recommend that both centres:
  - (i) Ensure that **all schools receive post-service materials** (where the school survey found their provision to be variable), and the benefits of their use emphasised;
  - (ii) Explore with small groups of school users **what might make them more likely to use the materials** (the school survey found

time to be a key issue, so how could the materials be either more firmly linked to the curriculum or capable of flexible delivery); and (iii) Explore whether **post-visit follow-up activity could include the use of ICT**– for example using PC-based video conferencing services to communicate with teachers and pupils in real time.

21. Review the vocabulary used by presenters for school sessions, particularly linked to mathematics and science, to ensure standardisation with that used in schools and in examinations.
22. Continue to take efforts to address the common barriers of accessing both onsite and outreach provision including continuing to offer subsidised travel costs and addressing the needs of schools in areas of particular deprivation. However it is recognised that onsite provision in particular is likely to continue to remain challenging while school budgets are under pressure. In addition, TQ and TQG should emphasise the benefits and impacts resulting for pupils from their activities to enable teachers to best make the case for investing in their provision.
23. Finally, we recommend that both TQ and TQG **continue with their ‘cluster booking’ approach** when delivering outreach services to more remote areas of Wales and as part of this share lessons with each other.

For **Techniquest**, specifically:

24. **Increase the involvement of STEM employers in the delivery of workshops and associated services** (such as site visits), to provide pupils with real life experiences of what careers in the STEM subjects might consist of;
25. **Include visits to Universities and colleges in their portfolio** as a means of stimulating increased interest in STEM as an area of further study, as well as illustrating the breadth of study options available;

**For Techniquet Glyndŵr** specifically:

- 26.** Take steps to **ensure performance targets for the grant are met**. As part of this review the target setting process and ensure that any future targets are stretching to stimulate performance but remain realistic in the context of available staffing resources and market size.
- 27.** **Expand further their university and industry links** to develop their secondary school offer both in terms of outreach and onsite provision;

### *Measuring impact*

As highlighted in the 2008 Techniquet Evaluation, there continues to be a clear appetite amongst funders and strategic partners for information on the benefits and impacts of TQ services. Our teacher survey suggests that teachers perceived there to be a range of impacts resulting from TQ and TQG services, data for which could be more routinely collected by both centres.

**For both centres**, and as set out in the recommendations to Welsh Government, we therefore recommend that:

- 28.** They meet with Welsh Government to **establish a realistic approach to assessing the impact of their school provision**. Working jointly, an annual programme of evaluation activity should be agreed, with a view to lessons being shared to inform the development of good practice. Areas to be explored could include impacts in terms of pupils choosing STEM subjects at GCSE, A level and further/higher education (through tracking studies with a sample of pupils receiving TQ/TQG provision at different frequencies ); as well as sustained attitudinal change (such as interest in science, and perception of science as a career). As part of this:
- (i) The approach should be underpinned by **a programme of routine evaluation data collection** on all school activities both onsite and outreach. Drawing on existing tools and approaches TQ and TQG could design a single common approach to data collection. This could take the form of a self-completion questionnaire provided to all teachers following an intervention,

featuring indicators (potentially Generic Learning Outcome measures) with specific questions on immediate and expected longer term impacts. Teachers should be actively encouraged to complete and return their forms. Where any additional funding support is offered such as to cover transport costs, the centres may wish to consider withholding this payment until a completed evaluation form has been received; and

(ii) Both centres are strongly encouraged to include: systematic data collection from a sample of **pupils** at least periodically; and a 6 month **follow up data collection** exercise with a sample of teachers to explore whether expected impacts achieved and/or sustained.

**29.** In parallel, **consideration should be given to undertaking a survey of schools using TQ/TQG services on an annual/bi-annual basis**, to focus on specific issues from a school/teacher perspective and with a view to directly informing provision and practice.

**30.** In addition, both centres should **explore any opportunities for discrete studies** that could provide specific contributions to the evidence base on the role of science centres in influencing STEM take-up among secondary pupils and beyond. In combination with enhanced internal evaluation activity at each of the centres, this would help make the case more widely for Welsh Government's continued investment in science centre provision.

### *Marketing and Promotion*

Finally, both centres, and the schools they work with, illustrated the challenge of communicating effectively with schools so they have a comprehensive understanding of the services available to them. While most schools in the survey reported receiving communications from both centres, and considered they were aware of the range of their services, there was evidence that this was not always the case.

**31.** Consequently we recommend that **both centres take a more proactive approach to recruiting both primary and secondary schools** directly and engaging more with the wider STEM and local

authority education infrastructure. As part of this, consider taking steps to promote specific services separately, such as the Mathcymru and wider mathematics offer, to ensure awareness is raised of new provision or services where substantial change has been introduced.

# ANNEXES

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## **Annex 2 Overview of Interviewees and Survey Respondents**

### **A2.1 Delivery staff interviews**

These consisted of:

- A one day site visit to both TQ and TQG consisting of a tour of the facilities and face to face interviews with a range of staff;
- Additional telephone interviews with key partner delivery organisations; and
- Follow up telephone interviews with the lead contacts from each centre.

#### *A2.1.1 Techniquest (Cardiff)*

Date of visit: 19th November 2012.

Interviewees with 5 staff members plus additional interviews with two partner organisations.

#### *A2.1.2 Techniquest Glyndŵr*

Date of visit: 21st November 2012

Interviewees with 12 staff members plus additional interviews with four partner organisations.

### **A2.2 National stakeholder interviews**

*These included:*

- 3 Welsh Government representatives.
- 4 Local Authority Advisers
- 8 wider STEM stakeholders

### **A2.3 The Teacher User Survey**

#### *A2.3.1 The Sample*

Given that this survey was with teachers that had used TQ and TQG services, it was most appropriate to collect details of schools that had engaged directly from the centres themselves. Following an opt-out process where all schools were informed of the study and given the opportunity to opt out, TQ and TQG

each provided us with contact details for schools using their services in the previous four years. Table 1.1 below shows the number of contacts for both centres by engagement type, date of last engagement and school type, and Table 1.2 the number of contacts for both centres by Local Authority.

Having fully cleaned and de-duplicated the databases provided by both centres, including removing schools using their services but based outside Wales, we had a total of 163 records available for sampling for TQG and 461 for TQ Cardiff, giving a total of 624 records from which to achieve our target of 200 interviews. This meant we would need to secure interviews with approximately 1 in 3 contacts. Teachers in schools using TQ or TQG services with the most recent experience of service use were prioritised for contact, to allow more recent recollections of delivery to be captured.

Table 1.1 Summary of Data Provided for Each Centre

	TQG		TQ	
	Count	%	Count	%
Total number of records:	163	100%	461	100%
Most recent engagement type:				
Inreach	68	42%	Na	Na
Outreach	91	56%	Na	Na
DK	4	2%	Na	Na
Engagement type (last 3 yrs):				
Inreach	Na	na	143	31%
Outreach	Na	na	87	19%
Both	Na	na	231	50%
Most recent engagement date:				
2012	146	90%	337	73%
2011	17	10%	86	19%
2010	na	na	36	8%
2009	na	na	2	0%
School type:				
Secondary	29	18%	77	17%
Primary	128	79%	372	81%

Special	4	2%	12	3%
Middle	1	1%	0	0%
College	1	1%	0	0%

Table 2.2 shows the distribution of the school contacts received by Local Authority.

Table 1.2 Summary of Data Provided for Each Centre – LA of Using School/Teacher

LA:	TQG		TQ	
	Count	%	Count	%
Conwy	21	13%	0	0%
Denbighshire	25	15%	0	0%
Flintshire	46	28%	0	0%
Powys	10	6%	15	3%
Wrexham	46	28%	1	0%
Gwynedd	9	6%	16	3%
Isle of Anglesey	6	4%	0	0%
Blaenau Gwent	0	0%	1	0%
Bridgend	0	0%	25	5%
Caerphilly	0	0%	62	13%
Cardiff	0	0%	64	14%
Carmarthenshire	0	0%	24	5%
Ceredigion	0	0%	4	1%
Merthyr Tydfil	0	0%	14	3%
Monmouthshire	0	0%	9	2%
Neath Port Talbot	0	0%	34	7%
Newport	0	0%	52	11%
Pembrokeshire	0	0%	8	2%
Rhondda Cynon Taf	0	0%	31	7%
Swansea	0	0%	40	9%
Torfaen	0	0%	26	6%
Vale of Glamorgan	0	0%	35	8%
Total number of records:	163	100%	461	100%

Having reviewed the available data it was agreed with the client that we would aim to achieve 200 teacher interviews with the following broad quotas applied:

- The number of user interviews between TQ and TQG would be 74%:26% respectively (i.e. 148 interviews vs 52);
- The inclusion of teachers/schools from each of the Welsh authorities;
- The inclusion of all service types and delivery models i.e. visits to centres, outreach provision, science and mathematics provision and CPD.
- In line with the available sample the inclusion of 80% primary and 20% secondary schools.

#### *A2.3.2 Teacher User Survey: Interviews Achieved*

All survey interviews were conducted by telephone by Beaufort Resesarch in the period: 18 February - 5 March 2013. A total of 203 interviews were achieved for the User survey – 145 (71%) from schools using TQ services and 58 (29%) from schools using TQG services. In terms of the distribution by primary and secondary:

- Overall 160 primary achieved interviews and 43 secondary (79% vs 21%)
- By centre – here the distribution between primary and secondary responses reflected reported use at the individual centre level:
  - TQ – 120 Primary vs 25 Secondary (83% vs 17%); and
  - TQG – 40 Primary and 18 Secondary (69% vs 31%)

While schools were associated with each Techniquest centre on the basis of the centre most often used, a small share of respondents (11 schools or 5%) had previously used both of the centres, comprising 10 primary and one secondary school.

## **A2.4 The 'Teacher Non-user' Survey**

### *A2.4.1 The Sample*

In addition to the sample of TQ/TQG users, a smaller sample had to be developed for the survey of 50 'non-users'. Here we were reliant on the availability of a known group of 'non-users', which was available for both TQ and TQG, although for the latter the numbers were quite small. For TQ we received in excess of 300 sets of contact details for schools that were known not to have used Techniquest services in the last four years. From TQG, we received contact details for 81 non-using schools (78 primary and 3 secondary).

Having reviewed the available data, and given that TQG were operating in a much smaller geographical area it was agreed that we would aim for a 75:25 (TQ: TQG) split for the non-user sample. This would translate into an achieved sample of 38 non-using schools from the TQ Cardiff sample and 12 non-using schools from the TQG sample. Within each of these, it was agreed that we would sample for 80:20 primary: secondary schools.

### *A2.4.2 Non-User Survey: Interviews Achieved*

Here the target of 50 interviews was achieved, with 34 (68%) non-using schools in the TQ catchment and 16 (32%) in the TQG catchment. As above, the primary and secondary school split was determined by the availability of contact details for each centre. The non-user responses by centre and school type were as follows:

- TQ - Primary 33, Secondary 1
- TQG - Primary 16, and no secondary

The split between primary and secondary non-users was 98% primary to 2% secondary – with interviews achieved with just one secondary school (the non-user survey was heavily dependent on the numbers of schools available to contact).

## A2.5 Additional follow up teacher interviews

We conducted additional follow up interviews with fifteen teachers that had participated in the survey and who had agreed to be re-contacted. These consisted of a mix of science and maths focused teachers from both primary and secondary schools including a special school. See Table A1 below.

**Table A 1 Overview of teacher respondents**

<b>School type &amp; Centre used</b>	<b>Science role</b>	<b>Maths role</b>	<b>Head teacher</b>	<b>Total</b>
Primary TQ	2	1	1	4
Primary TQG	1		2	3
Primary Both			1	1
Secondary TQ	3	1		4
Secondary TQG	2			2
Special TQ	1			1
Total	9	2	4	15

## Annex 3 Overview of Additional Grant Income for TQ and TQG

### A3.1 Techniquest

The tables below set out the funding that Techniquest has drawn in for its educational programme in 2010-11, 2011-12 and 2012-13. This does not include funding for public programmes, the exhibition or for outreach delivery. This also does not include any additional funding from the Welsh Government except through the National Science Academy (2010/2011, and 2012/2013) which is non-core grant. Welsh Government funding is presented separately in the main body of the report.

**Table A2 2010-11**

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
EU framework 7	32,352	ACCENT - environmental project
National Science Learning Centre	44,021	Teacher CPD
National Science Academy	32,000	Key Stage 2 curriculum updates
Equitable Charitable Trust	15,000	Key Stage 4 programme
Cassidian	2,596	Key Stage 4 programme
Office of National Statistics	15,291	Key Stage 5 programme
Western Power Distribution	6,685	Bright Sparks workshop
Wales and West Utilities	8,042	Gas Detectives workshop
Science Technology Facilities Council	3,750	Key Stage 3 programme
<b>Total</b>	<b>159,737</b>	

**Table A3 2011-12**

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
National Science Learning Centre	31,891	Teacher CPD
Science Technology Facilities Council	8,000	Chemistry planetarium show
Royal Astronomical Society	2,500	Mars planetarium show
Science Technology Facilities Council	4,758	Mars planetarium show
Arriva Trains Wales	2,000	Foundation Phase programme

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
Royal Academy of Engineering	11,473	Engineering ambassador project
Association of Science Discovery Centres	2,500	Sciencewise project
Ernest Cook	10,000	Foundation Phase programmes
MRC Centre (Cardiff University)	13,542	Contemporary Science Debate
Waterloo Foundation	14,000	Contemporary Science Debate
EADS	15,000	Work related experience workshop
<b>Total</b>	<b>115,664</b>	

**Table A4 2012-13**

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
Dow Corning	7,475	Foundation Phase programme
National Science Learning Centre	76,520	Teacher CPD in Wales
Sports Council	5,000	Radar gun exhibit
Rayne Foundation	9,465	Foundation Phase Programmes
Ecology Fund	1,348	Animal weekend busking activities
Wales and West Utilities	28,968	<i>Gas Detective</i> exhibits
Western Power Distribution	4,750	Summer Show
Equitable Charitable Trust	9,961	Starlab programmes
Tata Steel	12,500	Outreach Kits
Admiral	4,911	Summer theme
Biochemical Society	500	Summer theme busking activities
Wellcome Trust	17,071	Keyhole Surgery exhibit
National Science Academy	41,542	Re-development of RTH programmes
Wrap Cymru	31,040	Recycling exhibits and recycling bins
EADS	10,000	Lightning Strike exhibit
IET	5,000	<i>Eye in the Sky</i> copy
Thomas Howell Education Fund	3,000	<i>Eye in the Sky</i> copy
Millennium Stadium Charitable Trust	7,463	<i>Aftershock</i> copy and delivery

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
IET	1,013	RTH delivery
GE Healthcare	3,189	RTH delivery
People's Postcode	6,974	RTH delivery
Waterloo Foundation	570	<i>Size of Wales</i> workshop delivery
Wales and West Utilities	2,000	Community Roadshow in Valleys locations
IOP	1,000	Community Roadshow
Exonmobil	1,000	Schools' onsite support
EADS	1,000	Community Roadshow
HSBC	5,000	Community event
Admiral	3,177	Tickets for disadvantaged children
Awards for All	4,000	Community open weekend
Size of Wales delivery	5,576	Delivery of workshop in non-RTH areas, delivered by Careers Wales
<b>Total</b>	<b>311,012</b>	

### **A3.2 Techniquest Glyndŵr**

The tables below set out the funding that TQG has drawn in for its educational programme and does not include any additional funding from the Welsh Government except through the National Science Academy which is non-core grant. Welsh Government funding is presented separately in the main body of the report.

**Table A5 2010-11**

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
IoP 1 (Jul 10)	694	Development of 'Bright Sparks from History' for Wrexham Science Festival.
IoP 2 (Jan 11)	1,000	Purchase of equipment and delivery of 'StarDome' at the Odeon Wrexham
<b>TOTAL</b>	<b>1,694</b>	

**Table A6 2011-12**

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
NSA	216,387	Programme Development, refurbishment, equipment, delivery and associated costs.
Arts	3000	She Inspired art competition relating to women in STEM
ASDC-STFC (10/12-12/12)	1500	Development and delivery of 'Wales in Space' dome show
RAEng	15,223	Flight Competition
ASDC-STFC	1,500	Stargazing - delivery at Alyn Waters and Llay Legion
<b>TOTAL</b>	<b>237,610</b>	

**Table A7 2012-13**

<b>Funder</b>	<b>Amount (£)</b>	<b>Programme</b>
RAEng (05/12-02/13)	18,623	Bridge Building Competition
NSA (04/12-09/12)	25,712	Continued development of KS4/5 activities
IoP 3 (06/12-12/12)	1,000	Stargazing - delivery in Communities First areas
RSC (10/12-12/12)	550	Chemistry quiz night for 6th Formers
<b>TOTAL</b>	<b>45,885</b>	

## **Annex 4 Techniquet School Activity Examples**

### **A4.1 Foundation**

#### Interactive Shows

- Music Makers: Reception, Yrs 1 & 2
- Saving Seasons: Reception, Yrs 1 & 2
- Party Maths: Yrs 1 & 2
- Toy Trouble: Yrs 1 & 2
- Body Bother: Yrs 1 & 2
- Materials Mystery: Yrs 1 & 2
- Night Lights: Reception, Yrs 1 & 2

#### Starlab

- Alien Adventure: Reception, Yr 2.

### **A4.2 Key Stage 2**

#### Challenge Workshops

- Mars Mission Madness: Yrs 3 – 6
- Bridge Builder: Yrs 3 – 6
- Crime Scene Detectives: Yrs 3 – 6
- Solar Power: Yrs 3 – 6
- Wind Power: Yrs 3 – 6
- Gas Detectives: Yrs 3 – 6
- Bright Sparks: Yrs 3 – 6
- Sound Sensation: Yrs 3 – 6
- Body Inside Out: Yrs 3 – 6

#### Shows

- Maths on the Menu: Yrs 3 & 4
- Maths Detective: Yrs 5 & 6
- Science Explorers: Yrs 3 – 6
- Materials Magic: Yrs 3 – 6
- Exploring Forces: Yrs 3 – 6
- Light Fantastic: Yrs 3 – 6

#### Starlab

- Voyage through the solar system: Yrs 3 – 6

### Kits

- Maths Kit 1 & 2: Yrs 3 – 6
- Forces Kit: Yrs 3 – 6
- Materials Kit: Yrs 3 – 6
- Light & Sound Kit: Yrs 3 – 6

## **A4.3 Secondary**

### Starlab

- Voyage through the solar system: Year 7

### KS3 Workshop

- Backstage Challenge: Yrs 7 – 9
- Theme Park Challenge: Yrs 7 – 9
- Making Tracks: Yrs 7 – 9
- Wheel Extreme: Yrs 7 – 9

### KS4 Workshop

- Eye in the Sky: Yrs 10 –11
- Aftershock: Yrs 10 –11
- Construct!: Yrs 10 –11
- Club Challenge: Yrs 10 –11

### Contemporary Science Debate

- ADHD: Myth and Reality: Post 16
- The Size of Wales: Post 16
- Digital Identity Crisis: Post 16

## **A4.4 Examples of projects that deliver support beyond science and maths as part of wider STEM agenda**

- A programme of work-related experience workshops were developed as part of RTH for KS4 which introduced STEM careers such as engineering. One such workshop for example is “Aftershock” which sets out a scenario of the local town suffering an earthquake. The pupils have to identify professions that would be directly or indirectly involved in the rescue operation.

- A series of post-16 workshops as part of RTH to explore social and ethical issues resulting from the advancement of STEM such as the size of Wales, digital inclusion and ADHD workshops.<sup>69</sup>

#### **A4.5 Mathcymru**

- The Maths 1 Kit Programme: A set of 11 table top exhibits that allows teacher led experimentation with numbers, shape, space, measurements and handling data through challenging maths-based games and puzzles. The kit comprises 21 puzzles, including 3D Noughts and Crosses, Dominoes, Pythagoras Puzzle, Reach the Goal and Towers of Brahma. Suitable for pupils at Key Stage 2.
- The Party Maths Workshop Programme: A workshop providing pupils with opportunities to handle data and to experiment with numbers, shape, space and measurement. Suitable for pupils at Foundation Phase.
- The Maths Detective Show Programme: In this workshop pupils use graphs, solve number sequences, measure and use mathematical information to calculate, interpret and present findings in order to solve a crime. Suitable for pupils at Key Stage 2 (Yrs. 5-6).<sup>70</sup>

#### **A4.6 CPD**

The programme includes:

- Course 1: Learning Skills for Science – Secondary. This includes ‘Literacy in Science’- a two day course that focuses on examination preparation as well as controlled assessments, including scientific reading, scientific writing and data representation, scientific writing and knowledge presentation, and;
- Course 2: Teaching the Tricky Bits – Primary. A three day course that covers ways to teach science skills and topics such as different kinds of forces, the Earth and other planets and the forming of materials.

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<sup>69</sup> Information provided by TQ as part of November site visit.

<sup>70</sup> Information provided by TQ in March 2013.

Teachers are provided with activities to take back to the classroom. Participants have an opportunity to plan and carry out science activities with their class and to work with other non-specialist science teachers.

## Annex 5 Techniquet Glyndŵr School Activity Examples

### A5.1 Onsite

#### TQG's Onsite Education Programme

Education Stage	Activity Type
Foundation Phase & Key Stage 1	Toddler Days, Shows, Workshops, and LEGO® WeDo. Example: Minibeasts & Microscopes, Science show: (In centre & outreach) It explores what lives at the bottom of your garden and introduced pupils to bugs and bug-life. Basic classification and investigative skills are developed in this show.
Key Stage 2	Shows, Workshops, Techniquet Kits, LEGO® WeDo and MINDSTORMS® Example: Mars Mission Madness, Workshop: (in centre & outreach ). Pupils investigate the properties of materials relating to their uses, the science behind every-day objects and the way they are constructed and work, and the different kinds of forces involved.
Key Stage 3	Shows, Workshops, Debates, Techniquet Kits, LEGO® WeDo, Industry Visits, Stem days and More Able and Talented Days. Example: Mathamagic, Science show: (In centre & outreach) This explores practical mathematics and contains a large number of activities that explore the curriculum areas of number, shape, space and measurement. A complementary presentation in the Science Theatre provides an extra mathematical experience.
Key Stage 4 & 5	Industry linked workshops, Debates, Advanced LEGO® MINDSTORMS®, Stem days, Projects and Work Experience Example: C.S.I. – The Lab, Workshop Key Stage 4 ( In centre & outreach) The evidence has been gathered, but who committed the crime? Pupils can hone their lab skills and undertake a series of forensic tests in order to track down the killer. Example: Discuss DNA, Debate: Key Stage 5 (In centre & outreach). This presenter-led debate encourages debate about the social and ethical issues surrounding the National DNA Database. The resource helps students to recognise that scientific developments have an effect on the society in which they live. Topics include: DNA profiling; Forensic science; Gene ownership; and Developments in genetic technology and their impact on society.
Teachers	Industry visits, CPD, Curriculum Support Materials and Pre-visit tours.

Source: TQG (2012) *Inspiring, Challenging and Engaging*

Other examples include:

- Programmes delivered with funding from the Ingenious Grant – a Royal Academy of Engineering grant scheme – currently using this to

run a project “Bridging the Gap.” The focus of the project is to engage students with civil engineering by designing and a building a prototype bridge to cross the Mersey River.

- The LEGO® Education Innovation Studio which involves kit and workshops on robotics. (funded by National Science Academy). For example, LEGO® WeDo which includes a range of activities for all stages up to KS3. E.g. The Dancing Birds, Key Stage 1 – Years 1 & 2. During this hands-on workshop the children use LEGO® to build two birds then discover how to program them to dance. Working in teams, the children follow visual instructions to build their dancing birds and begin to recognise how each part of their design works. Using investigation skills the children can then find out how to make the birds spin in different ways by changing the position of the belt around the two pulleys. Also MINDSTORMS® includes a range of activities for key stages 3-5, e.g. “Gears and Performance”, Key Stage 4. This is a hands-on introduction to the engineering behind car design. This workshop demonstrates the evolution of car design, and allows pupils to conduct their own practical experiments with gear ratios and “Robot Inventor” Key Stage 3, 4 & 5. This workshop asks students to construct a robot and find a real world application for it, which must be presented in the form of a pitch (including a demonstration of the robot pre-programmed to undertake the desired task). The workshop builds upon construction and computer programming skills and encourages students to think enterprisingly, be creative, and consider the numerous existing and future applications of robotics technology.<sup>71</sup>

## **A5.2 Outreach**

- The Post Office, Workshop: Foundation Phase/Key Stage 1 (In centre & outreach) This involves pupils becoming a Post Office apprentice for the duration of the workshop. Curriculum links include Number,

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<sup>71</sup> These are all described in detail in their report *Inspiring, Challenging and Engaging*. 2012

Measures and Money, Shape, Position and Movement, Handling Data, and Places and People.

- StarDome Planetarium Dome show: Key Stage 2, (Outreach only). An inflatable dome experience, with interactive 360° audio visual presentations. Each show is tailored to the ages and abilities of your pupils. Shows last about 30-45 minutes including time for questions and discussion.
- Journey into the Cell Dome show: Key Stage 3 and 4, (Outreach only). This interactive inflatable dome show which gives pupils a micro view on a macro scale. Animal and plant cells and their organelles are presented, including an introduction to specialised cells, their functions and interrelations.
- Exploring the Atom, Dome show: Key Stage 4 (Outreach only). This allows pupils to take a journey to the centre of the atom in a fully immersive inflatable dome show. They look at how scientists use existing theories and models to expand their understanding of how the world works and find out how the smallest particles of matter can help us to understand the largest parts of the universe.
- Nuclear Power, Debate: Key Stage 5 (In centre & outreach) This presenter-led debate encourages debate about the merits and impact of nuclear power. Pupils discuss if and how we should use nuclear power as a source of energy in the future.
- Finally, TQG has worked with Glyndŵr University's Department for Creative Designs, to engage in schools in deprived areas helping "to raise aspirations". They visited seven schools across three counties (Denbighshire, Flintshire and Wrexham) over a nine month period and delivered workshops on programming through a combination of academic staff and TQG Presenters. They visited each school twice: an introductory session and a follow-up. The GU interviewee felt that it was a "*good partnership between the University and TQG*" – the University provided the expertise and TQG the Lego kit, the school and industry contacts.