London Schools Excellence Fund

Final report

Enhancing the teaching of STEM through Design and Technology (Mindsets STEM Enhancement Project)

Design & Technology Association

Project Oracle: Level 2
Report Submission Deadline: Round 2 - 30 September 2015
Report Submission: Final Report to the GLA

Project Name: Enhancing the teaching of STEM through Design and Technology (Mindsets STEM Enhancement Project)
Lead Delivery Organisation: The Design and Technology Association
London Schools Excellence Fund Reference: LSEFR1210
Author of the Self-Evaluation: Andy Mitchell
Total LSEF grant funding for project: £499,994
Total Lifetime cost of the project (inc. match funding): £693,501
Actual Project Start Date: January 2014
Actual Project End Date: September 2015

1. Executive Summary

This should be a brief summary of what information is included in the report, the evaluation methods and analysis used and a summary of the key findings from your project evaluation. (maximum 500 words)

The rationale for the 'STEM into Action with Design and Technology' project was based on participation and engagement of schools and teachers, through specifically designed resources, to enhance pupil learning. The resources were intended to provide new projects, or to complement existing ones, which made explicit links between Design and Technology and Science, Engineering and Mathematics. Led by 4 project officers, the schools initially involved were 4 exemplar schools, each supporting up to 5 main schools. These schools formed the nucleus of a network, driven by twilight Continuing Professional Development (CPD) sessions, to share practice and to support up to 80 main schools. Schools were free to select their own resource packs from the funding provided. Schools were expected to share their work as showcase examples on the 'STEM into Action with D&T' website.

Evidence was gathered from teacher and pupil questionnaires, feedback from twilight sessions, and work showcased on the website. Teachers were invited to complete questionnaires before and after project delivery. They were designed to measure change in confidence by asking respondents to self-report on their confidence in teaching 25 technology competences. The pupil questionnaire was based on an Intrinsic Motivation Inventory of 18 statements. These were designed to measure before and after project delivery, changes in interest and enjoyment in D&T, and competence. Twilight session feedback questionnaires were designed to indicate sufficiency of satisfaction with communication, venue, presentation and content, and networking. Work showcased on the website was scrutinised to identify the level to which schools had enhanced curriculum provision. Areas analysed were: use of resources through the nature of activity delivery; integration of STEM in D&T and impact of twilight CPD.

The evaluation of the project demonstrated the following key findings:

- The starting and end points of teacher confidence were significantly raised. Teacher confidence in delivering STEM projects within D&T increased. They implemented new projects and teaching styles.

- There was no significant change in pupil motivation and interest towards D&T as a consequence of the STEM into action resources observed. Their enjoyment in the subject remained the same; activity in D&T is typically popular anyway. There was a significant change in pupil perceived competence as a result of the D&T activities. Their understanding increased and the level of interest and motivation was maintained whilst using the resources.

- Fewer teachers attended twilight sessions than anticipated and planned for. However, those who did attend were highly satisfied and as a consequence were well prepared to incorporate the use of the resources in their teaching. They especially valued sessions which involved practical 'hands-on' activity.

- Persuading schools to showcase their work on the website proved more challenging than anticipated. However those who did showed imaginative approaches to project delivery to enhance curriculum provision.

- The showcased project work demonstrated schools made less explicit links, (as distinct from those implied by the resources) between STEM subjects than predicted.

Exemplary practice was evident in those schools whose teachers attended twilight sessions, completed feedback and showcased their work. Unfortunately, few schools showed this level of participation and engagement. However a significant number did engage with some aspect to the project's rationale. There is good evidence to show that schools' D&T curriculums have been enhanced as a consequence of the project but need further support to maximise the benefits of the concept of STEM through the use of the resources.

After completion of the evaluation, the following recommendations for future delivery and continuation of the projects are:

- Establish and sustain networks to support schools during a project's lifetime and beyond;
- Further develop the resources, taking into account the experience gained from trialling in schools to ensure that they will raise pupil motivation;
- Consider timing and nature of CPD to meet needs identified by participants to maximise subsequent attendance, engagements and effectiveness;
- Ensure the expectations, benefits and commitments together with detailed potential outcomes are fully understood by participating schools.

2. Project Description

This project was developed in recognition of the need to modernise the teaching and learning in Design and Technology (D&T), and it supported the development of a modern STEM related curriculum.

Through design and technology activity, the project introduced pupils to key concepts explored in maths, science and computer science, drawing these together and adding to them by encouraging pupils to engage in 'real world', meaningful activities. These utilised a unique range of 'high tech' materials and consumables that enhanced and/or will replace existing curriculum materials.

The project's approach supported the teaching and learning of the new National Curriculum programmes of study, providing stimulating activities and resources that in particular addressed the technical knowledge requirements. The project developed and:

- made available a range of resources and associated CPD to address teachers' knowledge and experience gaps whilst at the same time enhancing skill levels and helping develop confidence;
- created a network of centres of excellence able to provide training for local schools using peer-to-peer methods;
- ensured that STEM teaching keeps abreast of emerging technological developments;
- demonstrated that D&T can, and does underpin the delivery of STEM in the classroom;
- motivated pupils to explore STEM concepts more readily through a range of engaging activities and projects that are 'real world' and relevant;
- encouraged more pupils to consider future qualifications and careers that use STEM concepts in an applied context.

This programme:

- enabled students to engage in modern, 'high tech' STEM activity by helping them learn about, explore and better understand contemporary ideas and technologies through investigation and designing and making, using the same resources found in real world STEM contexts;
- provided each participating school with funding to purchase high-technology, low-cost physical resources that will enable students to create, for example, programmable robotic devices;
- improved teachers' subject knowledge and confidence in making STEM cross-curricular links in the design & technology classroom.

The programme was delivered in two phases. In the first phase, 4 schools (Exemplar Schools) who each worked with up to 5 linked schools (Initial Pilot Schools) were recruited to input into the programme design and to pilot a selection of resources. These schools benefitted from face to face support from project officers. In the second phase, the programme was rolled out to 80 schools supported by online learning, face to face training, networking opportunities and the use of social media.

The project was made available to all London secondary schools, and was aimed principally at secondary D&T teachers and Key Stage 3 pupils in state funded schools. The positioning of the 4 exemplar and 20 initial pilot schools ensured that the twilight training available to the main schools was widely accessible to maximise opportunities for these schools to engage with twilight CPD sessions.

Participating schools received funding which enabled them to select and trial new activities from a range of high technology but low cost physical resources developed by Mindset. The main 80 schools also received Crumble kits, an easy to use programmable controller, to enable them to address some of the technical knowledge aspects of the National Curriculum D&T Programmes of Study.

The programme was supported by experienced D&T staff, four of whom were London based to ensure the effective co-ordination, management and delivery of the programme. The 4 exemplar schools provided a peer-to-peer learning network that in the first instance supported the initial pilot schools within their cluster. Together these first phase schools provided support for the main cohort of schools. All CPD provided was supported by the project officers.

There is now a vibrant network of teachers who intend to continue to meet and share ideas and support activity within their schools.

2.1 Does your project support transition to the new national curriculum? Yes

If **Yes**, what does it address?

100 physical resources have been developed, 57 of which are available as downloadable teaching activities on the STEM into Action with D&T website, www.stemintoactionwithdandt,org.uk, a closed website for participating schools.

All of the resources are relevant to inform teaching and learning in D&T and suggest links with other STEM subjects. They have been reviewed by subject experts, and linked to relevant aspects of the science and mathematics Programmes of Study to enhance and reinforce learning through the activities.

The Crumble has been made available to the 80 main schools. The Crumble is a micro controller, which is programmed using simple, free software which is easily accessible to non-electronics specialists, but offers unlimited potential for advanced users. The Crumble helps teachers to address the area of Programmable Components which is now an explicit element of the Design and Technology Programme of Study.

2.2 Please list any materials produced and/or web links and state where the materials can be found.

The material produced for the website includes:

- 57 downloadable activities
- Supporting video material
- Detailed links to science and maths
- Showcase material provided by the participating schools

The website is currently operating as a closed site, and available to participating schools only. A username and password can be provided.

3. Theory of Change and Evaluation Methodology

The validated Theory of Change and Evaluation Framework are provided as Appendices 1 and 2.

3.1 Please list **all** outcomes from your evaluation framework in Table 1. If you have made any changes to your intended outcomes after your Theory of Change was validated please include revised outcomes and the reason for change.

Table 1- Outcomes

Description	Original Target Outcomes	Revised Target Outcomes	Reason for change
Teacher Outcome 1 D&T KS3 activity was modernised to support STEM teaching and learning	Nature of some of the pupil's activities is different to that which was typical before.		
Teacher Outcome 2 D&T teachers' subject knowledge was enhanced as a direct consequence of engaging with the programme	Teachers worked confidently with new activities and resources that require a level of technical knowledge frequently lacking		
Teacher Outcome 3 D&T teachers engaged with teachers from other	Cross curricular planning has taken place between subject teachers. Teachers aware of	Changed from wider outcome 1	On reflection, it is a teacher outcome

STEM disciplines in their own schools	content of other subjects NC Programmes of Study and school schemes of work.		
Teacher Outcome 4 Teachers developed a better understanding of the connection between STEM subjects and D&T's contribution. They were able to raise profile of D&T within their school	Teaching and learning in D&T includes references to other STEM subject knowledge	Changed from wider outcome 2	On reflection, it is a teacher outcome
Pupil outcome 1 Students' understanding of STEM and the links between different STEM subjects increased	Pupils link learning in other subjects to tasks they complete in D&T that contextualise for example maths or science knowledge and skills.		
Pupil outcome 2 Pupils' attitudes towards D&T were enhanced and they demonstrated increased motivation in D&T lessons	Pupils demonstrate increased enjoyment of designing and making in response to the replacement challenges being set.		
Wider system outcome 1 The peer to peer support network extended beyond the life of the programme	Teachers engaging with one another and exchanging experiences and ideas		
Wider system outcome 2 The resources and activities were and continue to be valued by the D&T community. As a consequence they included them within their SoW and replaced existing resources/activities	Change in the proportion of Mindsets high tech physical resources being consumed by London schools		

3.2 Did you make any changes to your project's activities after your Theory of Change was validated?

No

3.3 Did you change your curriculum subject/s focus or key stage?

No

3.4 Did you evaluate your project in the way you had originally planned to, as reflected in your validated evaluation plan?

There has been a delay in developing the resource pack for Initial Teacher Education (ITE) and Teaching Schools so there is no evidence on evaluation at the time of writing this report.

To date: A meeting has been held with representatives of ITE to explore and plan how best the resources created for schools can be used to create a resource pack for Teaching Schools and other providers of ITE working with students undertaking D&T ITE courses. Six bespoke resources have now been created by expert D&T teacher educators that explore the use of the STEM materials, making links to academic texts, appropriate pedagogy and research. These are currently being evaluated by four Teaching Schools before being made more widely available via the D&T Association website during the latter part of the autumn term.

4. Evaluation Methodological Limitations

4.1 What are the main methodological limitations, if any, of your evaluation?

No comparison group was used for this study. Instead the study followed a Quasi-experimental design (Wilson, 2009), whereby the measurement instruments were administered to the participants before and after the intervention. A large sample was selected to provide statistical inference between the two measures.

To determine the sample size necessary for this study, a power calculation was undertaken. Population data for the total number of state funded secondary schools was available from the Department for Education (2015) (N = 479). The sample size required was calculated as 59 (confidence interval 10% at 90% confidence level). The sample size for the study was 61 schools and was suitable at 90% confidence level.

Both the project and research activities suffered from very high rates of attrition. Only 9 schools, out of the original target sample of 104, completed all the activities required of them as part of receiving financial support. Even discounting the complications of taking part in the research and providing evidence of lessons, from the sample of 61 main schools who signed up to the project only 50 of these schools actually purchased any resources without intervention by the Design and Technology Association, despite having £200 credit to spend. The details of the number of participants in each data collection method are presented alongside the relevant data in Section 8.

Self report questionnaires were utilised in the assessment of the twilight sessions, teacher and pupil activities in schools. Issues with self report methods are:

- Participants write what they think is socially the correct answer to sensitive information;

- 50 to 80 percent of method variance may be produced by sources other than the intended;
- Participants try to maintain consistency with their answers, which produces relationships;
- Participants respond with their own implicit theories;
- The mood of the participant at the time of completing the questionnaire. (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Spector, 2011)

Throughout the project emphasis was placed on teachers contributing to the collection of evaluation data, from baseline information, through to the completion of showcase materials for the website. Additional data collected on an informal basis was provided by Project Officers and schools.

It was recognised from the start of the project that gathering generic pupil data for those engaged in the project, as requested in Tables 6 – 8, would not be possible. The different ways that schools divide up year groups into teaching groups varies considerably. A common approach involves a carousel system resulting in pupils rotating through different specialisms taught by different teachers. Rotations can be as frequent as six weeks. Given the difficulty in gathering basic data from the teachers it was recognised that they would not be willing/able to provide this level of detail for all of the pupils they worked with throughout the project.

4.2 Are you planning to continue with the project, once this round of funding finishes?

Yes. There are elements of this project which we have plans to develop further; in particular; some aspects of the resources and the development of a self supporting school network.

Resources Development
There were 100 physical resources available for the teachers to purchase and trial within their schools; referenced in the 52 downloadable teaching activities. Each of these activities has the potential to be extended and further developed. The intention is to create a series of teaching and learning resources making intrinsic links to science and mathematics providing clear guidance for teachers in how to extend the activities. These will continue to be made available to participating London schools on the bespoke website, and be made more widely available from the D&T Association website.

In addition the ITE pack we have developed will be promoted widely to ITE providers and teaching schools. The opportunity to develop and add to this material will continue.

School Network
103 schools have been engaged in the project with varying degrees of commitment. Whilst the uptake of the CPD available for main schools was disappointing, those who did attend these meetings found them to be a positive and worthwhile experience:

Over 75% of attendees rated the meetings including session content and opportunities to network at excellent or good.

Sample of teacher feedback:
"Enjoyed seeing and hearing about how other teachers have used the resources and developed them for their own schools/departments." Teacher, School 40
"Session was very interactive and informative." Teacher, School 1
"Always great to meet other colleagues and share ideas and network." Teacher, School 42
"Very useful, lots of ideas to take away." Teacher, School 87
"Superb project ideas and timing of project ideas." Teacher, School 47

If **yes**, will you (and how will you) evaluate impact going forward?

Resources
The D&T Association will monitor the uptake of the resources as they are made more widely available. With all our resources, we regularly receive feedback from schools that have used them. This can include reports and images provided of pupils outcomes. From January 2016, we will also be able to identify how the resources have been used to effect change and influence the development of D&T practice in schools through the soon to be published D&T Self Review Framework. The on-line Self Review Framework is being made available to D&T Association member schools and enables them to review, respond and upload evidence to record teaching and learning activity in their schools. The framework is divided into three domains, one of which is curriculum. Having reviewed their provision, schools are encouraged to engage with appropriate resources according to their individual needs and then upload evidence of activity in a similar way to using the STEM into Action with D&T website. The STEM resources produced through this project will be referenced within the framework.

School Network
We will continue to use D&T Association branch meetings to bring together teachers from participating schools that will be invited to present what they have done at these twilight events and complete evaluations.

5. Project Costs and Funding

Table 2 - Project Income

	Original[1] Budget	Additional Funding	Revised Budget [Original + any Additional Funding]	Actual Spend	Variance [Revised budget – Actual]
Total LSEF Funding	499,994	0	499,994	441,494	58,500
Other Public Funding					
Other Private Funding	193,507				
In-kind support (e.g. by schools)	4,800				
Total Project Funding	£698,301				

List details in-kind support below and estimate value.

The D&T Association provided additional support worth £118,500 which contributed towards:
- *Additional staffing costs and overheads throughout the project; Project Director, Administrator, Web/Publications Project Officer*
- *Access to equipment including computers, printers and photocopiers*
- *Venues for meetings*

Mindsets provided additional support worth £75,000 which contributed towards:
- *Resource development, including video support material*

[1] Please refer to the budget in your grant agreement

In-kind support

- *School support – the equivalent of £1200 per exemplar school for teacher time to develop resource and set up training.*

Table 3 - Project Expenditure (excluding in kind support)

	Original Budget	Additional Funding	Revised Budget [Original + any Additional Funding]	Actual Spend	Variance Revised budget – Actual]
Direct Staff Costs (salaries/on costs)	120698			120,698	
Direct delivery costs: Consultants: - Project Officers - Online CPD resource development; - Science and Maths Links - ITE resource pack	59400			54,400	5,000
Management and Administration Costs	34766			34,766	
Training Costs - Training Events	14130			14,130	
Participant Costs (e.g. Expenses for travelling to venues, etc.)	0				
Publicity and Marketing Costs	8000			8,000	
Teacher Supply / Cover Costs	13600			3,600	10,000
Other Participant Costs - Consumables	38400			31,200	7,200
Evaluation Costs	10000			10,000	
Programme Design Costs Teaching and Learning Resources, including programme design, content research, web design, print and design costs, video content costs, design of CPD materials, face-to-face and online web learning resources – Phase 1	135250			135,250	
Teaching and Learning Resources, including programme design, content research, web design, print and design	65750			29,450	36,300

costs, video content costs, design of CPD materials, face-to-face and online web learning resources – Phase 2					
Total Costs	£499,994			441,494	58,500

5.2 Please provide a commentary on Project Expenditure

The expenditure is broadly in line with the original approved budget. It was anticipated from the outset that a large percentage of the budget would be spent on programme design, including the development of the activities and the on-line mechanisms to support teachers. The website which provides access to the activities and supporting resources will remain freely available to the participating London Schools following the end of the project.

The resources which are being developed both for teachers and ITE providers will be made widely available, meaning that the reach of this programme will extend beyond the 103 schools engaged in the project.

In kind support, in particular from Mindsets has enabled us to work with a wide range of activities which support high tech activity in the classroom which they have previously sourced and developed.

Table 3 shows an under spend of £58,500.

- **Teacher Supply Cover Costs**
  Whilst all participating schools were invited to claim £100 towards supply cover costs for attending twilight training sessions, only a very small proportion of the schools did.
- **Consumables**
  Despite recruiting a total of 103 schools for the project, a number of schools withdrew from the programme. Reasons for this are outlined in Section 11. In addition, not all of the participating schools claimed all of the funding available for the resources.
- **Programme Design**
  Delays in schools trialling materials, has resulted in delays in some of the resource development which has impacted on the budget.

6. Project Outputs

Table 4 – Outputs

Description	Original Target Outputs	Revised Target Outputs *[Original + any Additional Funding/GLA agreed reduction]*	Actual Outputs	Variance [Revised Target - Actual]
No. of schools	104	104	82	22
No. of teachers	No data (nd)			
No. of pupils	nd			
No. teaching and learning resources	100			
CPD: Exemplar School inducted into programme and introduced to the project	2			
CPD: Initial Pilot Schools introduced to the programme	1		4	
CPD: Cluster meetings for main schools introducing them to the programme	1		6	
Programme of face-to-face twilight sessions was delivered: broken down as below:	60	56	52	4
No. CPD sessions for each exemplar school	4 sessions per school delivered by Project Officers	No Change		
No. CPD sessions for each initial pilot school	5 sessions per school	4 sessions with Exemplar school; 1 session with main schools	15 Supplemented by individual visits to schools by Project Officers	9
No. CPD sessions	1 session per school	2 sessions per school	16 of 61 schools (26%)	45

attendance for each main school			2 of 4 exemplar schools (50%) 6 of 17 initial pilot schools (35%)	
Schools to upload showcase example projects	1 example per school	No Change	20 of 82 schools (24%)	62
Centres of excellence established	4 centres of excellence led by Exemplar Schools, supported by further 20 initial pilot schools at the end of phase 1	No Change	4 Exemplar Schools, 17 initial pilot schools	3
A peer to peer network for school support established	Peer to peer network created and utilised	No Change	nd	
A resource pack for Initial Teacher and Teaching Schools created				

Reasons for non attendance at twilight events – Initial Pilot and Main Schools

Attendance at twilight sessions did not reach the numbers anticipated. This reflects our experience of providing other CPD programmes in the recent past. Schools were unable to attend twilights for a variety of reasons as outlined below. In response to this, Project Officers time was redirected. They made contact with schools and provided alternative support through additional visits and by phone and email.

Clashed with a school event	2
GSCE deadline	3
Urgent school issue – staffing, supply cover	4
Personal issue – transport issues, family illness, family commitments, illness	6
Too far to travel	1

7. Key Beneficiary Data

7.1 Teacher Sub-Groups (teachers directly benefitting counted once during the project)

Table 5 – Teachers benefitting from the programme

School No.	**No. teachers**	**% NQTs)**	**% Teaching 2 – 3 yrs *(in their 2nd and 3rd years of teaching when they became involved)***	**% Teaching 4 yrs + (over 4yrs when they became involved)**	**% Primary (KS1 & 2)**	**% Secondary (KS3 - 5)**
103	130					100%

Not all of the schools involved provided base line data. However a summary of those who did is provided below:

42% of schools provided baseline data

Of these schools:

19% had NQTs involved in the programme
30% had teachers with 2 – 3 years of experience involved in the programme
78% had teachers with over 4 years of experience involved in the programme

On average, these schools had 1.9% of teachers in the department involved in the programme; with one school having a team of 5 teachers involved. In 2% (3) schools, the programme was run by an NQT; in 27% (12) schools the programme was run by teachers with 2 – 3 years experience; and in 53% (23) schools the programme was run by teachers with 4 years of more of experience. The remainder of schools had a cross section of teachers involved in the project.

7.1.2 Please provide written commentary on teacher sub-groups e.g. how this compares to the wider school context or benchmark *(maximum 250 words)*

We do not have data relating to teacher sub-groups

7.2 Pupil Sub-Groups (these should be pupils who directly benefit from teachers trained)

Tables 6-8 – Pupil Sub-Groups benefitting from the programme

Individual data is not available for the pupils participating within the project. It was discussed and agreed with GLA that because of the structure of D&T within school it would be too onerous a task for teachers to provide specific pupil data. Appendix 3 attached shows the whole school information that provides a picture of the overall structure of the school. It has not been possible to provide a breakdown of the ethnicity of each individual school.

School No.	No. Pupils	% LAC	% FSM	% FSM last 6 yrs	% EAL	% SEN
See Appendix 3						

School No.	%. Male pupils	%. Female pupils	No. KS4 pupils	% Lower attaining	% Middle attaining	% Higher attaining
See Appendix 3						

Data not available

	% Asian Indian	% Asian Pakistani	% Asian Bangladeshi	% Asian Any Other background	% Black Caribbean	% Black African	% Black Any Other Background	% Mixed White & Black Caribbean	% Mixed White & Black African	% Mixed White & Asian	% Mixed Any Other Background	% Chinese	% Any other ethnic group
Project Total													
School 1													
School 2													
School 3													
School 4													

	% White British	% White Irish	% White Traveller of Irish heritage	% White Gypsy/Roma	% White Any Other Background
Project Total					
School 1					
School 2					
School 3					
School 4					

7.2.1 Please provide a written commentary on your pupil data e.g. a comparison between the targeted groups and school level data, borough average and London average *(maximum 500 words)*

Following discussion with GLA, it was agreed that in light of the large number of schools worked with, the number of boroughs involved and the pupil data available through the programme that it was not necessary to complete this section.

8. Project Impact

8.1 Teacher Outcomes

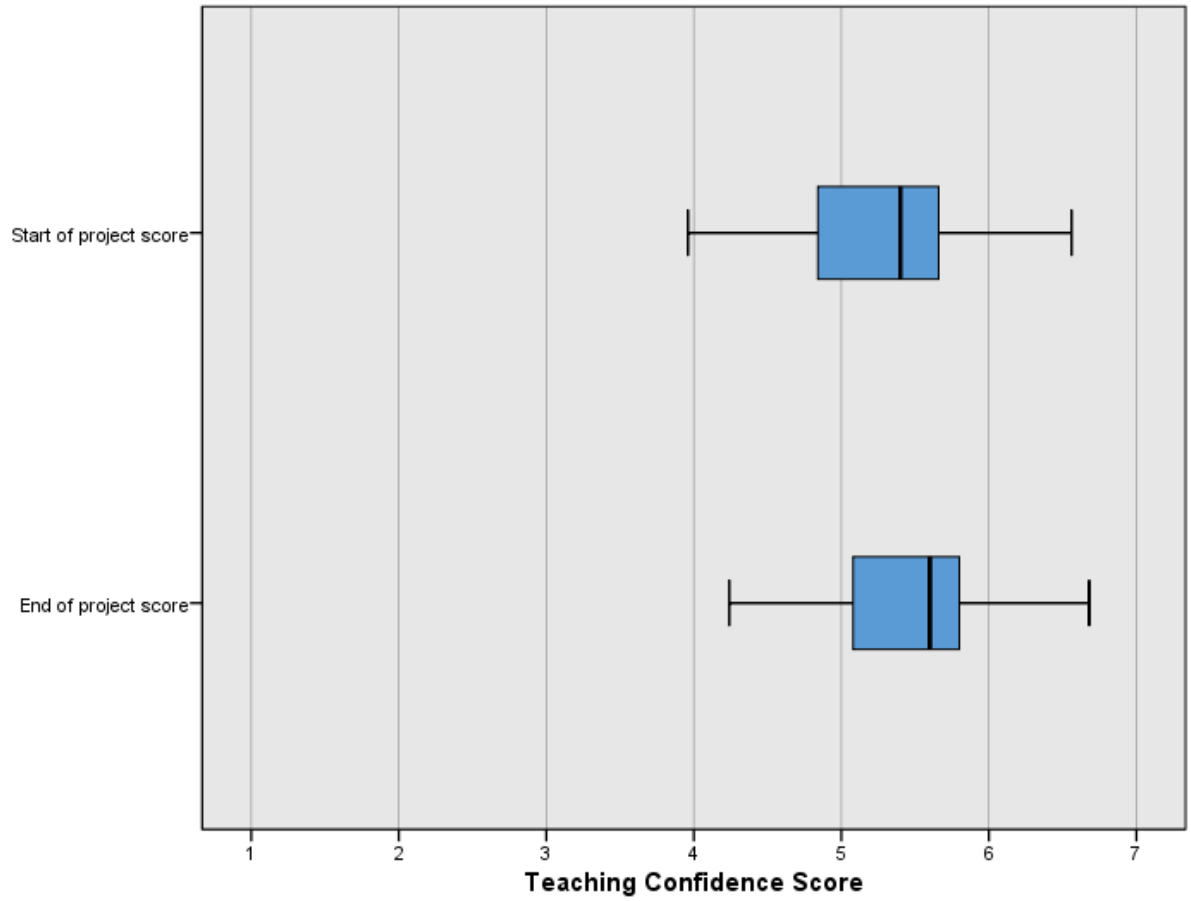
Date teacher intervention started: Varied dependent on schools signing up to project: Jan 2014 to March 2015

Table 9 – Teacher Outcomes: teachers benefitting from the project

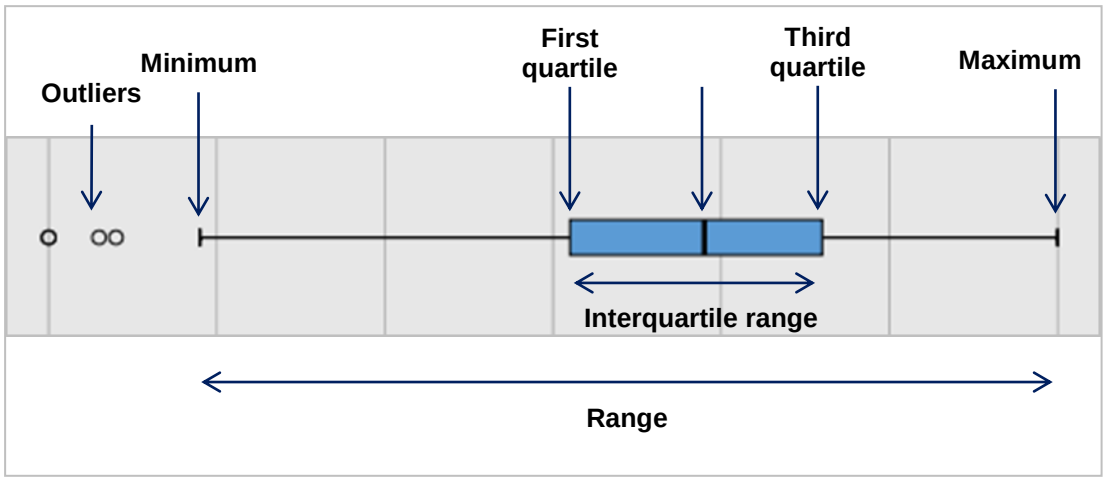
Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
Teacher outcome 1 D&T KS3 activity was modernised to support STEM teaching and learning	*Qualitative analysis of showcase examples*	*47 showcase examples from 20 schools*	*Qualitative analysis criteria, see below*	*Nd*	*Schools uploaded evidence to project website by end of July 2015*
Teacher outcome 2 D&T Teachers subject knowledge was enhanced as a direct consequence of engaging with the programme	*Questionnaire Self-reported measure of confidence in teaching 25 technology competences*	*33 questionnaires were returned from the sample of 82 schools. Profile of teachers is discussed below*	*Teachers were requested to rate their confidence of 25 items on a 7 point Likert scale.* *1 = no confidence* *2 = Unconfident* *3 = A little unconfident* *4 = Neutral* *5 = A little confident* *6 = Confident* *7 = Complete confidence*	*(n = 19, Mdn = 6, IQR = 1)* *Collected before the teaching of the project in each individual school*	*(n = 24, Mdn = 6, IQR = 2)**** *Collected after the teaching of the project in each individual school*
Teacher outcome 3 D&T teachers engaged with teachers from other STEM disciplines in their own schools	*Scrutiny of showcase examples and analysis of feedback from twilight sessions*	*47 showcase examples from 20 schools* *87 feedback forms from 17 twilight sessions*			
Teacher outcome 4 Teachers developed a better understanding of the connection between STEM subjects and D&T's contribution. They were able to raise profile of D&T within their school	*Scrutiny of showcase examples and analysis of feedback from twilight sessions*	*47 showcase examples from 20 schools* *87 feedback forms from 17 twilight sessions*			

****** Significant increase in score calculated using Wilcoxon Signed Ranks Test of Exact Significance (2-tailed) (n = 15, Z = -3.150, p = .001, r = .58)***

The box plot below displayed the descriptive statistics for Teacher outcome 2.



Box plot of teaching confidence scores



Features of a box plot

Table 10 – Comparison data outcomes for Teachers *[if available]*

Not available

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
e.g. Increased Teacher confidence	*e.g. E-survey*	*e.g. 100 respondents from a total of 200 invites.* *The profile of respondents was broadly representative of the population as a whole.*	*e.g. Mean score based on a 1-5 scale (1 – very confident, 2 – quite confident, 3 neither confident nor unconfident, 4 - quite unconfident, 5 – very unconfident)*	*e.g. Mean score*	*e.g. Mean score*

8.1.1 Please provide information (for both the intervention group and comparison group where you have one) on:

Characteristics of the sample responding to the teacher questionnaire

There were 33 responses to the teacher questionnaires from 31 schools. Two teachers responded from School 7 and School 13. The number of questionnaire responses and the amount of missing data from the responses are shown in the table below.

22 teachers returned the start of project questionnaire, 3 of the start of project questionnaires were rejected due to missing data or errors made on the questionnaire resulting in a total of 19 complete responses.

30 teachers returned the end of project questionnaire, 6 of the end of project questionnaires were rejected due to missing data or errors made on the questionnaire resulting in a total of 24 complete responses.

18 teachers returned both the start and end of project questionnaire, 3 participants results were rejected due to missing data or errors made on the questionnaire resulting in a total of 15 complete responses.

Number of questionnaire responses and missing data for the teacher questionnaire

	Number of responses	Number of Complete Responses	Missing Data
Start of project teacher questionnaire	22	19	13.64%
End of project teacher Questionnaire	30	24	20.00%
Both the start and end of project teacher questionnaires	18	15	54.55%

Total unique teachers (n = 33)

The teachers in the sample were 39% male (n = 13) and 48% female (n = 16), 12% missing data (n = 4).

The majority of participants had their first degree in a creative arts and design subject (n =16). The other participants had their first degree in engineering and technology (n = 2); architecture, building and planning (n = 2); business and administrative studies (n = 1) and 12 participants with no response. Degree types were split into BA (n = 21), BSc (n = 4), BEng (n = 2), other (n = 2) and 4 participants with no response.

The most common route for ITT was a 1 year PGCE course (n = 18). In descending order the other routes followed for ITT were 2 year PGCE (n = 4), Undergraduate (n = 3), Teach First (n = 3), other (n = 1) and 4 participants with no response.

The reported levels of experience were high: more than 10 years teaching experience (n =10), 6 to 10 years teaching experience (n =10), 1 to 5 years teaching experience (n = 8), less than 1 year of teaching experience (n = 1) and 4 participants with no response. The levels of experience are reflected in the seniority of the participants within their schools: head of faculty (n = 6), subject leader (n = 10), STEM coordinator (n = 2), teachers (n = 11) and 4 participants with no response.

Levels of Participation and Engagement as at 1 August 2015: Main School Twilight Sessions and Showcase Examples

Of the 4 exemplar schools:

Attendance at main school twilights:	3 schools
Evidence on website:	2 schools
Twilight attendance and evidence on website	2 schools

Of the 19 pilot schools:

Officially withdrawn:	2 schools
Attendance at main school twilights:	14 schools
Evidence on website:	8 schools
Twilight attendance and evidence on website	6 schools

Of the 17 remaining pilot schools: 82% attended main school twilights
47% evidence on the website
31% attended and evidence

Of the 78 original main schools:

Officially withdrawn:	5 schools (a)
Since sign-up, no contact despite calls, emails and offers of visits:	6 schools (b)
Visit from Project Officer, attended cluster meeting but contract not returned, no engagement:	6 schools (c)
Ordered resources	50 schools (d)
Remaining in project (78-(a+b+c):	61 schools
Not ordered resources (78-(a+b+c+d)):	11 schools
Resources purchased by D&T Association	7 schools
Attendance at twilights:	39 schools

Crumble trial schools:	8 schools
Evidence on website:	10 schools
Twilight attendance and evidence on website	9 schools

Of the 61 remaining main schools: 81% ordered resources
63% attended twilights
16% evidence on the website

As a measure of project impact, 20% of schools where teachers attended twilight sessions showcased their work.

Main School Twilight Sessions

From the original schedule for 24 twilight:

Events Planned	23 sessions
Ran as scheduled	17 sessions
Postponed and subsequently cancelled due to only 1 participant booked	2 sessions
Cancelled due to 1 participant booked	1 session
Cancelled due to 0 participant booked	1 session

For the 17 main school twilight sessions that ran as scheduled, 96 participants attended of 105 booked, from 43 schools of 78 pilot and main schools. This represents an attendance rate of 91% from 55% of schools remaining in the project.

Date of session	Attended	Booked	Feedback sheets
10-12	10	9	10
08-01	8	7	8
20-01	1	2	1
27-01	5	4	5
04-02	2	2	2
06-02	2	3	2
12-02	10	11	6
26-02	3	4	3
04-03	7	5	6
05-03	4	3	4
12-03	6	8	6
17-03	5	5	5
25-03	6	9	6
25-03	2	4	2
15-04	10	10	10
21-04	8	8	7

05-05	7	11	5
Totals	96	105	87

Number of participants attending 1 twilight sessions: 41

Number of participants attending 2 twilight sessions: 14

Number of participants attending 3 twilight sessions: 5

Number of participants attending 5 twilight sessions: 1

At the start of the project, the intention was that, for every school involved with the project, there should be attendance at 2 twilight sessions. Teachers from 10 of 82 schools (12%), and 20 of 96 teachers (19%) attended more than one session.

Twilight Session Feedback Form

87 participants of 96 attending twilight session completed the *STEM in Action with D&T Feedback Form (*completion rate of 91%):

Participants were invited to rate, on a 1-4 scale (1 – poor, 4 excellent), their reflection on 5 aspects, which were: communications, venue, session presentation, session content and opportunity to network.

No responses rated any of the aspects as poor (1). The responses for 2 to 4 were rescaled as -1 to +1 (-1 indicated less than satisfactory, 0 as satisfactory, +1 as better than satisfactory).

The resultants averages, from these rescaled responses, provide an indicator on a 0 to 1 scale to indicate overall satisfaction for each aspect. The data are represented in the following table:

Aspect	**Less than satisfactory**	**Satisfactory**	**Better than satisfactory**	**No response**	**Level of satisfaction**
Communications (85 responses)	2	9	74	3	0.85
Venue (86 responses)	1	11	74	2	0.85
Session Presentation (85 responses)	0	14	71	3	0.84
Session Content (86 responses)	0	20	66	2	0.77
Opportunity to network (86 responses)	1	11	74	2	0.85

Overall, the responses show a very high level of satisfaction with all aspects of the twilight sessions. The lowest score was session content, the nature of which was reflected by participants' comments with respect to management of expectations. The commentary below explores these comments in more detail.

Participants were invited to 'provide any additional feedback on the session'. From the 87 completed sheets, 56 responses were made to this question.

The most frequent responses praised the quality of the presentations, the example projects made from the resources and the opportunity for networking. 'Hands-on' sessions were valued more than those which were 'show-and-tell'. Participants wanted to trial resources as well as being told for what they could be used. Made examples were valued, from either presenters or from other schools in the project. These raised confidence and generated ideas to try out in participants' own schools. Taking away additional resources, such as exemplar booklets or worksheets were particularly welcomed.

Participants were invited to specifically indicate:

a) If they would trial resources being shown as either class work, homework, a new project or slip into an existing project.

b) Had learnt or seen anything new as a result of attending the session.

c) What might be helpful to support trialling and STEM project delivery?

a) Trialling Resources

From the 87 completed sheets, 65 responses were made, all of which indicated 'yes' they would trial resources. Most of the responses indicated multiple uses, with over 60% indicating class work and/or new project. Ten percent (20%) indicated homework or slipping into existing projects. Four responses indicated, use in school clubs or extra-curricular activities.

b) New Material

From the 87 completed sheets, 82 responses were made, all of which indicated that the sessions had provided new material. Most frequent responses were 'Crumble' programming, textile resources, networking with and ideas from presenters and other participants.

c) Help and Support

From the 87 completed sheets, 36 responses were made, most of which indicated more examples and continued networking. Some participants indicated that they would like follow-on support in schools through trainers' visits. Several responses indicated concern about sustaining the work beyond the life of the project and, especially continuation of CPD and networking.

Resource Packs

The resource packs available to schools, containing sufficient material for 10 pupils, are of two categories:

1) Tutorial (ref: STEMTxxx). These resources provide packs of material samples. The supporting worksheets focus on introducing new words, information about materials and investigations. The investigations are either fastening samples to the worksheet or experiments on the materials' properties.

2) Practical Task (ref: STEMPxxx). These resources provide packs of project parts. The supporting worksheets focus on background (or introduction) to the project, design and making the projects, and developing the project (what next?). The projects are supported by additional sheets covering KS3 curriculum links to the Programmes of Study D&T, Science and, when appropriate, Mathematics.

On the worksheets, there are no links between the STEMT and STEMP resources. As a consequence of this, with the exception of two schools, the showcase examples were either based on one category of resource or the other. The two schools linked smart material tutorial sheets to practical projects. Nevertheless, schools showcasing work based on STEMT resources frequently used the activities to drive pupils' design intentions: not necessarily from the STEMP projects.

Showcase Examples on Website

20 schools showcased work on the website with 47 examples, from:

50% Exemplar Schools (2 of 4)
47% Pilot Schools (8 of 17)
16% Main schools (10 of 61)

There was no showcased work from 1 of the exemplar schools or its pilot schools

The table below shows how many schools ordered and showcased the resource packs. All packs are included, arranged in sequential order, STEMT packs first followed by STEMP packs.

	Showcased (schools)			**Main School Ordered**	
Resource pack	**Pilot**	**Main**	**Total**	**Number of schools**	**Number of kits**
Metals (STEMT001)		2	2	12	29
Memory Metals (STEMT002)		1	1	25	73
Wood Products (STEMT003)				10	49
Polymers (STEMT004)				10	50
Thermochromic Materials (STEMT005)	3		3	26	95
Photochromic Materials (STEMT006)	3		3	23	81
Glow-In-The-Dark Materials (STEMT007)	1		1	17	63
Composite Materials (STEMT008)		1	1	13	65
Strange Materials (STEMT009)				13	37
Reflective Materials (STEMT010)				8	26
Colour (STEMT016)				3	4
Too Small To Measure? (STEMT018)				2	2
Seeing The Invisible (STEMT020)				4	5
Strengths & Weaknesses (STEMT021)				2	4
Electric Motors (STEMT024)				3	6
Energy Sources (STEMT025)				8	19
Smart Phone Polariscope (STEMT027)				3	3

Theft Alarm (STEMT028)				3	4
Enigma Machine (STEMP004)		1	1	13	42
Friction Sketch Pad (STEMP007)	1		1	5	6
Smart Phone Kaleidoscope (STEMP008)	4		4	23	67
Using Your E-Pack (STEMP009)	2		3	16	22
Fridge Magnet (STEMP013)	2	2	4	20	43
Photo-Image For A Card Pouch (STEMP014)				2	2
Picture Stand (STEMP015)		1	1	11	38
Glow Tag (STEMP016)				8	18
LED Lamp (STEMP017)	4	4	8	29	81
Smartcord Wristband (STEMP020)	2	1	3	15	72
Smart Phone Periscope (STEMP021)				2	4
Thermal Image Test Card (STEMP022)				2	4
UV Awareness Badge (STEMP023)				7	15
Vibro-Bug (STEMP024)	2		2	11	24
Strange Conductors (STEMP025)				4	10
Spin Art Machine (STEMP026)	2	1	3	10	15
Smart-Link Automaton (STEMP027)				4	7
Gyro-Spinner (STEMP028)				3	5
Micro-Robot Positioning (STEMP029)				3	6
Micro-Robo-Rover (Single Motor) (STEMP030)				3	4
Electric Ball Launcher (STEMP031)				5	8
Kinetic Art Drawing Machine (STEMP032)				10	19
Wow – Is That A Clock? (STEMP033)				4	9
Docking Station (STEMP034)				9	14
Solar Powered Toy (STEMP036)	2	1	3	4	4
Aroma Mood Machine (STEMP038)				3	3
Flashing LED Cycle Lamp (STEMP039)				2	3
Flat LED Torch (STEMP040)	1		1	11	44
Flashing Garment Safety Light (STEMP042)	1		1	2	3
Garment Safety Light (STEMP043)	1		1	2	4
Electric Paper Plane Launcher (STEMP045)	1	2	3	8	13
Powder Pictures (STEMP046)	1		1	2	2
Mad Gadget: LED Water Timer (STEMP047)				2	4
Telephone (A Toy Or Intercom) (STEMP048)				1	1
LED Effects Projector (Moving Wheel) (STEMP049)				5	6
LED Vibro Projector (STEMP050)				1	2
LED Effects Projector (Water Cell) (STEMP051)				0	0
IQ4 Alarm With Buzzer Output (STEMP052)				2	2
IQ4 Nightlight (STEMP055)	1		1	3	3
Crumble	2	2	4	Nd*	Nd*

From this table, key findings, of the 57 resource packs available to schools, including Crumble are:

- 25 (44%) packs were showcased on the website by 20 schools;
- 56 (98%) packs were ordered by main schools;
- 1 pack was not ordered by any school (STEMP051: LED Effects Projector (Water Cell);
- 41 (71%) packs were ordered by exemplar schools and their pilot schools.

* In addition to the £200 provided to the main schools, the schools were also all provided with a Crumble kit. The Crumble kit included sufficient resource to enable them to run activities with a class. The Crumble is a micro controller, which is programmed using simple, free software which is easily accessible to non-electronics specialists, but offers unlimited potential for advanced users. The Crumble will help teachers to address the area of Programmable Components which is now an explicit element of the Design and Technology Programme of Study.

The most ordered resources were those which provided all the materials for pupils to make a complete product. Order of popularity (frequency of the resource packs is shown in the following table.

	Showcased (schools)			**Ordered (schools)**		
	Exemplar and Pilot	Main	**Total**	Exemplar and Pilot	Main	**Total**
LED Lamp (STEMP017)	4	4	**8**	16	29	**45**
Thermochromic Materials (STEMT005)	3		**3**	12	26	**38**
Memory Metals (STEMT002)		1	**1**	7	25	**32**
Photochromic Materials (STEMT006)	3		**3**	8	23	**31**
Smart Phone Kaleidoscope (STEMP008)	4		**4**	8	23	**31**
Using Your E-Pack (STEMP009)	3		**3**	14	16	**30**
Glow-In-The-Dark Materials (STEMT007)	1		**1**	9	17	**26**
Fridge Magnet (STEMP013)	2	2	**4**	5	20	**25**
Smartcord Wristband (STEMP020)	2	1	**3**	5	15	**20**
Composite Materials (STEMT008)		1	**1**	6	13	**19**
Spin Art Machine (STEMP026)	2	1	**3**	7	10	**17**
Flat LED Torch (STEMP040)	1		**1**	6	11	**17**
Enigma Machine (STEMP004)		1	**1**	3	13	**16**
Vibro-Bug (STEMP024)	2		**2**	5	11	**16**
Metals (STEMT001)		2	**2**	2	12	**14**
Picture Stand (STEMP015)		1	**1**	0	11	**11**
Electric Paper Plane Launcher (STEMP045)	1	2	**3**	3	8	**11**
Friction Sketch Pad (STEMP007)	1		**1**	3	5	**8**

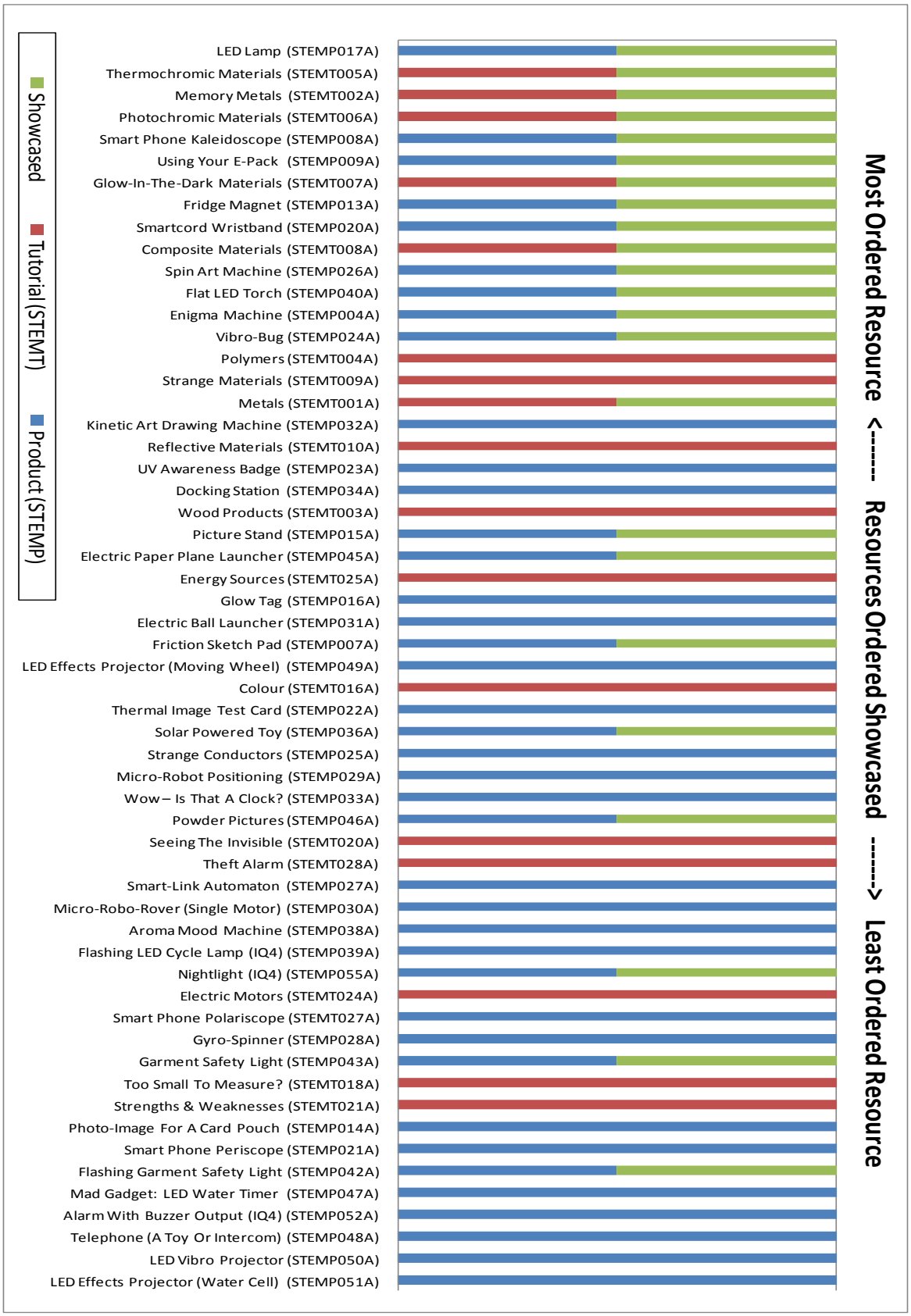
Solar Powered Toy (STEMP036)	2	1	**3**	2	4	**6**
Powder Pictures (STEMP046)	1		**1**	3	2	**5**
IQ4 Nightlight (STEMP055)	1		**1**	1	3	**4**
Garment Safety Light (STEMP043)	1		**1**	1	2	**3**
Flashing Garment Safety Light (STEMP042)	1		**1**	1	2	**2**
Crumble	2	2	**4**		nd	

Of the 23 most ordered resources showcased, 17 were based practical tasks (STEMP) and 6 on materials. Of the 'top 10' most ordered resources showcased, 5 were based on each:

1	LED Lamp (STEMP017)	pilot and main schools
2	Smart Phone Kaleidoscope (STEMP008)	pilot schools
3	Using Your E-Pack (STEMP009)	pilot and main schools
4	Fridge Magnet (STEMP013)	pilot and main schools
5	Smartcord Wristband (STEMP020)	pilot and main schools

1	Thermochromic Materials (STEMT005)	pilot schools
2	Memory Metals (STEMT002)	pilot schools
3	Photochromic Materials (STEMT006)	pilot schools
4	Glow-In-The-Dark Materials (STEMT007)	pilot schools
5	Composite Materials (STEMT008)	main schools

The chart, below, represents all of the resource packs, in descending popularity from top to bottom and whether or not they were showcased. Overall, and understandably, there is a bias towards practical tasks to produce pre-determined outcomes from kits of parts at the expense of creativity and independent learning. The schools showcasing their work did not lack creativity in the work being presented by their pupils. Nevertheless, this is a snapshot from 24% of the schools involved in this STEM project


Showcased
Tutorial (STEMT)
Product (STEMP)
LED Lamp (STEMP017A)
Thermochromic Materials (STEMT005A)
Memory Metals (STEMT002A)
Photochromic Materials (STEMT006A)
Smart Phone Kaleidoscope (STEMP008A)
Using Your E-Pack (STEMP009A)
Glow-In-The-Dark Materials (STEMT007A)
Fridge Magnet (STEMP013A)
Smartcord Wristband (STEMP020A)
Composite Materials (STEMT008A)
Spin Art Machine (STEMP026A)
Flat LED Torch (STEMP040A)
Enigma Machine (STEMP004A)
Vibro-Bug (STEMP024A)
Polymers (STEMT004A)
Strange Materials (STEMT009A)
Metals (STEMT001A)
Kinetic Art Drawing Machine (STEMP032A)
Reflective Materials (STEMT010A)
UV Awareness Badge (STEMP023A)
Docking Station (STEMP034A)
Wood Products (STEMT003A)
Picture Stand (STEMP015A)
Electric Paper Plane Launcher (STEMP045A)
Energy Sources (STEMT025A)
Glow Tag (STEMP016A)
Electric Ball Launcher (STEMP031A)
Friction Sketch Pad (STEMP007A)
LED Effects Projector (Moving Wheel) (STEMP049A)
Colour (STEMT016A)
Thermal Image Test Card (STEMP022A)
Solar Powered Toy (STEMP036A)
Strange Conductors (STEMP025A)
Micro-Robot Positioning (STEMP029A)
Wow – Is That A Clock? (STEMP033A)
Powder Pictures (STEMP046A)
Seeing The Invisible (STEMT020A)
Theft Alarm (STEMT028A)
Smart-Link Automaton (STEMP027A)
Micro-Robo-Rover (Single Motor) (STEMP030A)
Aroma Mood Machine (STEMP038A)
Flashing LED Cycle Lamp (IQ4) (STEMP039A)
Nightlight (IQ4) (STEMP055A)
Electric Motors (STEMT024A)
Smart Phone Polariscope (STEMT027A)
Gyro-Spinner (STEMP028A)
Garment Safety Light (STEMP043A)
Too Small To Measure? (STEMT018A)
Strengths & Weaknesses (STEMT021A)
Photo-Image For A Card Pouch (STEMP014A)
Smart Phone Periscope (STEMP021A)
Flashing Garment Safety Light (STEMP042A)
Mad Gadget: LED Water Timer (STEMP047A)
Alarm With Buzzer Output (IQ4) (STEMP052A)
Telephone (A Toy Or Intercom) (STEMP048A)
LED Vibro Projector (STEMP050A)
LED Effects Projector (Water Cell) (STEMP051A)
Most Ordered Resource <------ Resources Ordered Showcased ------> Least Ordered Resource

The LED lamp practical task (STEMP017) was the most frequently ordered and showcased by pilot and main schools. This is not surprising because this project was frequently flagged-up at twilight sessions to illustrate the initiative's aims. As a consequence, teachers attending from main schools followed this lead. There is no clear explanation for correlation between twilight lead, resources ordered and showcased. However, where resources were seen and used at twilight sessions there is a tentative correlation with ordering, but not showcasing. This is understandable if confidence factors are considered. However, a project requirement was that all schools should present something in the showcase area.

Showcase examples provided some notable evidence of impact on the schools' D&T curriculums. Before considering these, it is necessary to consider matters concerning STEM within D&T in all of the examples showcased. Schools' D&T provision has tended to focus on the 'T' and not the 'D' (Ofsted, 2008, 2011, 2015). The introduction of STEM is an opportunity to address this. However, it does require D&T staff to communicate and engage with staff in their schools' Science and Mathematics departments. Engineering is an entirely different state of affairs in that there are seldom school departments or specialist staff in this field. This is reflected in the STEMP resources' supporting curriculum links sheets. None of showcase examples showed links to these. Searches of all the showcased work showed:

- 4 links to Science departments: active involvement of one physics and one chemistry teacher.
- Links to technology were confined to programming and electronics.
- 1 link to engineering through mechanisms.
- 1 potential link to mathematics; after the Enigma Machine practical task delivery it was realised that the mathematics input needed to be increased, which has subsequently been agreed by the school's mathematics department.

The conclusion to be drawn from this is that the D&T practical projects were driven by STEM in name only. They were not driven by secure links to the four components of STEM to enhance. Nevertheless, showcase evidence does show impact in enhancing the schools' D&T curriculums through the introduction of new projects capable of being linked to science and mathematics.

The showcase evidence shows impact on how D&T/STEM projects can be delivered in imaginative approaches. Examples of this are:

- Using the STEMT sheets as focus practical tasks to enhance pupils' progress in the design and make tasks;
- Homework tasks, extracurricular activities and clubs;
- Frequent links to art textiles;
- Enhancing or replacing existing projects;
- Whole school activity days and suspended timetables, focussing on STEM;
- Taster session, as short projects, to encourage year 9 uptake for GCSE;
- Enterprise activity;
- Links to school tutor system and PSHE to promote team work through Year 12 led STEM peer groups (Yrs 7-9).

In summary, schools' D&T curriculums have been enhanced by using imaginative approaches offered by the STEM resources. STEM links need to be made more explicit to be effective STEM in D&T. One fifth of the schools in the project provide very positive evidence of successful implementation. Sustaining success in these schools and increasing uptake in others will be dependent on continued support.

Supporting Evidence References

Ofsted (2008). Education for a technologically advanced nation, Design and technology in schools 2004–07. London: HMSO

Ofsted (2011). Meeting technological challenges? Design and technology in schools 2007–10. London: HMSO

Ofsted (2015). "The Current State of Design and Technology: what we know, what the data is (*sic*) telling us and the threats, challenges and opportunities ahead". Keynote Lecture, delivered by Diana Choulerton, D&T Association Summer School, 9 July 2015, Loughborough University (http://www.slideshare.net/Ofstednews/design-and-technology-association-data-summer-school-keynote-2015, accessed 15 September 2015)

8.2 Pupil Outcomes

Date pupil intervention started: Varied dependent on when schools signed up to project: Jan 2014 to March 2015

Table 11 – Pupil Outcomes for pupils benefitting from the project

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
Pupil outcome 1 Students' understanding of STEM and the links between different STEM subjects increased	*Questionnaire. 18 item questionnaire developed from the Intrinsic Motivation Inventory.* *The Perceived Competence subscale was used.*	*959 questionnaires were returned from the sample of 82 schools. Profile of pupils is discussed below*	*Pupils were asked to rate their level of agreement to 6 items on a 7 point Likert scale (1 = Disagree Very Strongly, 2 = Disagree Strongly, 3 = Disagree, 4 = Neutral, 5 = Agree, 6 = Agree Strongly, 7 = Agree Very Strongly) at the start and end of the projects.*	*(n = 743, Mdn = 4.7, IQR = 1.0)* *Collected before the teaching of the project in each individual school*	*(n = 598, Mdn = 4.8, IQR = 1.2)**** *Collected after the teaching of the project in each individual school*
Pupil outcome 2 Pupils' attitudes towards D&T were enhanced and they demonstrated increased motivation in D&T lessons	*Questionnaire. 18 item questionnaire developed from the Intrinsic Motivation Inventory.* *The Interest/Enjoyment subscale was used and is the self-report measure of intrinsic motivation.*		*Pupils were asked to rate their level of agreement to 7 items on a 7 point Likert scale (1 = Disagree Very Strongly, 2 = Disagree Strongly, 3 = Disagree, 4 = Neutral, 5 = Agree, 6 =*	*(n = 743, Mdn = 4.9, IQR = 1.5)* *Collected before the teaching of the project in each individual school*	*(n = 598, Mdn = 4.9, IQR = 1.5)* *Collected after the teaching of the project in each individual school*

			Agree Strongly, 7 = Agree Very Strongly) at the start and end of the projects.		

No significant difference between start (n = 743, Mdn = 4.9, IQR = 1.5) and end (n = 598, Mdn = 4.9, IQR = 1.5) of project Interest/Enjoyment scores was found using a Wilcoxon Signed Ranks Test of Asymp. Sig. (2-tailed) (n = 458, Z = -1.427, p = .154, r = 0.07). There was no significant change in the whole study scores of pupil Interest/Enjoyment (Motivation) as a result of the projects.

*** A significant difference between start (n = 743, Mdn = 4.7, IQR = 1.0) and end (n = 598, Mdn = 4.8, IQR = 1.2) of project Perceived Competence scores was found using a Wilcoxon Signed Ranks Test of Asymp. Sig. (2-tailed) (n = 458, Z = -3.994, p < .001, r = 0.16). There was a significant increase in the whole study scores of pupil Perceived Competence as a result of the projects.

The calculated scores for all the factors are presented as box plots, see below, for descriptive analysis. There were more responses to the start of project questionnaire (n = 743) compared to the end of project questionnaire (n = 598). The score is based on a 7 point Likert scale, scores greater than 4 are positive responses from pupils; scores less than 4 are negative responses. The central tendency statistics and box plot show the high starting position for Interest/Enjoyment and Perceived Competence. Higher scores are desirable for Interest/Enjoyment and Perceived Competence.

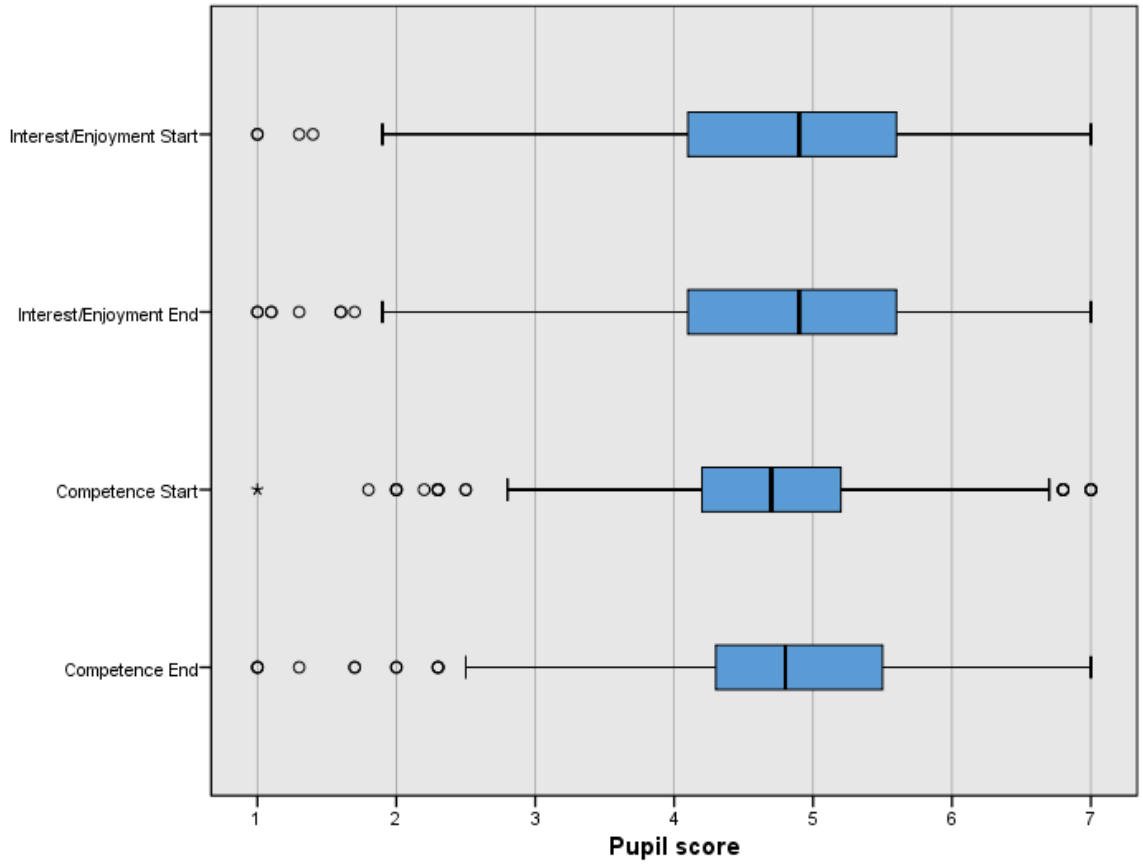


Figure 1 – Box plots of calculated pupil IMI scores
Note. Outliers are identified as: o = outliers. * = extreme values

Table 12 - Pupil Outcomes for pupil comparison groups *[if available]*

No data

Target Outcome	Research method/ data collection	Sample characteristics	*Metric used*	1st Return and date of collection	2nd Return and date of collection
e.g. Increased educational attainment and progress in Writing	*e.g. Pupil assessment data*	*e.g. Characteristics and assessment data collected for 97 of 100. The profile of respondents matches that initially targeted in the Theory of Change.* *Please find detailed analysis of the profile of respondents in Section 7.2*	*e.g. mean score or percentage at diff National Curriculum Levels or GCSE grades*	*e.g. Mean score- 3.7, collected September 2015*	*e.g. Mean score- 4.5, collected June 2015*

8.2.1 Please provide information (for both the intervention group and comparison group where you have one) on:

Characteristics of the sample responding to the pupil questionnaire

Number of questionnaire responses and missing data for the pupil questionnaire

	Number of responses	Number of Complete Responses	Missing Data
Start of project pupil questionnaire	860	743	13.60%
End of project pupil Questionnaire	699	598	14.45%
Both the start and end of project pupil questionnaires	652	458	29.75%

Total unique pupils (n = 959), Total unique Schools (n = 31)

The sample size of 458 provides a confidence interval of 4.58% at 95% confidence level. The total number of unique pupils that participated in the study was 959. The gender distribution shown was 234 male, 419 female and 306 with no answer given. The distribution of gender was skewed towards a high percentage of female pupils responding. Of the 31 responding schools, 3 were all girls and 1 was all boys.

To assess the motivation of pupils in this study, the Intrinsic Motivation Inventory (IMI) was used (http://www.selfdeterminationtheory.org). The IMI questionnaire is a multidimensional instrument containing seven subscales: interest/enjoyment; perceived competence; effort;

value/usefulness; felt pressure and tension, perceived choice while performing a given activity and experiences of relatedness. The instrument has been used in prior research (Deci, Eghrari, Patrick, & Leone, 1994; Plant & Ryan, 1985; Ryan, Connell, & Plant, 1990; Ryan, Koestner, & Deci, 1991; Ryan, 1982) and specifically in measuring pupils in educational research (Loukomies et al., 2013; Sproule et al., 2013; Vaino, Holbrook, & Rannikmäe, 2012).

Three of the subscales were chosen for use in this study: interest/enjoyment; perceived competence and pressure/tension. The interest/enjoyment subscale is the self-report measure of intrinsic motivation and contains 7 items. The perceived competence subscale is a positive predictor of intrinsic motivation and contains 6 items. Pressure/tension is a negative predictor of intrinsic motivation and contains 5 items. It is expected that there will be correlation between the factors and to provide validation between factors. The collected data from the pupil questionnaire was subject to Exploratory Factor Analysis to ensure the data correctly represented the three factor subscales. The use of reverse items on the questionnaire and calculations of Cronbach's alpha tested the data for internal consistency to find it suitable before analysis. The sample size of 458 provides a confidence interval of 4.58% at 95% confidence level.

Sample sizes for the number of teachers, and for pupils in individual schools were small. Non-parametric statistical methods, using exact significance have been used to accommodate the small sample sizes (n < 30).

8.3 Wider System Outcomes

Table 13 – Wider System Outcomes

Target Outcome	Research method/ data collection	Sample characteristics	*Metric*	1st Return and date of collection	2nd Return and date of collection
Wider System Outcome 1: The peer to peer support network extended beyond the life of the programme	*Participating schools become part of the D&T Association to benefit from the links with other schools; branch events are set up and maintained in the London area*	D&T Association members	*Measure of participating schools membership of the D&T Association at the start and end of the project*	*Data collected as schools joined programme*	*Data collected at the end of July 2015*
Wider system outcome 2: The resources and activities were and continue to be valued by the D&T community. As a consequence they included them within their SoW and replaced existing resources/activities	*Material uploaded onto the Showcase illustrates impact of resources on teaching in school. Data gathered on repeat orders from Mindsets on the use of these resources.*	*Schools ordering Mindsets material*	*Measure of repeat orders of the resources*		*Details of repeat orders received from participating schools*

8.3.1 Please provide information on *(minimum 500 words):*

Wider Outcome 1:
At the start of the programme, of the 103 schools engaged, 83, 82% were not members of the D&T Association. As a result of joining the programme, 18 schools, 37% are now members of the Association.

By becoming members, these schools now have access to a wealth of resources and CPD opportunities at reduced prices. They will have access to a range of additional benefits including experts who are able to offer help, advice and support in all aspects of teaching, and have the opportunity to be part of a wide network of D&T teachers.

As a result of the programme, a teacher from School 8 has approached their local authority (London Borough of Enfield) to ask about setting up a 'Technology Hub' for teachers and students. The hub will be a collaborative group; share ideas, resources, best practices, concerns and provide a platform locally to support each other, while looking at strengthening our subject/knowledge and curriculum changes that are/will take place. The D&T Association will be fully supporting this initiative, and looking to encourage other schools from the network to join or set up similar hubs in their boroughs. This may form the basis on which other hubs can be created subject to further funding being acquired.

Wider Outcome 2
As at the end of July, not all of the schools involved in the project had purchased further resource from Mindsets. However as previously outlined in section 8.1, those schools who have uploaded Showcase examples on the website have indicated that the activities are now built into their teaching and schemes of work have been updated accordingly. This indicates that further schools will have/and will continue to purchase resource into the autumn term.

School 8 have been working directly with Mindsets to develop a new Solar Lamp project, utilising elements of the activities provided through this programme. This is currently being delivered in school, and will be developed as a case study.

8.4 Impact Timelines

Please provide information on impact timelines:

- At what point during/after teacher CPD activity did you expect to see impact on teachers? Did this happen as expected?
- At what point during/after teacher CPD activity did you expect to see impact on pupils? Did this happen as expected?
- At what point did you expect to see wider school outcomes? Did this happen as expected?
- Reflect on any continuing impact anticipated.

Teacher Impact
We would have expected to start to see an initial impact on teacher engagement shortly after purchasing and trialling the materials. Evidence from the Showcase repository on the website has provided evidence of impact on the schools' D&T curriculums, and there is further anecdotal evidence from other schools on the impact of the programme. Data provided from the teacher questionnaires, and reported in section 8.1 of this project indicates that teachers' level of confidence has increased as a consequence of engaging with the programme. However the percentage of schools where there is evidence of impact is lower than anticipated, which we believe is for the reasons listed below:

- **The delay in the start of the project had a major impact on the project:**
    - Exemplar schools were required to develop and trial resources during a very busy term. Typically emphasis on GCSE teaching begins to take an even greater precedence at the time schools engaged, which was challenging. The project officers offered flexible support to fit around teachers existing work commitments.
    - Recruitment and engagement of initial pilot schools, also presented challenges for similar reasons. To support these schools, four rather than one cluster meetings were arranged, and those schools who could not attend these meetings were as an alternative, provided with a visit from a Project Officer to their school, to get them up and running quickly.

- **Recruitment**
    - Two of the original exemplar schools had to be replaced. One due to staff changes, and one due to a poor Ofsted resulting in subsequent lack of commitment from the school as they were required to direct their energies elsewhere. The two replacement schools were given additional support from the Project Officers.
    - Delays in the recruitment process of the initial and main schools had an impact on the programme delivery. Late sign up resulted in some schools not purchasing or starting to trial materials until the summer term.
    - The slow uptake is a sad indictment, reflecting the pressures that teachers in D&T are subjected to which impact on their ability to undertake curriculum development. Schools were offered resource, free face to face CPD, free web based support, expert advice and guidance, but often declined involvement or withdrew from the programme due to existing commitments/time pressures.

Pupil Impact
The measure of impact on the pupils was always going to be a longer process. Initial evidence from the questionnaires returned by the pupils (section 8.2) indicates that whilst their enjoyment of the subject remained the same, there was a significant change in pupil perceived competence as a result of the D&T activities.

Wider Outcome Impact
We expected to see the schools engaging with one another and exchanging experiences and ideas at the CPD and twilight events, and this was evident from the start. Schools highly value the opportunity to network with colleagues.

Evidence, as reflected in feedback on the Showcase repository, and verbally, has indicated that schools value the activities and resources available through the project. Funding provided to the schools has enabled them the opportunity to trial a number of resources, and therefore during the project additional purchases of the resource were not anticipated. We would expect to see a rise in Mindsets sales from the autumn term, as the schools start to introduce the activity into their curriculum.

Anticipated Continuing Impact

- Schools who have engaged with the project have reported in the website showcase repository, and through email and verbal contact that they will continue to run and trial the projects past the end of the project.
- Some schools have developed strong links with other local schools. For example, evidence provided from a school newsletter, 'School 15 and School 12 moving forward Departments and Faculties are now working much closer together. Design Technology are exploring joint projects - https://hollyfield.pythonanywhere.com/cms/default/ebulletin.html
- Feedback at the twilight meetings indicated that the schools wanted the network to continue, and there are plans in place to retain a network. The extent to which this is undertaken is dependent on funding available, but the schools will be encouraged to attend the D&T Association local branch network meetings in the London area.
- School 8 has already made enquiries with their local authority to set up a 'Technology Hub' which will be made available to all schools in the borough. This has been approved by the borough and work is underway to set this up.
- Anticipated impact on pupils might include an increased uptake in D&T GCSE option, and longer term – FE/career choices, however the cost implications of measuring this in the future are high.

9. Reflection on overall project impact *(maximum 1,500 words)*

The London Schools Excellence Fund (LSEF) is based on the hypothesis that investing in teaching, subject knowledge and subject-specific teaching methods and pedagogy will lead to improved outcomes for pupils in terms of attainment, subject participation and aspiration.

The aims of the Fund:
I. Cultivate teaching excellence through investment in teaching and teachers so that attention is re-focused on knowledge-led teaching and curriculum.
II. Support self-sustaining school-to-school and peer-led activity, plus the creation of new resources and support for teachers, to raise achievement in priority subjects in primary and secondary schools (English, mathematics, biology, chemistry, computer science, physics, history, geography, languages).
III. Support the development of activity which has already been tested and has some evaluation (either internal or external), where further support is needed to develop the activity, take it to scale and undertake additional evaluation.
IV. In the longer term, create cultural change and raise expectations in the London school system, so that London is acknowledged as a centre of teaching excellence and its state schools are among the best in the world.

The long term goal for the Theory of Change model interpretation for 'Enhancing the Teaching of STEM through D&T' was "to develop a supportive community of practice established with a shared vision, linked to membership of the D&T Association and wider network." This should be measurable as project impact. Research evidence obtained during this evaluation of the 'STEM into Action with D&T Project' shows that project impact has been achieved to some extent. Indicators of this are attendance at main school twilight sessions by 96 teachers from 43 schools, and showcase evidence on the' STEM into Action with D&T' website from 20 schools. However, considering the number of schools (82) involved and predicted teacher attendances (164) involved this indicates less than 50% impact through engagement. What needs to be questioned is what strategies should have

been built in to ensure that all schools provided evidence of being contributory to the long-term-goal.

The outcomes indicated in the Theory of Change model interpretation for 'Enhancing the Teaching of STEM through D&T' were:

For better learning:

- Teachers buy resources	81% ordered resources
- High tech competence	Teacher questionnaire shows Significant increase (p= 0.001)
- STEM awareness	24% schools showcased
- Teachers sharing	29% schools attending twilight attendance 24% showcased

For better teaching:

- STEM knowledge	Teacher questionnaire shows Significant increase (p= 0.001)
- Motivation	No change in pupil motivation Increased teacher motivation
- Cross-curricular connections	6 links to Science Engineering and Maths cited in showcase examples
- Engagement with others	29% schools attending twilight attendance Anecdotal implied links to colleagues in schools

An indication of impact of the 'STEM into Action with D&T Project' is considering examples of best practice. In such examples, teachers from the participating schools involved should have demonstrated the following levels of engagement:

- attended 2 twilight sessions and completed session feedback sheets;
- delivered at least two projects in a unique or imaginative approach that explicitly links STEM strands to D&T;
- submitted completed questionnaires that self-reports their levels of confidence in technology teaching before and after project delivery;
- submitted pupil questionnaires that indicate levels of enjoyment, motivation and competence before and after project delivery;
- showcased outcomes; on the STEM into Action website.

One school met all five of the above impact criteria for engagement to the specified level. However, a further three schools met the five criteria to some extent. Collectively, they provide a good benchmark to show what can be (and should have been) achieved.

School 44

School 44 is a main school in the STEM into Action with D&T project. It is Ofsted rated as Outstanding (November 2011). "A successful, multi-cultural, over-subscribed high school for 1800 students living in the local area, male and female, aged between 11 and 19. We have new facilities and specialise in Business and Languages. We are rated outstanding by Ofsted and are in the top 100 schools nationally for student progress. We are one of only 12 schools in London to have been awarded the Mayor of London's Gold Club status for the progress our students make for each of the last 3 years." (Source: Google+ profile)

The school showcased three projects on the website.

1.1 The Balancing LED Lamp project (STEMP017). This 14 hour project highlighted STEM links to challenge Year 8 students by applying physics in a practical way. Students were taught, through experimentation how moments can be used to balance objects. They experimented with light projection to create silhouettes and coloured lights.

1.2 Spinning Toy Project based on the Solar powered Toy project (STEMP036). This 14 hour project aimed to develop Year 8 pupils' skills in materials and electronics and learning about the use of renewable and non-renewable energy.

1.3 Picture Stand (STEMP015). This 14 hour project was introduced using a range of tools materials, processes and machines in Year 7. Students were asked to design and make a picture/note holder and a piece of pewter jewellery in the theme of a specific charity to be sold to raise funds for the charity.

One teacher from the school attended three twilight sessions. Overall level of satisfaction was 86%, the main criticism being, "All venues very far and hard to get to from NW London." Of particular value was learning about and seeing new projects with relevant application, and programming (IQ4 and Crumble).
The teacher's response to the statements in the questionnaire indicated a significant increase in confidence in delivery of STEM project in D&T (level of significance before and after, p=0.013 or 98.7%). Students' responses showed a small increase in enjoyment, motivation or competence. However, of importance is that these levels were very high before the start of projects.

School 72

School 72 is a main school in the STEM into Action with D&T project. It is an 11-18 Academy, Ofsted rated as Outstanding (May 2013). "We promote high achievement in a learning community. We provide a stimulating and caring environment so that all members of the school can grow in knowledge, skills, understanding and character and achieve to the best of their ability. We have a strong sense of purpose. We encourage our students to be enthusiastic about learning and positive about the future; to have high self-esteem and be confident and successful in what they do; to have understanding and respect for others; to have the ability and desire to further their own development and contribute to the society in which we live. We believe in equality of opportunity and in celebrating success of all kinds." (Source: School 72's website)

The school showcased one project on the website.

2.1 Injection Moulding based on the Injection Moulded Tag project (STEMP013). A 1hr 50 minute activity using the injection moulding resource pack was used to complement an existing Year 7 plastics project. Students had not previously been

able to experience how plastics can be shaped using heat and moulds. This was linked to a homework task to research how plastic products are injection moulded in industry.

One teacher from the school attended one twilight session. Overall level of satisfaction was 100% with all aspects of the session. Specific feedback concerning help and support was, "Continue programme into next year. More links with primary and secondary to understand what skills and knowledge students will arrive within Year 7"

The teacher's response to the statements in the questionnaire indicated a significant increase in confidence in delivery of STEM project in D&T (level of significance before and after, p=0.041 or 95.9%). Students' responses showed no change in enjoyment and motivation, and a highly significant increase in competence (level of significance before and after, p=0.002 or 99.8%). Of particular importance is whilst motivation levels were high from the start, excellent gains have been made in pupil progress.

School 85

School 85 is a main school in the STEM into Action with D&T project. It is an 11-18 Catholic Girls' School. It was rated as Outstanding by Ofsted (March 2008) and described as, "an exceptional school. It is successful, very popular and has a deservedly good reputation. The Catholic ethos underpins the friendly, purposeful environment and reflects the school's core mission of 'Learning through rigour and care'. It is highly effective in providing an inclusive and challenging education where every child is supported and encouraged to do as well as they can." (Source School 85's website)

The school presented one project on the website.

3.1 The Balancing LED Lamp project (STEMP017). This project was used for a STEM day activity of 90 minutes, with mixed age groups working together. The students had some basic electronics and electricity experience. The brief was to design and manufacture a skeleton lamp that uses a centre of gravity to stand upright. The teacher commented that the "students enjoyed working across the age groups as it helped them to bring more knowledge and understanding into the project".

One teacher from the school attended one twilight sessions. Overall level of satisfaction was 100% with all aspects of the session. New knowledge acquired was programming the Crumble.

The teacher's response to the statements in the questionnaire indicated from a high starting point, an insignificant increase in confidence in delivery of STEM project in D&T. Students' responses showed a small increase in enjoyment and motivation, and a significant increase in competence (level of significance before and after, p=0.033 or 96.7%). Of particular importance is whilst motivation levels were high from the start there was a small change, with good gains made in pupil progress.

School 100

School 100 is a main school in the STEM into Action with D&T project. It is an 11-18 Academy, Ofsted rated as Requiring Improvement (February 2014). It "is a school of choice where: Through outstanding teaching, inspirational opportunities and exceptional learning we open-minds and develop unique individuals. Students and staff have the best possible environment in which to achieve progress, learn and thrive. They are

positively focussed, determined and demonstrate respect for all. We are at the heart of our local community, a school in which all students, parents, staff, stakeholders and partners are proud to make success happen." (Source: School 100's website)

The school presented one project on the website.

4.1 The Smartphone Kaleidoscope (STEMP008). This activity was used as a 1 hour focused practical task to enhance an existing project, a USB light. It gave pupils the opportunity to make a kaleidoscope and to incorporate a chosen colour scheme to develop their ongoing USB lamp.

One teacher from the school attended two twilight sessions. Overall level of satisfaction was 100% with all aspects of the session. The session was described as "fun" with "good ideas to try in existing projects". New knowledge acquired was Crumble programming and 'textiles incorporating electronics.

The teacher's response to the statements in the questionnaire indicated an increase in confidence in delivery of STEM project in D&T (level of significance before and after, p=0.18 or 82%). Students' responses showed a small increase in enjoyment and motivation, and a highly significant increase in competence (level of significance before and after, p=0.004 or 99.2%). Of particular importance is whilst motivation levels were high from the start there was a small change, with excellent gains made in pupil progress.

The findings from the above main school examples of best practice are a clear indicator of what is achievable with commitment to participate in all afforded opportunities. A further 2 schools showcased good examples and attended twilight sessions and submitted teacher, but no pupil questionnaires. And 5 schools showcased good examples and attended twilights with no submission of teacher and pupil questionnaires. These schools evidenced imaginative delivery through, for example: linking material tutorial resources to practical projects; STEM clubs; using older students to provide peer-support to younger students; combining multiple resources into a theme.

"Of concern is that whilst there is some good evidence of enhancing schools' curriculum for D&T, it is from a minority of the schools in the project. The overarching outcome of the Theory of Change model interpretation for 'Enhancing the Teaching of STEM through D&T' was, "Pupils engaged in modern 'high tech' D&T. Improved performance at KS3 and beyond." The majority of schools purchased resources intended to achieve this outcome. However, the emerging data-set shows that most of these schools have not yet submitted evidence to show this."

Evidence suggests the project has contributed to the overall aims of LSEF, however at the time of reporting, not to the extent that was originally envisaged. Investing in teaching, subject knowledge and subject specific teaching methods and pedagogy has impacted on the confidence levels of the teachers involved, and this has in turn had an impact on their pupils.

The attempt to development of self-sustaining school-to-school and peer-led activity was only in part successful. The many barriers preventing teachers from different schools coming together to work collaboratively (as has existed in the past) are challenging to overcome as is the cultural shift away from schools working in isolation which is now common.

The concept of teaching excellence through investment in teaching and teachers so that attention is re-focused on knowledge-led teaching and curriculum development is an

important theme for D&T as the necessary subject knowledge changes rapidly in response to technological developments. The project focussed teachers' minds on what their current skills and knowledge levels were and what needed to be addressed. It is recognised that this project could only begin to do this. But there are signs that this project and subsequent activity that emanates from it are contributing to cultural change and raise expectations in the London school system.

10. *Value for Money*

10.1 Apportionment of the costs across the activity

Broad type of activity	Estimated % project activity	£ Estimated cost, including in kind
Project Planning and Development; includes meetings and evaluation, management and admin costs	25%	£122,343.5
Producing/Disseminating Materials/Resources; including web development, resource development, online CPD	40%	£371,662
Teacher CPD (face to face/twilights)	11%	£78,432
Events/Networks for Teachers	11%	£64,077.5
Teacher 1:1 support	12%	£53786
Events/Networks for Pupils	0	
Others as Required – Please detail in full Marketing	1%	£8,000
TOTAL	100%	£698,301

Please provide some commentary reflecting on the balance of activity and costs incurred: Would more or less of some aspects have been better?

It was anticipated from the outset that a large percentage of the budget would be spent on programme design, including the development of the activities and the on-line mechanisms to support teachers. It is recognised that a key component of curriculum development and the adoption of new and modern skills and processes is teacher confidence. Experience has shown that by providing teaching resources, teachers can be 'led by the hand' remotely and are more likely to implement change.

This is reflected in the estimated cost and project activity. These elements of the project will provide the legacy for the work to move forward, with the resources developed and the website remaining freely available to the participating London Schools after the project has ended, as well as the resources being made more widely available nationally through the D&T Association website.

In addition the ITE resource pack which will be made available to providers of D&T related Initial Teacher Education, will continue to extend the reach of the programme providing comprehensive teaching resource to trainee teachers across England. This comes at a time

when nationally, the supply of sufficient teachers to teach D&T and in particular those who have the necessary capability to engage with STEM activity is at question. With ITE being dissipated across a large number of providers (now over 200), with Schools Direct being the Government preferred route for trainees, it cannot be guaranteed that those in training are able to gain any experience in developing skills in for example, electronics or control as their host institutions do not have this expertise.

The project planning and development costs accurately reflect the staffing time to set up, administer and run the project.

Partially due to the number of schools involved in the project, the issue of data collection has been challenging throughout the project. This was in part due to the difficulty in persuading teachers working in the schools to collect and provide us with information requested (lack of time was given as the most common reason for failing to do this) but also the way that cohorts of pupils are organised and managed in different schools in design and technology lessons, using a combination of whole class teaching and dividing classes into smaller teaching groups that rotate through different teachers/specialist areas throughout the year. Further resource to gather this information through school visits would have been useful, but time consuming and expensive.

More of the budget than anticipated was spent on face to face activity. The adjustment was made as a consequence of teachers not being able to secure release from school commitments enabling them to attend CPD sessions. This applied to both day time activity (initial meetings) and also those held after school at a time when it was hoped teachers would be able to travel after teaching finished and still access training lasting between 1hour 30 minutes and 2 hours. In response to this, changes were made allowing the Project Officers to spend more one to one time with individual schools rather running network events, some of which had to be cancelled due to poor or no uptake.

In order to ensure the sustainability of the project moving forward, we recognise that developing networks is a more cost effective way of providing support to teachers and therefore further work needs undertaking to address the insular culture that has developed. Although still not appealing to all, twilight sessions rather than half day events would seem to provide the most attractive solution to teachers, with sessions run from host institutions as close to their place of work as possible. Whilst the four exemplar schools were located in different parts of London and clusters were set up around these, there were still teachers involved in the programme who felt that the events were too far away. On reflection, once the main schools had been identified, it might have been more successful to host further twilights at these schools in an attempt to improve accessibility and provide more extensive support for the teachers.

All of the programme's events concentrated on teacher activity and their personal development through engagement with a variety of training. On reflection and in response to suggestions made by teachers at twilight events and following completion, it would have been interesting to experiment with other approaches that involved working with teachers and pupils together at events created specifically for the purpose. Where this did take place i.e. when a Project Officer worked closely with a school providing support in advance and then during a lesson, it was apparent that confidence was developed more quickly, there being seen to be less risk on behalf of the teacher.

10.2 Commentary of value for money

Please provide some commentary reflecting on the project's overall cost based on the extent to which aims/objectives and targets were met. If possible, draw on insight into similar programmes to comment on whether the programme delivers better or worse value for money than alternatives.

The project has met its deliverables and worked with a large number of schools across London. As previously detailed, the resources which have been developed will be made available to a wider audience, and ensure the sustainability and legacy of the project.

The evaluation evidence provided in section 9 demonstrates that in the schools that have engaged most with the project, there are clear indicators to show that the overall aims and objectives are being met and the nature of D&T activity to include modern STEM teaching and learning has developed. The project aimed to:

- develop a range of resources and associated CPD to address teachers' knowledge and experience gaps at the same time enhancing skill levels and helping develop confidence;
- create a network of centres of excellence that will then train local schools using peer-to-peer methods;
- ensure that STEM teaching keeps abreast of emerging technological developments;
- demonstrate that D&T can, and does underpin the delivery of STEM in the classroom;
- motivate pupils to explore STEM concepts more readily through a range of engaging activities and projects that are 'real world' and relevant;
- encourage more pupils to consider future qualifications and careers that use STEM concepts in an applied context

The evidence shows that the teachers' level of technical competence through the programme has risen, and evidence of STEM awareness has been showcased. There is also evidence to suggest that teacher confidence has increased. Some but not as many as would have been expected have shared their practice through the Showcase on the website and through presenting the results of their pupil's work at twilight events.

It has not been possible to measure whether the project will have an impact on pupils' future exam and career selection. It would be necessary to measure the uptake in D&T GCSE and A levels in these schools over the coming years to be able to accurately measure this area of the project.

It is disappointing that more evidence isn't available to illustrate the engagement of more schools particularly as we know it exists. Teachers were happy to talk about their successes but either due to reluctance or through lack of time, were less inclined to make this more widely available, based sometimes in the belief that it was of less good quality. For reasons previously identified a number of schools engaged minimally with the programme, but there are also schools who did engage but who failed to provide evidence either in the form of completed questionnaires or showcase material on the website.

The significant amount of money that has been invested in this project is not dissimilar to that invested in projects the D&T Association has run previously. These include Electronics in Schools, CAD/CAM in schools and Digital D&T Programme. The experience of these helped inform both the setting up and the running of STEM into Action through D&T but also provides interesting comparisons. Each of these programmes operated with a hub system, providing regular support and training to schools within their region. Evidence from these projects, which all ran for a number of years, showed that sustained support to schools does have an impact on the skills, knowledge and confidence levels of teachers who engage in the activity available.

The evidence collected reflects the impact of the programme on a small number of schools. Supported by the resources and website, which will remain available to both the participating schools and other London schools, this does indicate good value for money.

10.3 Value for money calculations
Note: This section is only required for projects with control or comparison groups

In order to demonstrate the cost effectiveness of the project we would like those projects who had control or comparison groups to provide some value for money calculations. Further guidance will be issued to support projects with this.

11. Reflection on project delivery

Key Enablers and Barriers to Achievement

Internal and or/external factors

- There was an issue with school engagement which has impacted on the project success. 22 schools who originally signed up to the programme, attended cluster meetings, and or/ had face to face visits by Project Officers did not engage in the project Reasons for this are outlined below:

Teacher signed up but then left school, no-one else in department able to take on commitment	7
Teacher's role changed /teaching pressures	7
Shortage of staff in department	1
Pressure of Ofsted	1
No SMT support; poor GCSE results	1
No response – to phone calls, emails, further visit offers	5

- Support from the SMT, time to learn new skills and trial them in lessons: The level of engagement varied widely. Some schools have struggled to find the time to review and select the resources to trial. This is in part dependent on the individual teachers and their commitment to the project and in part due to the level of support from the SMT and the value placed on the subject in school.
- Value of D&T in School: Design and Technology departments are under increasing pressure to retain time in the curriculum as school accountability measures and league tables consistently undervalue the subject. See Appendix 4 – Designed and Made in Britain… A D&T Association campaign flyer outlining the issues and challenges facing the subject.

Ways in which issues have been addressed:

- Where schools have struggled to find time to review and select resources to trial, we have ordered a selection of activities on their behalf.
- Additional face to face CPD sessions were provided for the initial and main schools.
- Project Officers made individual contact with a number of schools either via phone or email, and/or face to face visits, in some instances working alongside teachers to deliver the activity within their school.

What factors need to be in place in order to improve teacher subject knowledge:

- Time in Initial Teacher Education to ensure that newly qualified teachers have sufficient knowledge and skills to teach a modern, and relevant D&T curriculum.
- CPD that improves and extends teachers' subject knowledge which teachers can access.
- Support from SLT to allow teachers to attend CPD and have time to embed learning into the curriculum.

11.2 Management and Delivery Processes

The management and delivery processes were effective. The team of four London based project officers meant that there were experts in place to provide support to all of the participating schools, but in particular the exemplar and initial pilot schools. Access to non-teaching D&T experts is relatively rare and for some teachers, this was the first time in their career that an external subject expert had visited their department during their career, there being no LA subject specialist advisers and very few ex-Advanced skills teachers (ASTs) or new Specialist Leaders of Education (SLEs). Whereas this project was developed with this in mind, providing in the main alternative systems of support that worked on a remote basis, it is interesting to note the positive response to the face to face contact that was on occasions made possible.

Contacting and communicating with the schools was challenging. To try and retain contact with all schools a variety of methods was employed, including DotMailer flyers, social media, phone calls and emails. Some of the project officers shared mobile phone numbers and texted schools with reminders for events. Developing one to one relationships with schools was valuable, but given the number of schools engaged in the project, this was not feasible for all participating schools.

11.3 Future Sustainability and Forward Planning

It is our intention to maintain the STEM into Action with D&T website, and make this and the resources available on the site freely available to all London schools. By opening up the website to all London schools, we anticipate the reach of the project will be extended to schools who weren't involved in the original project. In addition, this will enable the collection of uploaded exemplar work to grow and provide further examples to illustrate to schools what is possible.

The teacher resources which are being developed to support the project will include Schemes of Work, a PowerPoint with teacher notes, and pupil worksheets will be made available through the STEM into Action with D&T website. They will build on the bank of resources already offered by the Association, specifically designed to provide materials to help deliver the requirements of the National Curriculum. The resources will also be made more widely available to all schools through the D&T Association website.

Schools involved in the project continue to be encouraged to provide case studies. These will be used on the website, and also to promote the materials through the D&T Association membership publications.

Additional activity has been identified by the D&T Association, which could be funded by the project under spend.

Based on feedback received from those schools who have participated in the project, and the wider teacher network with whom the Design and Technology Association work, the Association have recognised the need to:

- Support teachers in developing skills to teach iterative design processes and working in contexts – both a key requirement of the Programmes of Study and the new GCSE for D&T.
- Provide support, advice and guidance for teachers to address the new D&T GCSE and how the high tech elements can be taught.
- Provide further support in the use of programmable components, relevant to those teachers – for instance those teaching textiles who currently have little knowledge and experience. To be able to teach the new D&T GCSE, which is to be first taught in September 2017, knowledge and understanding of this aspect will become a requirement.

The additional activity has been identified in light of feedback from participating schools; evidence from the project evaluation carried out by Loughborough University and from the recent Annual Survey undertaken by the Design and Technology Association which has clearly identified these issues as priority areas for teachers/the subject.

The material developed and the planned courses will further embed the learning from the original outcomes of the STEM into Action with D&T project, as well as continuing to strengthen and support the network of teachers we have worked with.

We intend to capitalise on the interest and related concerns being expressed by teachers as a consequence of the significant changes being proposed for GCSE. Teachers feel inadequately equipped and want to know how and what they need to change at KS4, but also in preparation, at KS3. The resources and the CPD will provide the opportunity for them to make use of the resources already produced but will be accompanied by new resources targeted at KS4. We believe that this can form the basis on which support hubs can be built in the future, to enable the work to continue and be self sustaining.

Project knowledge will be used to inform future proposals; in particular the lessons learned from the project, and the evaluation methods employed

12. Final Report Conclusion

The evaluation suggests that the following outcomes were achieved:

- D&T KS3 in participating schools activity was modernised in ways that can support STEM teaching and learning;
- D&T Teachers subject knowledge was enhanced as a direct consequence of engaging with the programme;

The following outcomes were partly achieved:

- Students' understanding of STEM and the links between different STEM subjects was increased;
- D&T teachers engaged with teachers from other STEM disciplines in their own schools but not as extensively as is desired;
- The supporting resources provide a catalysis that encourages interaction between teachers of different disciplines but their use as such depended to a large degree on

the D&T teachers' commitment to developing cross curricular connections and the additional resources such as time to do so.

There is insufficient evidence to confidently state whether:

- Pupil attitudes toward D&T were enhanced and they demonstrated increased motivation as a direct consequence of the intervention. D&T is a naturally popular subject and as a predominately practical subject, is intrinsically motivating.
- Teachers developed a better understanding of the connection between STEM subjects and D&T's contribution. Because in many of the schools, STEM exists only as a convenient 'label' as opposed to a thread that pervades curriculum design and delivery, the concept and benefits of making curriculum links remains underdeveloped.
- The peer to peer support network extended beyond the life of the programme. Undoubtedly links between some schools and individual teachers will continue to be maintained but it is too early to confidently state the longer term effect of attempts to develop a self maintaining peer to peer network.
- The resources continue to be used and valued by the participating D&T community.

Key lessons learnt for assessment of project delivery

What activities/approaches worked well?

- The use of Project Officers able to provide a range of support to the schools was successful. Providing them with the autonomy to be proactive and react appropriately to requests from schools based on experience worked well. The range of support from email and telephone support, to visits and in some instances short term team teaching with schools where teacher confidence/expertise was low, was very well received by schools and effective.
- Where teachers engaged in the twilight sessions, they were well received and provided them with new skills, ideas and network opportunities. Face to face events though problematic to set up and challenging to achieve attendance, were obviously beneficial – particularly when dealing with the introduction of practical curriculum activity.
- The showcase repository provided an opportunity for schools to share examples of their work; providing ideas for other teachers to try in their own schools.

What activities/approaches worked less well?

- Initially the CPD sessions were planned as an opportunity to bring together all of the teachers involved in the project to start to develop the network. It was felt that this would at an early stage encourage participation and collaborative working. However because, particularly due to the issues with teacher release, these events were duplicated in order to provide more choice, teachers did not all have the chance to meet at the start of the project. In addition, because most of the events designed to support the initiative were moved from day time to twilight, less overall time was available for networking and developing relationships.

What difficulties were encountered in delivery and how could they be mitigated in the future?

- Achieving attendance at events was ultimately one of the major challenges. In some cases, teachers failed to sign up to attend any training, or failed to attend events they had booked.

Mitigation in the future:

- Signed up support from the SLT to ensure that the teacher is allowed time to attend events.
- Charge a small fee for attendance to ensure teachers' value the training; free events are not always as valued as paid for events.

Informing future delivery

On reflection, the project should have:

- Offered more opportunities for the teachers to network through increasing the number of schools running twilight events throughout the project.
- Offered more contact between members of each school's SLT and the Project Officers to ensure support at a higher level and involvement of staff at a senior level. It proved insufficient to concentrate only on teachers and assume subsequent involvement of subject leaders.
- Provided more teaching resources for schools earlier on in the project. Having more worked examples and exemplar materials easily accessible would have been beneficial.

On reflection, the project should have offered less:

- At the outset a number of schools were overwhelmed with the choice of physical materials available from Mindsets for them to trial (although not all teaching activities were initially available) and they found it difficult to select which tasks would be most appropriate for their individual school circumstance. On reflection, it may have been more appropriate with some schools to be more prescriptive and restrict the element of choice, suggesting a smaller number of activities. This could have also been accompanied by an orchestrated process of implementation, although this would have been dependant on a longer lead in time and increased one to one support.

Final recommendations:

Evidence, including verbal feedback from the participating teachers involved, indicates that had the project run for another year and continued to offer a range of support sessions, engagement with the initiative would have had greater impact. In some instances the schools were slow to engage with the curriculum activity provided even though they demonstrated initially they were keen to do so. In some cases, by the time they had purchased and started to trial the activities the project and its associated support had finished.

We would recommend that a project of this type should run for a minimum of 3 years in order to establish a strong, viable network of schools; and better allow for evidence of impact in schools to be identified and collected. Collecting more information about the individual school departments and any existing links being made between D&T and other STEM subjects before the intervention took place would have been helpful as would a longer lead time allowing schools to plan the use of resources and strategies for the following school year. If this activity had been made possible in the main schools in the summer term preceding the beginning of the following school year, transition would have been less rushed.

Ensuring more formal engagement of other STEM teachers in the participating schools by increasing the requirement to identify another individual from science or mathematics would help ensure that further cross subject discussion took place in school and would provide additional and more immediate points of contact and support.

Enhancing the teaching of STEM through Design and Technology Project, LSEFR12

Evaluation Plan

Outputs	Indicators of Outputs	Baseline data collection	Impact data collection
100 downloadable teaching and learning resources were produced to support the programme (learning activities, homework activities, 5 minute taster sessions, 6 week project plans) that address teachers' knowledge gaps April 2014 - Sept 2015	The resources have been produced and made available to teachers in Main schools. Resources have been accessed and planning to use them in teaching in schools has been undertaken. January 2014 – April 2015	Number of schools planning to use each of the resources collected. Schools complete a return questionnaire itemising the minimum number of resources they plan to use. The number of online downloads is also logged giving an indication of the initial interest in individual resources.	Having accessed and planned to use the resources, teachers complete an online questionnaire relating to their pupils experience. Examples of additional resources developed by teachers and examples of their pupils work uploaded to the project website exemplar section. (September 2014 – April 2015)
Programme of CPD training (to include afternoon /twilight sessions) was delivered Jan 2014 – April 2015	2 CPD sessions for Exemplar Schools (Feb/April 2014) 1 CPD sessions for Initial Pilot schools (April/ May 2014) 1 CPD session for Main Schools (Sept – Oct 2014)	Registers of attendance completed indicating number of teachers accessing CPD. Teachers attending complete tick box questionnaire indicating: gender; distance travelled to attend; average length of time per year they access subject specific CPD. Skills profile of D&T teachers attending collected using self assessment template issued to participants.	Attendance lists of CPD sessions Reasons for non attendees or intermittent attendees collected Participants' evaluation forms collated into feedback report
Programme of face-to-face twilight sessions was delivered	16 Twilight sessions for Exemplar Schools (March – September 2014)	Number of teachers attending; gender of teachers attending;	Attendance lists of CPD sessions Analysis of reasons for non attendees or

March 2014 – April 2015	20 Twilight sessions for Initial Pilot schools (May – Oct 2014) 24 Twilight session for Main Schools (October – April 2015)	distance travelled to attend; average length of time spent on CPD over programme's life	intermittent attendees Participants' evaluation forms collated into feedback
Centres of Excellence possessing more detailed knowledge of the resources were established Sept 2014	Four Centres of Excellence (using Exemplar Schools) were initially created in Pilot Phase. This was extended to 24 in Delivery Phase to include 20 Initial Pilot schools	Questionnaire completed by teachers involved in pilot phase. Includes data with respect to: Number of teachers involved in each Pilot phase school; seniority levels; length of teaching experience, gender and ethnicity	Brief case study of each Pilot phase school compiled from data supplied. Includes feedback as to teachers perceptions of effectiveness of the project resources they have engaged with
A peer-to-peer network for school support was established with teachers participating in the project able to link with others April 2014	Peer-to-peer support network successfully created and utilised in Pilot Phase. (April 2014). A map of hubs linked to Initial pilot schools created and in turn linked to Main schools (May – October 2014)	Map of support network supplied to participating schools containing names and contact details (October 2014)	Level of interaction between peer-to-peer schools. Schools complete online questionnaire questions in April/May 2015 indicating links made and their respective value
A Resource Pack for Initial Teacher and Teaching Schools was created Jan 2015	Resource Pack containing a range of resources delivered	London designated Teaching Schools contacted by letter and invited to attend a bespoke ITT meeting to consider use of the resource pack	Self evaluation questionnaire completed by lead teacher trainers indicating usefulness of the resources and inclusion in training programmes June 2015
Outputs **Teacher outcomes**	**Indicators of Outcomes**	**Baseline data collection**	**Impact data collection**
D&T KS3 activity was modernised to support STEM teaching and learning	Nature of some of the pupil activities is different to that which was typical before and includes for example, some teaching and learning of electronics. Resources have been adopted requiring acquisition of replacement consumable materials and components	Pre intervention audit of current activity mapped against Technical knowledge aspects of D&T Programme of study completed by teachers. Teachers complete a short self-audit tool issued at the initial meeting with Main schools. (Sept/Oct 2014)	Audit of activity post intervention, engaging with CPD and using resources, mapped against Technical knowledge aspects of D&T PoS Criteria set by project officers using the D&T Association Progression framework as a basis for the audit (May – July 2015)

D&T teachers' subject knowledge was enhanced as a direct consequence of engaging with the programme	Teachers worked confidently with new activities and resources that require a level of technical knowledge frequently lacking	Teachers skill and experience audit completed using data collection tool issued at initial meeting with Main school teachers and completed electronically (Sept/Oct 2014)	Audit completed again post intervention. Issued electronically to enable comparison with baseline data (May- July 2015)
Pupil Outcomes	**Indicators of Outcomes**	**Baseline data collection**	**Impact data collection**
Students' understanding of STEM and the links between different STEM subjects was increased	Key Stage 3 teacher assessments of pupil knowledge or development of a test Use of control group or RCT to be explored with external evaluator	Sample pupil survey on relationship between the subject areas (to be explored with external evaluator) (April – July 2015)	Investigate possibility of developing an assessed D&T designing task which required use of knowledge from the other subject areas (April – July 2015)
Pupils' attitudes toward D&T were enhanced and they demonstrated increased motivation in D&T lessons	Pupils' demonstrate increased enjoyment of designing and making in response to the replacement challenges being set.	Pre intervention survey completed by one class of individual pupils in 10 Main schools. Short questionnaire provided to teacher to administer and return Sept 2014	Survey completed by same pupils following engagement with resources. April 2015
School System / 'Culture Change' Outcomes	**Indicators of Outcomes**	**Baseline data collection**	**Impact data collection**
D&T teachers engaged with teachers from other STEM disciplines in their own schools	Cross curricular planning has taken place between subject teachers Teachers aware of content of other subjects NC PoS and school schemes of work	Pre intervention audit of teachers current experience of planning with other subject members of staff collected through initial survey introduced at initial meeting with Main school teachers (Sept/October 2014)	Audit of teachers engagement with other STEM subject specialists in their school following intervention. Data collected using 20 (25% of Mainschools) telephone interviews conducted by project officers and compared with baseline data (May – July 2015)

Teachers developed a better understanding of the connection between STEM subjects and D&T's contribution They were able to raise the profile of D&T within their school	Teaching and learning in D&T includes references to other STEM subject knowledge	Pre intervention audit of science and mathematics reference in current SoW – Main school teachers complete check list (Sept/October 2014)	Repeat audit of science and mathematics reference in SoW – Same teachers complete check list indicating where changes have been made or are planned to be made (May – July 2015)
The peer-to-peer support network extended beyond the life of the programme July 2015	Teachers engaging with one another and exchanging experiences and ideas	All participant teachers provide details including: Whether they are already members of the D&T Association? Attendance at national or local D&T Association events Attendance at other relevant national or local events Named links they have with D&T teachers in other London schools (Sept/Oct 2014)	From membership statistics: Number of teachers continuing as members of the D&T Association Number of teachers subsequently joined the D&T Association From electronic questionnaire: Number of interactions: visits, email/phone correspondence with others involved in the programme Adoption of ideas/teaching resources acquired as a consequence of peer to peer support (April – July 2015)
The resources and activities were and continue to be valued by the D&T community. As a consequence, they included them within their SoW and replaced resources/activities they were using prior to the intervention.	Change in the proportion of Mindsets high tech physical resources being consumed by London schools.	Sales/shipping data from Mindsets Autumn term 2013	Sales/shipping data form Mindsets Summer 2014 and monthly thereafter (Some of the rise will be as a direct consequence of schools completing tasks within initiative but there may be an additional increase indicating additional take up.)

Theory of Change: Enhancing the teaching of STEM through D&T

Key

Activity

Long term goal

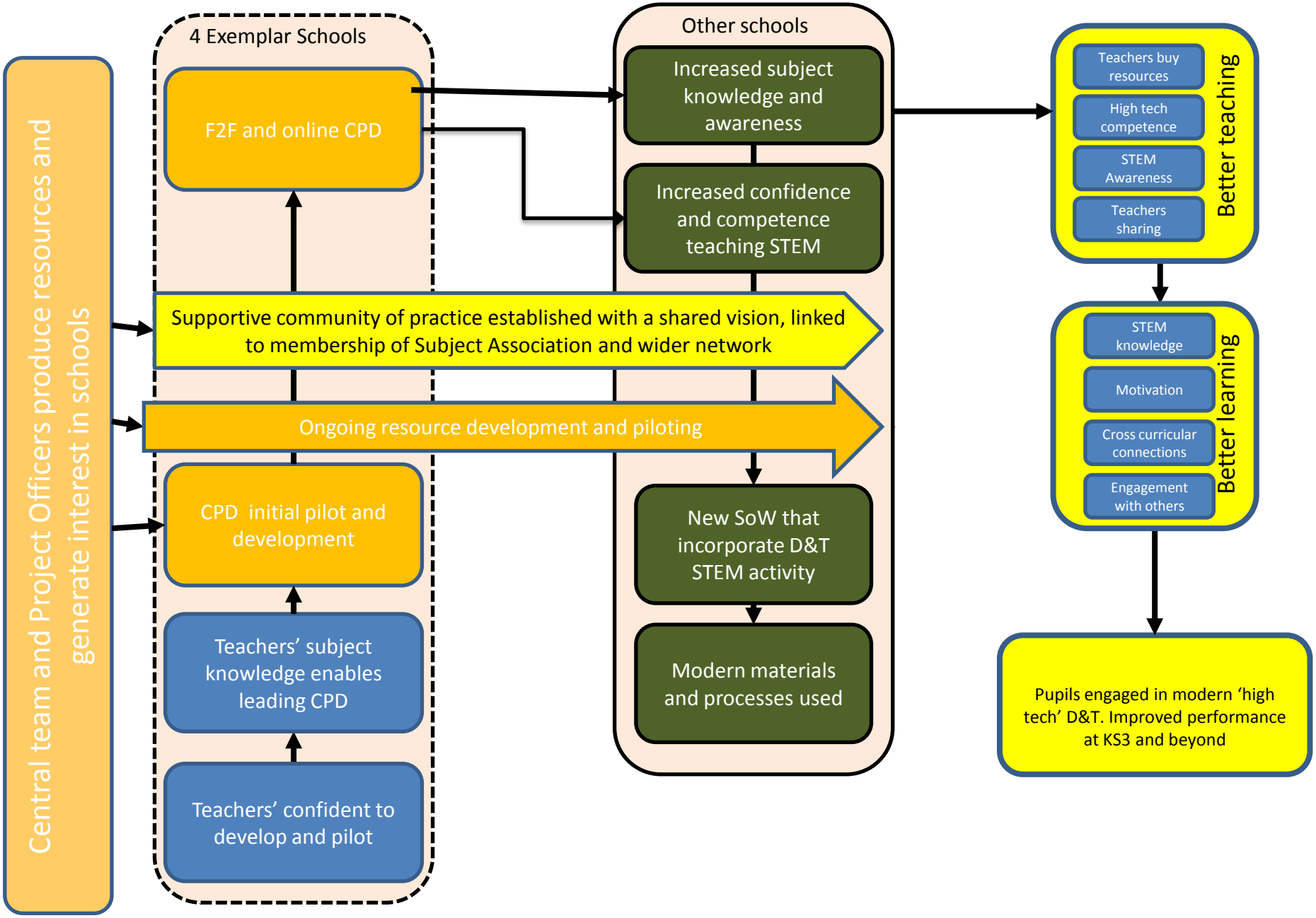
Outcomes

Assumptions

Acronyms

CPD	Continuous professional development
F2F	Face-to-face
SoW	Schemes of work
KS3	Key stage 3

Theory of Change: Enhancing the teaching of STEM through D&T



Annex 3 - Pupil Data Tables 6 - 7

School No.	No. Pupils	% LAC	% FSM	% FSM last 6 yrs	% EAL	% SEN		%. Male pupils	%. Female pupils	No. KS4 pupils	% Lower attaining	% Middle attaining	% Higher attaining
1	1514	nd	7.3	17.7	6.1	3		4.6	95.4	208	11	54	35
2	1038	nd	29.9	57.4	38.9	7		56.6	43.4	149	12	56	31
3	1340	nd	9.9	24.4	42.6	8.1		61.8	38.2	208	9	61	30
4	766	nd	23.2	40.1	24.7	12.5		54.3	45.7	143	15	53	32
5	809	nd	25.9	42	59.8	7.2		51.1	48.9	115	24	64	12
6	1774	nd	19.8	47.2	49.8	8.3		2.5	97.5	277	12	43	45
7	1449	nd	1.6	3.8	5.3	6.1		49.8	50.2	201	2	21	77
8	1143	nd	16.1	34.3	39	7.4		0	100	186	5	59	36
9	1255	nd	19.8	45.1	53.5	8.4		99.2	0.8	170	12	66	22
10	606	nd	36.6	67.7	56.3	8.7		0	100	120	14	67	19
11	1960	nd	11.7	23.7	27.9	4.3		51.9	48.1	248	10	30	60
12	1087	nd	12.7	26.2	18.9	7.9		56.7	43.3	212	9	40	51
13	1644	nd	3.5	10.4	2.2	7.1		48.2	51.8	237	6	49	45
14	1538	nd	8.3	17.1	13.1	3.8		49.9	50.1	247	8	52	40
15	1123	nd	12	21.9	24	5		64.5	35.5	179	9	47	44
16	1647	nd	3.3	8.6	11.5	6.7		4.2	95.8	240	5	52	42
17	1041	nd	1.7	3.9	9.4	0.4		5	95	137	0	4	96
18	1157	nd	25.5	39.8	26.7	5.6		55.9	44.1	219	14	65	22
19	1511	nd	4.7	11.9	4.2	7.4		95.4	4.6	217	7	52	41
20	780	nd	48.8	74.7	84.6	9.4		58.6	41.4	115	22	65	13
21	1311	nd	11.4	22.5	30.8	3.6		2.1	97.9	207	13	58	38
22	1434	nd	3.1	10.4	12	2.9		3.3	96.7	209	0	10	90
23	992	nd	15.8	22.8	12.5	3.9		51.9	48.1	171	12	53	35
24	594	nd	32.9	56.7	38.7	9.3		51	49	118	18	60	22
25	2019	nd	20	35	41	7.4		51.2	48.8	275	15	53	32
26	1655	nd	13	21.8	64.5	6.6		55	45	251	9	52	39
27	918	nd	53	73.1	75.4	12.2		58.6	41.1	143	21	65	14
28	1243	nd	3.4	8.3	8	6.5		47.9	52.1	183	5	55	40
29	1096	nd	11.8	26.3	53.1	11		58.9	41.1	165	12	60	27
30	743	nd	19.9	39	12.7	9.3		51.4	48.6	157	17	49	35
31	1167	nd	28.9	49.8	61.6	3.3		54.7	45.3	216	20	50	30
32	1472	nd	23.3	46.4	68.3	13.5		50	50	121	19	53	28
33	nd	nd											
34	1209	nd	22.6	36.9	12.5	12.2		97.8	2.2	205	20	59	21
35	1282	nd	22.5	36.7	20	10.5		0.9	99.1	226	17	63	20
36	1229	nd	20.6	30.3	46.1	6.4		55.3	44.7	187	14	61	26
37	1134	nd	16.6	30.8	6.7	6.4		53.9	46.1	162	19	49	32
38	1308	nd	22.5	38.2	27.1	6		50.2	49.8	206	10	60	30
39	577	nd	35.9	52.3	15.1	5.2		44	56	100	22	67	12
40	891	nd	57.6	68.2	69.8	8.9		45	55	160	31	43	26
41	1411	nd	21.4	36.9	17.4	18.9		98.8	1.2	224	17	58	25
42	792	nd	27.7	51.5	42.8	29.3		52.9	47.1	155	27	58	15
43	767	nd	7.2	14.9	5	4.3		54.6	45.4	184	10	54	36
44	1841	nd	23.1	42.5	45	10.5		51	49	241	18	61	21
45	1641	nd	14.7	30.5	18	13		53.5	46.5	250	11	50	39
46	1786	nd	12.7	37.7	22.9	5.3		50.8	49.2	196	11	48	41
47	795	nd	18.7	36.9	8.8	10.8		55.7	44.3				
48	962	nd	4.1	9.6	2.6	8.5		55.3	44.7	192	12	58	30
49	1259	nd	29.6	57.5	41.3	3.9		56.3	43.7	199	19	56	25
50	1075	nd	25.1	51.8	74	3.6		50.4	49.6	201	32	53	16
51	1004	nd	24.5	50.3	31.8	4.4		55.4	44.6	137	13	65	22
52	1225	nd	43	72.7	70	16.5		59.3	40.7	202	22	54	24
53	1140	nd	19.5	38.9	24.1	15.3		53.2	46.8	174	15	59	26
54	nd	nd											
55	nd	nd											
56	1038	nd	30.1	53.6	47.8	9		1.2	98.8	217	16	55	30
57	923	nd	4.5	10.5	65.4	2.4		100	0	120	0	17	83
58	890	nd	37	51.4	42.4	15.6		60	40	165	27	55	18
59	1220	nd	20.9	38.5	33	2.3		4.3	95.7	179	8	51	41
60	698	nd	8.7	23.1	14.3	3.6		0	100	88	8	44	48
61	1371	nd	3.5	9	30.9	0.9		57.7	42.3	181	0	1	99
62	1491	nd	11.3	19.4	3	6.1		58.9	41.1	233	12	71	17
63	726	nd	72.9	96.7	57.4	11.8		55.2	44.8	122	28	62	10
64	674	nd	20.6	46.1	24.3	16.3		97.9	2.1	109	12	44	43
65	2405	nd	36.6	47.9	82.8	11.7		53.7	46.3				
66	1711	nd	10.2	25.8	27.6	8.5		52.6	47.4	241	5	41	54
67	35	nd	54.3	91.4	0	100		100	0	7	86	14	0
68	1158	nd	22.5	36.9	21.5	3.8		2.1	97.9	195	14	57	30
69	468	nd	34.8	51.7	71.6	13.9		100		102	17	57	25
70	1009	nd	36.7	56.6	36.6	7.8		50	50	181	20	53	27
71	1195	nd	50.1	71.9	83.7	12.2		51.6	48.4	176	26	56	18
72	1632	nd	14.5	23.7	63.2	3.9		53.6	46.4	281	7	45	48
73	1019	nd	45.1	65	38.5	12.9		62.7	37.3	178	20	57	24
74	865	nd	18	34.2	22.4	1.7		10.5	89.5	115	8	54	38
75	1366	nd	51.2	70.9	65.9	26.9		55.1	44.9	206	20	53	28
76	995	nd	20.2	36.3	32.3	7.5		50.9	49.1	180	17	56	27
77	999	nd	38.7	66	52.8	11.2		98.7	1.3	149	18	63	19

78	1369	nd	23.3	39.4	39.3	4.5		6.2	93.8	186	13	55	32
79	1294	nd	32.9	39.9	51.2	8.3		100		186	12	60	28
80	1060	nd	7.1	16.9	17.5	2.4		0	100	210	7	67	26
81	357	nd	34.6	58.3	54.3	11.8		10.9	89.1	86	27	69	5
82	869	nd	23.3	53	36.5	12.7		2.2	97.8	147	15	58	26
83	974	nd		2.5	20.1	1.7		87.9	12.1	118	0	0	100
84	1112	nd	9.7	18	26.1	6.9		59.4	40.6	179	14	58	28
85	1235	nd	5.8	13	14.7	2.1		0	100	190	3	42	55
86	nd	nd											
87	1005	nd	38.7	49.6	24.5	12		53.2	46.8	173	25	58	17
88	1226	nd	57.6	77.9	86.5	16.1		70.6	29.4	204	21	60	20
89	945	nd	13.3	27.4	12.3	4.9		54.1	45.9				
90	727	nd	39.5	63.6	39.6	10.6		58.3	41.7				
91	913	nd	32.9	45.6	60.2	3.7		53.3	46.7	168	21	59	20
92	nd	nd											
93	1072	nd	35	40.7	48.7	18.1		7.6	92.4	148	5	39	56
94	778	nd	16.2	23.5	45.5	2.3		0	100	120	12	46	42
95	805	nd	50.3	76.1	58.3	24.3		62.5	37.5	126	41	54	5
96	1657	nd	26.1	46.5	26.9	12.3		55.9	44.1	235	14	60	26
97	763	nd	34.4	49.2	46	6.8		64.9	35.1	148	22	50	28
98	nd	nd											
99	1432	nd	11.2	18.3	9.5	6.8		56.7	43.3	187	10	57	33
100	1244	nd	27.3	41.7	46.4	2.2		59.1	40.9	176	17	556	27
101	1309	nd	21.1	34.2	78.1	5.7		53.1	46.9	182	16	47	37
102	756	nd	27.5	51.2	66	5.2		95.1	4.9	124	13	56	31
103	807	nd	45.1	69.9	67	11.2		56.3	43.7	170	39	50	11

DESIGNED AND MADE IN BRITAIN...?

Design and Technology in schools is critical to the UK's future success.

Act Now!

D&T the design and technology association

With the introduction of the National Curriculum in 1989 England and Wales were the first countries in the world to establish D&T as a statutory entitlement for all pupils. It is ironic that whilst our achievements in D&T education are seen as world-leading and worthy of replication in other parts of the world, they come under repeated question in the UK.

What are the issues?

Critical shortage of qualified D&T teachers

- Uncertainty about D&T teaching career prospects and status caused by successive curriculum changes.
- Recruitment into D&T Initial Teacher Training (ITT) 50% below target for the last 2 years.
- At least 1,200 fewer secondary D&T teachers in the system than needed from September 2015 – 1 in 3 schools will be a teacher short.
- Many primary trainee teachers receive less than 6 hours training for D&T.

Need for a modern D&T curriculum and workforce

- Insufficient use of 21st century digital technologies in some secondary schools reduces curriculum relevance for pupils and employers.
- Difficulties for secondary teachers to access Continuing Professional Development (CPD) to keep up-to-date with rapid changes in design and manufacturing processes and material technologies.
- Lack of primary D&T subject expertise, particularly in more technical aspects.
- Most primary teachers have received little or no D&T CPD in recent years.
- Often inadequate funding for resources, equipment and consumable materials in many schools.

Latest estimates are that the UK will need:

1.82 million new engineers in the decade up to 2022 (Engineering UK, 2015)

1 million people to fill new creative jobs by 2030 (Nesta, 2015)

Effect of school accountability measures and league tables

- Current Government policy acts against a broad and balanced curriculum to meet all pupils' needs, interests and aptitudes.
- Pupils in Academies or Free schools have no entitlement to D&T education – currently this includes 61% of secondary schools and 15% of primary schools.
- Primary schools judged on pupils' performance in English and mathematics, which take over 50% of teaching time – compared with 5% or less for D&T.
- Secondary schools are judged on pupils' GCSE grades in English Baccalaureate (EBacc) subjects (English, mathematics, history or geography, science and a language) – reduced incentive for subjects like D&T.
- No secondary school can be considered 'Outstanding' by Ofsted from September 2015 unless all pupils do well in EBacc subjects – a further disincentive for subjects like D&T.
- D&T increasingly marginalised, and in some schools being cut, with additional impacts on related areas of learning including: computing; coding; cooking and nutrition; health and well-being education.

Serious decline in GCSE numbers

- The loss of statutory status and current accountability measures have caused a 50% fall in D&T GCSE entries from 2003 to 2014 (D&T was a compulsory GCSE until 2004).
- Craft-related GCSE entries fell 25% from 2007 to 2013.

Every child is entitled to the unique contribution that D&T makes to their educational experience. If we are to preserve the subject, and our world lead, for the benefit of future generations of young people immediate and co-ordinated action is required by Government, employers in design and technology-related industries and the D&T community itself.

What must happen?

Government should:

- Make a creative and/or technical subject compulsory for all pupils at Key Stage 4.
- Address D&T teacher shortages through increased bursary incentives to attract the best entrants into secondary ITT and require all primary trainees to have sufficient D&T training.
- Ensure new D&T GCSE and GCE qualifications have credibility and status with universities.
- Promote wider understanding of D&T, its contribution to STEM and to career paths in engineering and the creative industries.
- Require Ofsted to acknowledge D&T's contribution to all young people's learning.

Awarding Organisations and Ofqual should:

- Develop GCSE and GCE qualifications that support modernisation of the subject and reward innovation, risk taking and entrepreneurship.

D&T-related employers should:

- Highlight D&T's value to Government departments through their companies, professional institutions and organisations.
- Collaborate with teachers in the development of real-life and relevant D&T activities and resources.
- Help teachers to provide opportunities for learners to engage with professional practice through study visits and work experience.

The D&T community should:

- Modernise and develop the curriculum to make it fit for the 21st century.
- Provide CPD that improves and extends teachers' subject knowledge – especially in digital and more technical aspects in both primary and secondary phases.
- Encourage collaboration across schools, colleges and universities to support progression of experience and learning – from Early Years to Postgraduate.
- Take every opportunity to publicise D&T, and related careers, to parents, school management, governors and employers.

The D&T Association will:

- Lobby Government to implement the required actions without delay.
- Work to increase understanding of D&T at policy level and encourage MPs to visit schools to see D&T in action.
- Support and advise Awarding Organisations in the development of new qualifications.
- Draw on design and manufacturing industries' expertise to ensure practice in schools supports employers' needs.
- Actively challenge and support schools to improve the quality of D&T on offer.
- Provide resources to support high quality D&T training, teaching and learning.

D&T the design and technology association







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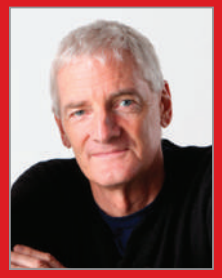

"Design and Technology is a phenomenally important subject. Logical, creative and practical, it's the only opportunity students have to apply what they learn in Maths and Science – directly preparing them for a career in engineering. Policy-makers must recognise D&T's significance and strive not just to preserve it, but to make sure it appeals to the brightest of young minds."

Sir James Dyson, Founder and Chairman of Dyson and Patron to the D&T Association

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DESIGNED AND MADE IN BRITAIN...?

D&T education makes a unique and valuable contribution to the education and preparation for life for every child – at work or leisure. For some it can be the start-point for highly satisfying and successful careers in industries that bring increasing economic benefit to the UK.

What are the pressures?

The UK's emergence from economic difficulty is revealing significant areas of weakness, particularly relating to skills shortages. It comes as no surprise therefore, that many associations and organisations in engineering and the creative industries are engaged in campaigns to raise awareness about the shortfall in the availability of suitably qualified workers. Pressures on the school curriculum, alongside outdated perceptions of these areas of activity, are preventing young people from making subject choices that can lead to a wide range of engaging careers.

National context

Reducing creative and technical education threatens the UK's recovery from economic downturn. The consequences go beyond pure economics in terms of the well-being of individuals and society. Many of the shortfalls centre around skills shortages in engineering, manufacturing and the creative industries, which are predicted to grow strongly and contribute billions of pounds to the UK's economy. Estimates are that the UK will need:

- 1.82 million new engineers in the decade up to 2022 (Engineering UK, 2015)
- One million new creative jobs by 2030 (Nesta, 2015)

By contrast, the number of 18 year-olds available to progress into Further and Higher Education will decrease (by 8.9%) in the decade up to 2022 (Department for Business, Innovation & Skills, 2011). Additionally, employers consistently state that current curriculum and qualifications systems are not delivering the skill sets they look for in young people entering employment (Confederation of British Industry, 2015).

D&T: status and marginalisation

D&T is nearing a point where the decline in participation threatens its critical mass and thereby endangers its future. Growing evidence from secondary schools shows that D&T is often sidelined and, in some schools, is being cut from the curriculum altogether. In primary schools D&T has been on the margins for some years and the ever-increasing focus on English and mathematics leaves less time for other subject learning.

More than a third of secondary schools responded to a D&T Association survey in March this year. The following points emerged from the schools' responses:

- 89% agreed that Progress 8 and EBacc measures are influencing option choices and result in lower D&T GCSE numbers.
- 83% agreed that changes in curriculum time allocation and numbers taught are likely to reduce D&T staffing.
- 35% indicated that compared with last year, D&T curriculum time at Key Stage 3 (Years 7 to 9) will be reduced from September 2015.

Schools reported that D&T is consistently being undervalued by comparison with EBacc subjects. In the most extreme cases students are actively discouraged from opting for D&T, or prevented from doing so through the restricted curriculum choices on offer.

Many referred to more able students being persuaded not to choose D&T, in favour of additional EBacc subjects. Given these pressures, numbers will inevitably decline and the full ability range will not be represented across the GCSE entry.

Modernising the D&T curriculum

The pace of technological change over the past 26 years has brought many additional demands to the D&T curriculum, in terms of areas of learning to be included such as digital design and manufacture (CAD/CAM).

During this same period a lack of funding for resources and restricted access to Continuing Professional Development for teachers has limited the continuing review and development required to ensure that the curriculum on offer remains up-to-date and serves both pupils' and employers' needs.

Initial Teacher Training (ITT)

Most newly qualified primary teachers start their careers with insufficient subject expertise to teach D&T well. In the secondary sector take-up by ITT applicants is the lowest of any subject, leading to a chronic shortage of qualified teachers. Bursaries provided to incentivise the study of shortage subjects are imbalanced (up to £25,000 for mathematics, physics, chemistry, computing and languages; up to just £12,000 for D&T).

Only 2 undergraduate ITT programmes remain in England. The majority of training is delivered through school-based routes, linked to universities with little knowledge of D&T education. Many schools report difficulty in filling teacher vacancies – increasing the likelihood of the subject being marginalised.

Purpose of Study

'Design and Technology is an inspiring, rigorous and practical subject. Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants and values. They acquire a broad range of subject knowledge and draw on disciplines such as mathematics, science, engineering, computing and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising and capable citizens. Through the evaluation of past and present design and technology, they develop a critical understanding of its impact on daily life and the wider world. High-quality design and technology education makes an essential contribution to the creativity, culture, wealth and well-being of the nation.'

National Curriculum in England: Design and Technology programmes of study, Department for Education, September 2013

What does D&T offer?

Given its breadth and depth D&T has much to offer across a wide range of career paths in engineering, manufacturing and the creative industries. In addition to learning about designing and making processes, materials technology and programmable systems and control, D&T contributes to the development of important life skills and personal qualities such as team working, risk taking and enterprise.

All learning is best secured by the successful application of knowledge, skills and understanding in different contexts. The D&T curriculum provides many opportunities for literacy, numeracy, computing and scientific knowledge and understanding to be practically applied across all stages of education.

Design thinking

The rigorous process that underpins designing and making activity demands both creative speculation and logical decision making to arrive at valid, and better, solutions. The essential core of D&T lies within the balances between: creativity and control; and thought and action. These thinking and practical skills are invaluable to each and every individual.

Evaluation of products and services

Industry and consumerism are now integral parts of our culture and everyone needs to be equipped to play their part, be it through contribution or response. D&T helps pupils express preference and exercise influence on their spending decisions and in doing so challenge manufacturers' and suppliers' assumptions about the quality or suitability of products and services – especially important when safety or well-being are at stake.

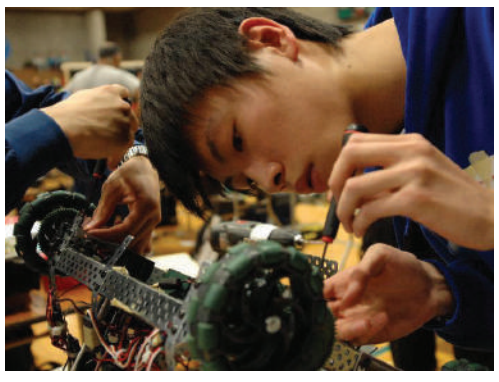
Skills for life

Through engaging with designing and making activities in D&T young people develop a range of skills and personal qualities which will support them through life – and are valued by employers. These skills include independence, team working, resilience, resourcefulness, risk taking and entrepreneurship.

In summary

It is D&T that supports the development of a wide range of capabilities, within and beyond immediate subject content, which forms an essential part of education and preparation for life for all young people. For some this will be the start-point of graduate, technician or craft level careers in the creative, engineering and manufacturing sectors. But, D&T is for all and it must also be right that decision makers at a public level, including county councillors, politicians and company executives, have the skills, knowledge and understanding to take actions that best promote quality of life, protect security and preserve the environment.

We therefore owe it to all young people in education now, the generations to come, the well-being of society and the UK's future success to do whatever we can to retain and develop D&T education...while we can and before it's too late!



Technological understanding

Through modern and developing technologies we exert an ever-greater influence on our surroundings by making improvements to housing, transport, communications and the everyday objects we use, at work and in leisure. D&T helps to develop the knowledge, skills and understanding which makes this possible. It also prepares young people to meet the future challenges of sustainability, in the face of increasing world population, climate change and finite resources, and to continue the development and control of technological advances.

D&T the design and technology association

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DESIGNED AND MADE IN BRITAIN...?

"Design and Technology is a key subject in drawing the next generation towards engineering. It makes a critical link between science and mathematics and provides real-world contexts in which these subjects can be applied through design. But D&T is not just about future engineers. By teaching D&T we are ensuring that all children are not passive bystanders in our increasingly technology driven world but are informed citizens who understand how design impacts on their quality of life and how technology can be used for the benefit of mankind."

Dr Rhys Morgan, Director of Education, Royal Academy of Engineering

"It is clear to me that D&T offers an unrivalled opportunity to inspire more young people towards a career in engineering and technology. Given the very significant projected talent shortfall in these areas it seems to me bewildering that we are steering students away from this hugely valuable subject."

Dr Paul Greening, Director, Centre for Engineering Education, UCL

"Science and maths alone cannot provide the creative thinking and hands-on expertise that is essential to producing world-class designers and engineers. An understanding of D&T ensures that students are equipped with the tools to thrive in an increasingly fast- paced, innovation-hungry marketplace."

John Mathers, Chief Executive, Design Council

"The fall in numbers in pupils studying D&T is a disaster. In all the talk about STEM we consistently underestimate the importance of D&T which is the perfect proving ground for craftsmanship, creativity and curiosity, which the CBI and others tell us are needed in the world of work."

Professor Bill Lucas, Director: Centre for Real-World Learning, University of Winchester

"Without a varied curriculum the UK risks losing out at a time when global businesses increasingly value design skills and valuable jobs are given to students whose curriculum included design and technology. Part of what has made the UK great is its history of design and innovation against all the odds. Let's not lose our edge by failing our young people."

Kim Colin, Co-Founder, Industrial Facility

"D&T can be the critical link between, on the one hand the evolving 21st century skill-sets required by manufacturers and on the other, a vibrant, re-balanced and export-led economy that must re-invest and up-skill to deliver increased innovation. Without enthused students with a foundation in D&T to become tomorrow's skilled engineers we will be missing the key ingredient to the delivery of the long-awaited industrial strategy."

Andrew Churchill, Managing Director, JJ Churchill Ltd.

"If the government really wants a resurgence of manufacturing in this country it should start with schools: D&T is the vital subject that instils a love and fascination of making products."

Mark Miodownik, Professor of Materials & Society and Director Institute of Making, University College London

"Britain is great at engineering and needs more engineers. I am always optimistic about the future for engineering when I see great design and technology project work produced by young people."

Paul Jackson, Chief Executive Officer, EngineeringUK

"For Britain's economy to grow, we need a highly skilled workforce, fluent in upcoming technology. To meet this challenge a solid foundation in engineering, science and design is needed to create a resourceful workforce who can quickly adapt and embrace future technologies. It's not tomorrow's workforce I'm concerned about, it's this afternoon's!"

Sam Lanyon, Designer & Technologist, Founder of Concept Shed Ltd.

"Design and technology is a vitally important and valuable subject. It equips young people with a firm grounding in knowledge and skills such as problem solving, which are in great demand in the labour market. ASCL is extremely concerned about the potential demise of this subject and is committed to working with the Government, employers and the D&T Association to reverse this."

Brian Lightman, General Secretary, Association of School and College Leaders

"With creativity being at long last acknowledged as one of the main drivers and wealth creators of the British economy, it is time that D&T was taken more seriously across the school curriculum. This is a subject that encourages young people to become designers, manufacturers, entrepreneurs and to satisfy their own ambitions, and those of the nation."

Wayne Hemingway, Designer

"Thinking about my civil engineering career over the past 5 years, the A level choice that provided the most useful skill set was definitely design and technology – it taught me much more than just how to design and make things."

Claire Gott MBE, Civil Engineer, Costain Group PLC

"The Government's left hand sings the praises of the UK's Creative Industries while its right hand sweeps away the very education system which created it. The EBacc changes are decimating creative subjects (like D&T) which have, until now, fed a steady stream of talent into our world class creative industries."

Dick Powell, Founder, Seymourpowell Design

"D&T inspired me to train as a product designer. Creative thinking and problem solving are key skill sets for survival in the future knowledge economy. We need students trained in D&T to fuel this core British competency, which enables us to compete in the global marketplace."

Rob Law, Founder and Chief Executive, Magmatic Ltd. (makers of Trunki)

"Manufacturers are always on the look-out for young, fresh, talent. In particular they are seeking young people that have the right combination of academic qualifications and technical skills. Students taking practical subjects such as Design and Technology, which incorporates many key engineering principles, are attractive to manufacturing employers."

Verity O'Keefe, Senior Employment and Skills Policy Adviser, EEF – the manufacturers' organisation

"We need to ensure that the design and technology education young people are receiving is up-to-date, relevant and engaging – we need to take this opportunity to inspire creativity, build skills and develop the next generation of makers and innovators."

Pippa Morgan, Principal policy adviser – education, CBI

In D&T children and young people:

- learn to design, make and control high-quality products and systems
- develop practical skills though the use of tools, materials and components
- look to the future by being creative and innovative
- use knowledge and understanding to solve problems in real-life contexts
- evaluate and test their own ideas and become informed consumers of products and services
- learn about sustainability issues concerning finite resources and energy production
- develop the competence to fully participate in an increasingly technological world
- develop the desire to be enterprising and a readiness to take risks
- enjoy, value and are motivated by designing and making.

"The thought of D&T as a subject in danger worries and scares me. Without the passion and belief of my D&T teacher I would be a frustrated creative individual. I will do anything within my power to make sure that D&T gets appropriate recognition as an essential subject that teaches life skills and will shape the UK economy of tomorrow."

Max McMurdo, Designer, upcycler and TV presenter

"The current 'tech-savvy' generation will define and lead a dramatic change in the design and engineering community. So, how do we inspire this next generation of thinkers? We put the technology in their hands and show them the power of what's possible."

Carl Bass, President and CEO, Autodesk

"The UK motorsport industry is world-leading and depends on the outstanding design and technology talents that reside in Motorsport Valley UK . Good design is at the heart of that success and it would be a scandal if young people were not able to study D&T, which can demonstrate the excitement, thrill and enjoyment that so many have in engineering."

Chris Aylett, Chief Executive, Motorsport Industry Association

"The UK is experiencing an engineering and technology skills crisis. Our recent research with young people and their parents found that creativity and variety are the two features of an engineering and technology career that are most likely to appeal. Design and Technology is an important way of introducing these features at an early age, so should be protected in the school curriculum."

Nigel Fine, Chief Executive, Institution of Engineering and Technology

"It is my belief that all primary children should be entitled to learn D&T skills as a vital part of a broad, balanced curriculum. Children at our school love this area of the curriculum. Anyone visiting The Wroxham School can see the impact of D&T teaching on the vibrant environment where enquiry and high ambition are at the heart."

Dame Alison Peacock, Executive Headteacher, The Wroxham School

"Design thinking allied to practical making skills not only makes D&T a vital and unique subject in its own right, but also one which can help contextualise maths, science and computing. D&T should be an essential component in the curriculum of all students."

David Anderson, Headteacher, Queen Elizabeth's Grammar School

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The Design and Technology Association is the only professional organisation representing over 10,000 members and working on behalf of all those involved in D&T teaching and learning.

We believe passionately in the value of D&T education for all young people and will work tirelessly to ensure that our world lead, gained over the last 26 years, is not lost.

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