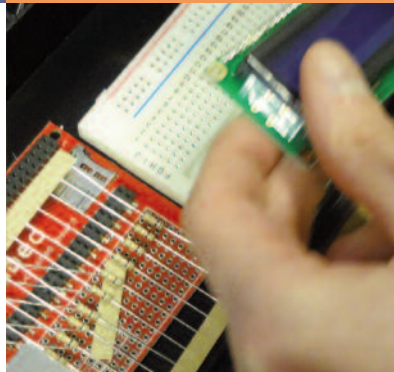


# FROM CPD EXPERIENCE TO STEM TEACHING IMPROVEMENT



A Research Study

11 May 2012

# FROM CPD EXPERIENCE TO STEM TEACHING IMPROVEMENT

---

**A Research Project**

**11 May 2012**

Survey Conducted by:

MRM Solutions Ltd  
PO Box 104  
Chipping Norton DO  
Oxfordshire  
OX7 6GD



Original versions of this document are printed on 100% recycled paper using eco-friendly inks.

If you have an electronic version of this document, please consider the environment before printing.

NEF: The Innovation Institute  
10 Bective Place  
London SW15 2PZ  
Tel: +44 (0) 20 8786 3677  
[thenef.org.uk](http://thenef.org.uk)

ISBN 978-1-906970-12-3

NEF: The Innovation Institute is an educational charity and Think Tank that focuses on developing vocational education through:

- Instigating Research
- Supporting Professional Development
- Enabling Knowledge Transfer and Innovation

Our mission is to achieve measurable and visible improvement in vocational education through partnerships by:

- Enriching teaching and learning professionalism
- Enhancing capability of providers and industry
- Empowering individuals to embrace contemporary practice

Thereby, creating a positive impact on society.

We look forward to your participation and support of our activities so that together we can achieve significant improvement in our vocational system.

# CONTENTS

---

Acknowledgements	4
<b>1. Executive Summary</b>	<b>5</b>
<b>2. Aim of Study</b>	<b>7</b>
<b>3. Introduction</b>	<b>9</b>
<b>4. Research Methodology</b>	<b>11</b>
<b>5. Respondent Profile</b>	<b>13</b>
<b>6. Benefit and Impact on STEM</b>	<b>15</b>
<b>7. Types of STEM Areas Supported</b>	<b>19</b>
<b>8. Impact on the STEM Lecturer</b>	<b>23</b>
<b>9. Future Chanegs in STEM</b>	<b>29</b>
<b>10. Conclusions</b>	<b>31</b>
Appendices	35

## ACKNOWLEDGEMENTS

---

We acknowledge with gratitude the on-going support of the Gatsby Charitable Foundation for our NEF CPD Programmes.

We would also like to thank the New Engineering Foundation's Advisory Panel<sup>1</sup> for their continued enthusiasm and effective involvement in making these CPD programmes a reality.

<sup>1</sup> The NEF Panel consists of senior representation from: Aseptika; Aston University; Atkins Global; BASF Plc; BBC; Bournemouth University; Centrica Energy; City University; CISCO; Department for Business, Innovation & Skills; Department for Energy & Climate Change; Department for Environment; Food and Rural Affairs; EDF Energy; EMC2; E.ON; Flybe; Gatsby Foundation; Lloyds TSB Bank; Marshall Aerospace; MBDA Systems; Microsoft; Middlesex University; National Grid; National Physical Laboratory; National Skills Academy for Nuclear; National Apprenticeship Service; OFSTED; Prosonix; Rolls-Royce; Siemens; Technology Strategy Board; Transport for London; Wellcome Trust; UK Commission for Employment & Skills; Unilever; UnionLearn/TUC; and Westinghouse.





## 1. EXECUTIVE SUMMARY

---



The purpose of this research study is to identify the impact that NEF technical professional development programmes have had on post 16 Science, Technology Engineering and Mathematics (STEM) provision in Further Education colleges in the UK, with respect to the following.

- Programme development & improvements
- Learners' experience
- Lecturers' capability
- College support and commitment
- Knowledge exchange (cascading and embedding new knowledge)

The research also gained an insight into areas for future STEM related Continuous Professional Development (CPD). These NEF CPD programmes are supported by the Gatsby Charitable Foundation.

The sample population of 155 respondents was achieved following an invitation to all participants of CPD programmes (Industrial Fellowship Scheme, Masterclasses and Technical Briefings) across the past six years.

The research methodology employed was a mix of survey through structured questionnaire and semi-structured depth interviews via telephone. The questions for the survey were initially run with a small test group to define the contents of the questionnaire, and to calibrate against objectives.

Across all respondents questioned 95% claimed that the CPD programmes that they had engaged in had been directly beneficial to them and to their technical teaching and learning practice.

The findings indicate that the majority of respondents received clear benefits as a result of attending NEF CPD activities. In particular, 76% of respondents reported benefitting from visiting an industry site, as well as networking with their peers (40%) and making contacts with industry (44%). 74% of respondents stated that their knowledge had been updated, enabling their teaching to be much more productive.

NEF CPD programmes have had a positive impact from an individual's point of view, in terms of providing demonstrations and practical activities as well as developing technical expertise, inspiring new methods of teaching and informing the delivery of current and new courses. Broader impacts at a departmental STEM level included new curriculum development, improved teaching practice and an underpinning of scholarly activities to assist in course development and validation

The findings suggest improvements made as a result of engaging in NEF CPD activities were made to courses in Engineering, Manufacturing and Technologies, and Construction, Planning and the Built Environment. In these subject areas, specific new courses were developed as a result of respondents' engagement in NEF CPD programmes. Improvements were also made to courses in Science and Mathematics, Information and Communication Technology and Agriculture, Horticulture and Animal Care.

Almost two thirds of respondents confirmed learner engagement and retention had improved, and 20% of respondents stated that even student recruitment in STEM had been impacted positively as a result of CPD activities through NEF.

Although 64% of respondents reported planning their CPD activities, a minority of respondents did not plan their CPD. The findings also indicated that the majority of respondents (48%) chose to engage in a CPD activity based on 'Topic'. 'Relevance' to their subject areas (35%) and 'Price' (12%) also contributed to the decision to undertake a CPD activity.

91% of respondents stated receiving senior management support to engage in NEF CPD programmes. In addition, findings indicated that it was the perception that senior management are more likely to support a CPD activity if it helped to improve technical knowledge, enhance college reputation, was readily available, was funded and enabled staff to teach at a higher level.

Many respondents reported sharing the knowledge with their colleagues and/or heads of departments on an informal basis (69%). The majority also stated that they had reflected on their learning, and this reflection had encouraged them to look at ways to disseminate and embed the knowledge further. A third of respondents stated that they had produced teaching materials and notes as a result of their CPD experience that their peers could use and adapt. However, the findings also showed that less than a quarter of respondents formally presented to their department on their CPD, through a formal presentation or cascade activity.

## 2. AIM OF STUDY

---



The aim of this research study was to identify the impact that NEF's STEM related CPD activities has had on STEM in Further Education (including learners, lecturers, employers and future development).

Specifically, this report details the impact that NEF's Industrial Fellowship Scheme and Masterclasses have had on Post 16 STEM programmes in Further Education colleges in the UK.

### 2.1 Objectives

In order to meet the stated aim, the study addressed the following specific objectives:

- identify the degree of planning involved in STEM CPD activities
- identify the level of senior management commitment and support to these CPD activities
- clarify the STEM areas that CPD support is required
- identify the STEM areas that have been impacted by CPD activities
- qualify the impact of STEM CPD on areas outside Post 16 provision (such as full cost recovery and knowledge exchange)
- identify the types of improvements that have been made to post 16 STEM provision
- quantify the number and type of courses improved as a result of CPD activities
- quantify the effect of course improvements on learner recruitment and retention



- identify the degree and type of evaluation and reflection processes for CPD
- qualify the degree and type of processes for embedding knowledge

### 2.2 Outcomes

The outcomes of this research study will:

- qualify the types of courses and areas of curriculum that have been most supported
- correlate the impact on student recruitment and retention against effective technical CPD and subsequent improvements made to STEM teaching practices and actual course content
- inform and shape new CPD programmes that NEF will develop for the FE sector, particularly around effective planning and development of technical CPD
- ensure the focus of Industrial Fellowship Scheme reflects key areas for STEM curriculum improvement
- advise on new STEM areas for NEF Masterclasses, thereby ensuring that the technical CPD/ company opportunities provided to lecturers are in the areas of most need and are relevant to curriculum enhancement and development
- enable more effective models of knowledge embedding to be created and demonstrated within the FE sector
- ensure that NEF's future programmes develop senior STEM managers as strategic leaders that embrace technical CPD as key for motivating and building capability in their STEM teaching staff.



## 3. INTRODUCTION

---



The NEF STEM CPD programmes remain to be the FE sector's first choice for technical knowledge and skills updating. As part of the ongoing improvements and evaluation of the impact of these programmes, this study supported by the Learning and Skills Improvement Service (LSIS) has been undertaken by the New Engineering Foundation in partnership with MRM Solutions Ltd.

The focus of this study is on NEF's Industrial Fellowship Scheme, and Masterclasses and Technical Briefing programmes. These programmes are backed by funding from the Gatsby Charitable Foundation and are heavily supported by business and industry.

### 3.1 Industrial Fellowship Scheme

The NEF Industrial Fellowship Scheme (IFS) enables FE colleges to apply for a grant towards the secondment of one or more STEM lecturers into industry. The IFS provides a unique opportunity for the lecturer to exchange knowledge and gain industry experience with the ultimate aim of benefitting the students in the STEM subjects that they teach. Following their secondment period, STEM lecturers capture their updated knowledge in new teaching materials and e-learning, which is then shared throughout the FE STEM community.

### 3.2 Masterclasses/Technical Briefings

NEF Masterclasses are immersive, professional development events that provide Further Education (FE) lecturers with hands-on knowledge and exposure to current and emerging processes and technologies. The Masterclasses are conducted at a company or university's research centre. Each Masterclass follows a tried and tested delivery format that includes technical updating and practical application followed by examples and case studies. Participants are taught appropriate pedagogical models to use in the classroom/workshop to support the embedding of teaching techniques and learning examples.

The Masterclass programme enables FE lecturers with an opportunity to update their skills and knowledge in line with industry developments in hi-tech and emerging technologies in specific STEM areas. The key objective of the NEF Masterclasses is to provide FE lecturers with the industry relevant knowledge to update their existing curriculum or develop new curriculum areas. The Masterclasses are designed to inform education and training providers in the planning of new course development.

Technical Briefings are half-day events providing an overview of recent patterns and trends in a specific technical sector that may affect workforce development and training provision. These Briefings bring together education, business and industry and policy decision-makers to inform participants of opportunities and challenges in the sector. The aim of the briefings is to initiate action in the educational sector to develop and enhance provision across STEM curriculums that would match 'real life' requirements today and in the future.



*"It's been a complete eye opener, it's been fantastic. It's shown me a lot of what's out there at the moment that I didn't know about. It's shown me how it's all linked together and has enabled me to bring the information back to the college and integrate it back into the course. Industry was telling us what THEY wanted from our students so we've actually derived courses from that idea. Now when I teach Programmable Logic Control, the knowledge I have is much greater than before. The overall picture is that I've been able to devise a new course for my students that have enabled them to become multi-disciplined."*

– Nigel Godwin  
City of Bristol

## 4. RESEARCH METHODOLOGY

---



The research methodology employed was a mix of survey through structured questionnaire and semi-structured depth interviews via telephone.

The questions for the survey were initially run with a small test group to define the contents of the questionnaire, and to calibrate against objectives.

An invitation was sent to all STEM staff in FE colleges in the UK who had participated between the years 2005 – 2011 in any one or more of the NEF CPD programmes. All individuals were contacted via e-mail with a link to the survey. The individuals who completed the survey were then invited to participate in telephone depth interviews. Those individuals, who consented to this invitation, were then followed up, and the interviews undertaken to drill down further in to their responses regarding their experience and impact of the NEF CPD programmes.

### 4.1 Study design and sample frame

The study used a sample frame which consisted of past participants of IFS, Masterclasses and Technical Briefings.

Out of a total of 631 individuals who were contacted, 155 delegates participated in this study (a response rate of 25% of the colleges contacted). A further 33 individuals (who completed the survey) consented to participate in the depth interviews.

The survey was developed using a balanced questionnaire that consisted of both quantitative and qualitative questions. The structure of the questions was designed to elicit responses that would assist in meeting the stated objectives of this research study.

The subsequent telephone interviews followed up on responses that had a qualitative element attached and could not be captured through survey techniques alone.

“ ”

*“I’ve used the activities to get my HE students to reflect and this gave me valuable insight in to what areas they needed more training on. The [Ofsted] Inspectors were very keen on this practice, which I learned about on the NEF Masterclasses.”*

– Robert Wegg  
Hull College



## 5. RESPONDENT PROFILE

---



Respondents were a mix of STEM lecturers, Curriculum Managers and Leaders, and Heads of STEM Departments.

The survey was undertaken nationally across all Further Education Colleges that had participated in NEF's professional development programmes over the last six years. 43% of respondents stated that they had taken part in the Industrial Fellowship Scheme and 81% had taken part in the Masterclasses and Briefings programmes.

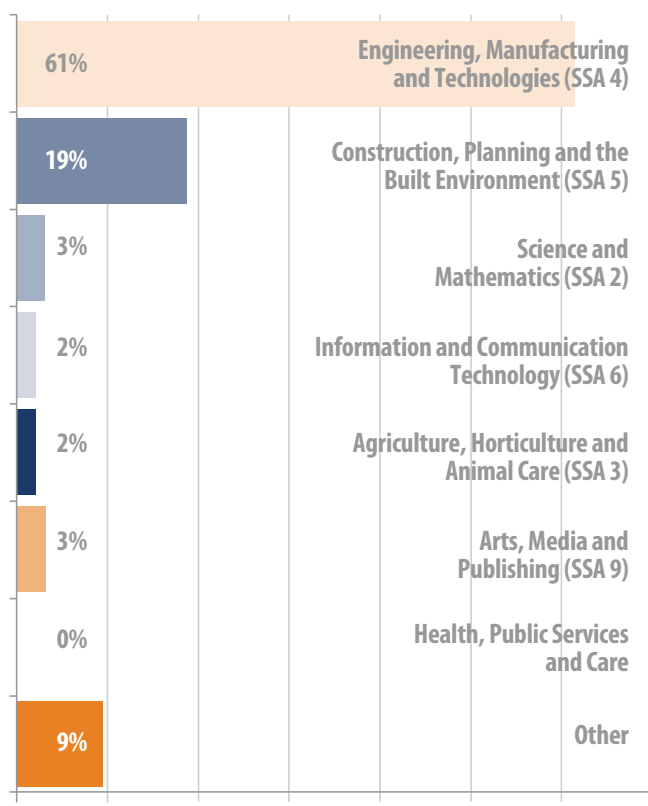
The majority of respondents had attended at least one masterclass (81%). 29% had taken part in more than one NEF CPD activity. 24% had attended other NEF CPD activities (including Briefings). From the survey, the Masterclass that received the largest representation in respondent population was 'Wind Power' (14%) followed by 'Mastering Advanced Composites' (8%) and Lean Manufacturing (7%). Across the renewable spectrum, the 'green' topics were well represented, indicating a CPD need in such areas as solar PV, biofuels, micro-generation of electricity and sustainable buildings design.

The focus on 'green tech' was clearly driven through the policy emphasis and interventions such as favourable 'Feed in Tariffs', 'Renewable Energy Incentives' etc. It should be noted that although these interventions have reduced, the demand for technical updating in these areas still persists (and is demonstrated in section 5 – New STEM subject areas requiring support).

## 5.1 Response by Subject Area

The proportion of respondents listed by subject sector area (Ofsted SSAs) is shown in Figure 1.

The majority of respondents taught Engineering, Manufacturing and Technologies (61%), followed by Construction, Planning and the Built Environment (19%), Science and Mathematics (3%) and Arts Media and Publishing (3%). The remaining respondents taught Information and Communication Technology (2%) and Agriculture, Horticulture and Animal Care (2%).



**Figure 1**  
OFSTED Subject Sector Areas (SSAs) taught by respondents



*“Senior management value this CPD. NEF opportunities are put in our staff bulletin so they are encouraged.”*

– Philip Parker  
PETROC

*“I ended up better informed to teach cutting-edge industry practice. After spending two weeks with a leading fibre optic equipment, design and manufacturing company I was brought back up to speed with both the technology and the commercial practices employed.”*

– David Blacklidge  
Blackburn College

## 6 BENEFIT AND IMPACT ON STEM

95% of respondents confirmed that they found NEF CPD programmes beneficial to them as shown in Figure 2.

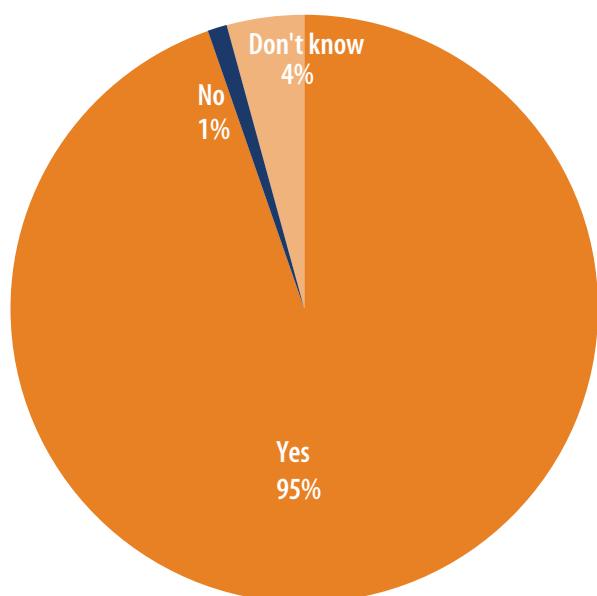
Respondents were asked to select the area (technical, professional or personal) that they had benefited the most. 46% of respondents stated that they benefited from increased expertise (technical), 40% benefited from better teaching practice (professional) and 14% reported personal benefits. This response indicates that dual professionalism has been supported and advanced through the NEF's CPD programmes.

Survey respondents were asked to determine which aspects of the CPD activities that they found most beneficial. The majority of respondents (76%) found it beneficial to visit an industry site. A further 44% benefitted from networking and making contacts with industry. In addition, 40% benefitted from networking with their peers.

### 6.1 Planning of STEM CPD

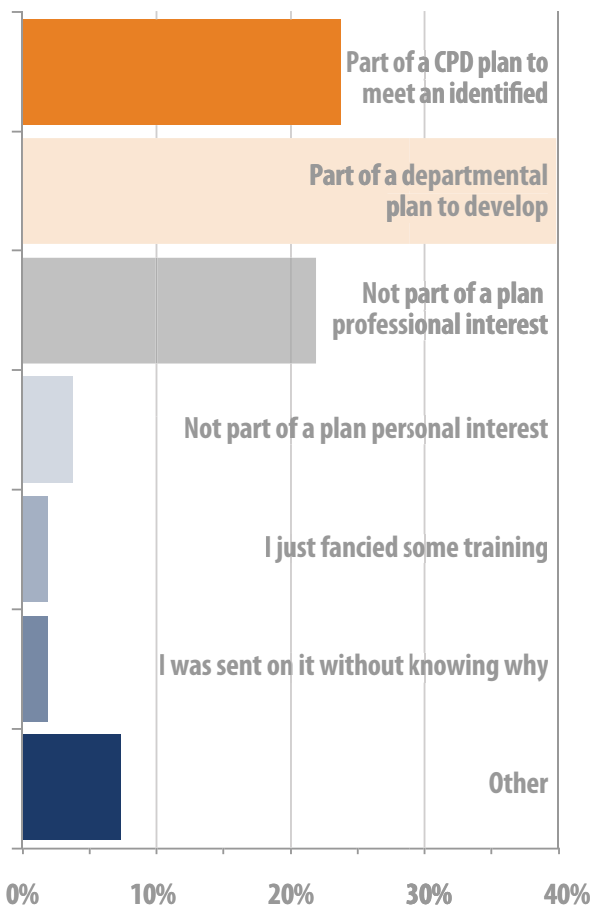
64% confirmed that NEF CPD activities had been undertaken as part of a plan of CPD, either to meet a specific need (24%) or to specifically develop technical curriculum (40%).

This response indicates that the support and planning for CPD is being taken on board in provider institutions, and the need for planning is being given a higher priority. It is interesting to note that over a fifth of respondents have undertaken NEF CPD activities on the basis of professional interest, indicating an appetite and potential growing momentum for knowledge replenishment and updating in lecturing staff, perhaps as a result of emerging technologies and practices.



**Figure 2**  
Respondents who found NEF CPD Programmes Beneficial





**Figure 3**  
Level of Planning involved in CPD

During the depth interviews, further focus was placed on why respondents selected to engage in NEF CPD activities. The majority of those interviewed reported using the NEF CPD activities to inform the delivery and content of current and new courses.

In undertaking the development of their CPD, respondents were questioned on factors that influenced their decision to engage in CPD. Almost half of respondents (48%) highlighted that 'Topic' was a major deciding factor, followed by 'Relevance' to their own subject area (35%),

and 'Price' (12%). It is interesting to note that respondents rated location far lower (4%), and many respondents in the depth interviews indicated that they had been willing to travel to an activity or event, as the gain of receiving topical, relevant knowledge outweighed the distance travelled. It is also important to state that this factor is further substantiated by the high number of participants who attended the 'Wind Power' Masterclasses, despite their locations being in difficult to reach places.

## 6.2 Senior Management Support for CPD

91% of respondents confirmed that participation in the CPD had received senior management support as highlighted in Figure 4. When this was drilled down in the depth interviews, the support was mostly deriving from an acknowledgement that lecturing staff would receive:

- i) technical updating from industry; and
- ii) an opportunity to build relationships and networks with industry and other peers in the sector. The sharing of knowledge was considered an important part of the CPD experience.

Senior management support had been found to be strong; however, given the economic environment and the budget cuts in the FE sector, there was considerable interest to identify what motivational factors would ensure this level of support and commitment from management.

Respondents were then asked to consider factors that would make CPD activities more attractive to senior management and gain their support. It should be noted that the responses were STEM staff perceptions of what would attract senior management and not specifically



responses from senior management themselves.

'Improvement to Technical Knowledge' was identified as the most attractive factor for senior management to support and commit to CPD (98%). This indicates that there is a perception from STEM staff that senior managers acknowledge the difficulty in securing technical knowledge updating and consider the development of modern technical capability as critical to a college's success.

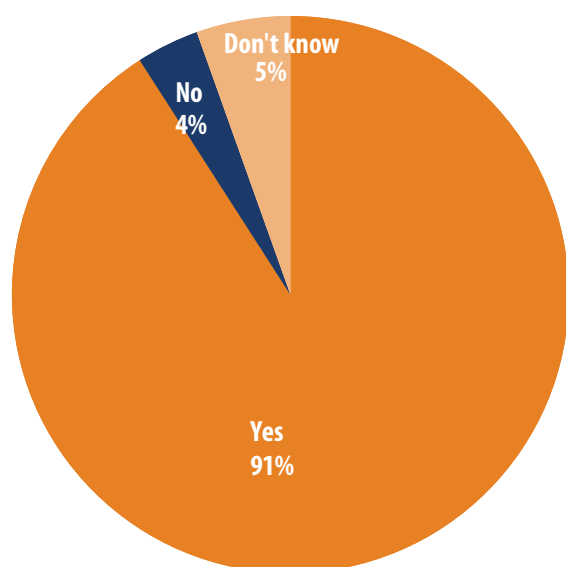
The second factor that was considered by respondents to attract senior management support was if the CPD 'Enhanced College Reputation' (94%). This response is not surprising given that senior managers have a strategic perspective, and view the benefit received from CPD on a college-wide basis. However, it also shows that to continue to attract senior management support, future CPD activity has to take on a strategic goal that not

only benefits the individual engaging but delivers holistic benefit to the college, learner, employer and the community as a whole.

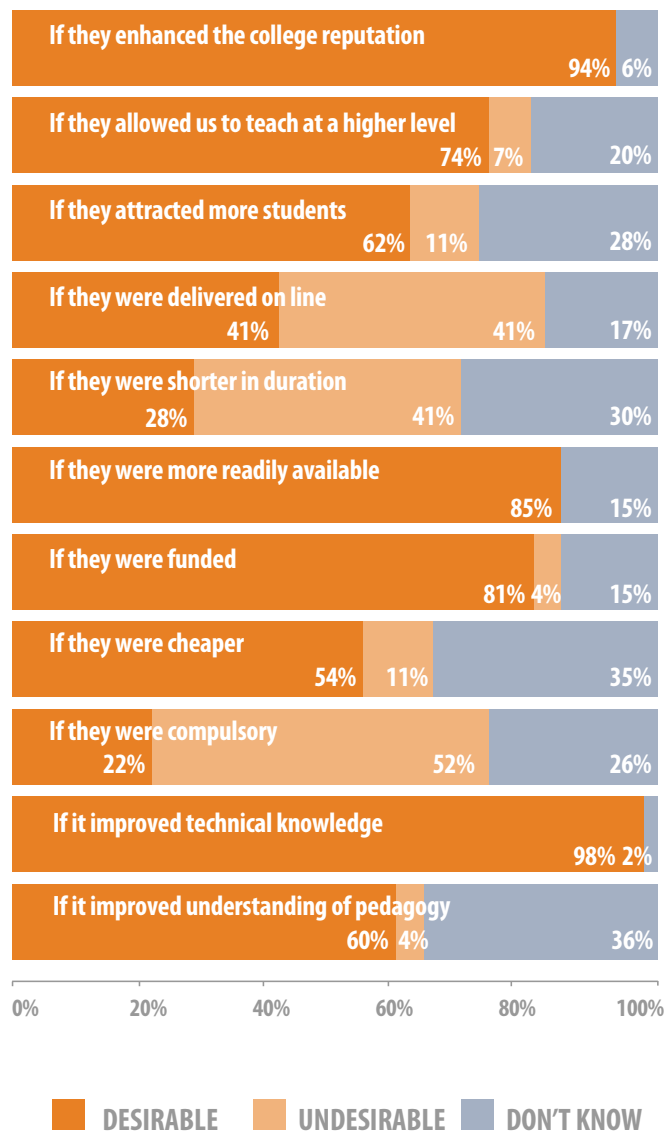
Respondents perceived that senior management would be attracted to support CPD activities if these activities came with some form of funding or grant. In the depth interviews, this was cited numerous times as a key component of why NEF CPD programmes were attractive to senior managers, alongside the obvious technical updating and industrial connectivity.

Other factors of note included: "If they [the CPD programmes] were Readily Available' (85%) and 'If it [the CPD] enables Staff to Teach at a Higher Level' (74%). The 'Readily Available' factor highlights the need to make CPD activities more accessible and frequent, and this response is clearly reflective of the perceived need for senior management to plan and budget, having the assurance that CPD activities will be sustained and refreshed concomitant to the needs of a college's professional development plans.

'Teach at a Higher Level', indicates a focus on the need for progression, both in the development of provision at higher levels (HND, Higher Apprenticeship, Foundation Degree, BSc etc.) and in developing lecturing staff capability and building capacity. With the increase in university tuition fees, colleges will be taking a greater role in HE development and delivery, and this response indicates that future CPD must prepare STEM staff with knowledge, skills and experience to enable them to deliver at higher levels. The full response to factors that would make CPD attractive for senior management support is shown in Figure 5 below.



**Figure 4**  
Senior Management Support for CPD



**Figure 5**  
Factors that would make CPD activities more attractive to senior managers



*“Our undertaking of IFS paved the way for us upgrading our Engineering provision in the college.”*

– Atila Mustafa  
Exeter College

*“Introduction of new ideas and significant improvement in getting the best use from laboratory equipment came from my IFS experience.”*

– Christopher Ndukub  
Central Sussex College

## 7 TYPES OF STEM AREAS SUPPORTED



It is been identified that 127 courses taught by the respondents and which cover levels 1 – 6 have been supported through STEM staff engagement in NEF technical CPD programmes. A full list of these courses can be found in Appendix A. From the responses, it has been qualified that the STEM areas that received support through the Industrial Fellowship, Masterclasses and Briefings, include the following:

- Science and Mathematics (levels 1, 2, 3 and 5),
- Agriculture, Horticulture and Animal care (levels 5 and 6),
- Engineering, Manufacturing and Technologies (levels 1, 2, 3, 4, 5, 6),
- Construction, Planning and the Built Environment (levels 1, 2, 3, 4, 5),
- Information and Communication Technology (levels 3 and 6),
- Arts, Media and Publishing (level 3)

### 7.1 Number of STEM Courses Improved

Across the 127 courses supported, respondents have confirmed that 48 of these courses have been improved with a further 15 new courses/units being developed as a result of engagement in NEF CPD activities.

From the responses, it has been qualified that the following STEM areas have received course improvement and/or new course development:

#### Science and Mathematics

- 2 courses improved at levels 2,
- 2 courses improved at level 3, and
- 1 course improved at level 5

#### Agriculture, Horticulture and Animal Care

- 1 course improved at level 5

### Engineering, Manufacturing and Technologies

- 5 courses improved at level 2
- 13 courses improved at level 3
- 8 courses improved at level 4
- 6 courses improved at level 5
- 7 new courses/units developed

### Construction, Planning and the Built Environment

- 1 course improved at level 1
- 1 course improved at level 2
- 8 new courses/units developed

### Information and Communication Technology

- 4 courses improved at level 6

### Arts, Media and Publishing

- 1 course improved at level 3
- 3 professional courses improved

A key example of how NEF technical CPD programmes have helped to drive curriculum development is South Devon College's Foundation Degree in Engineering Technologies (Environmental) in partnership with University of Plymouth. Simon Friend, Head of Technology at South Devon stated that: "a considerable amount of the scholarly activity needed to be evidenced to support the course validation for this course has come from NEF programmes such as IFS and Masterclasses". The use of NEF CPD is also cited in the course's validation approval document.

A list of all the courses improved and developed can be found in Appendix B.

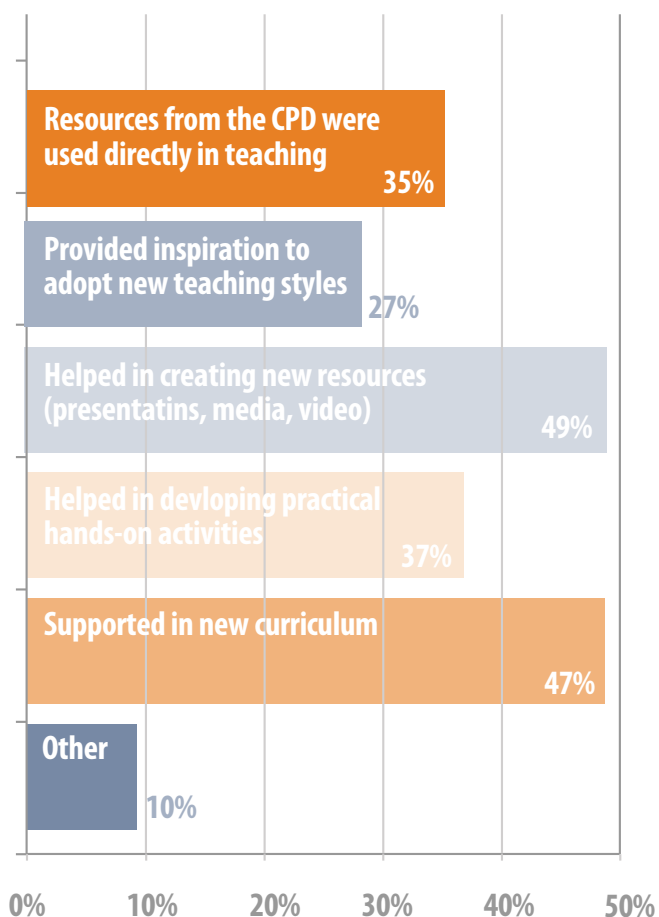
## 7.2 Types of improvements made to STEM courses

The respondents identified the ways in which improvements had been made to their courses, and these are illustrated in Figure 6. 49% of respondents stated that CPD activities had helped to create new resources such as presentations, media and videos, (having better resources could have impacted on increased confidence as the teachers knew they were delivering better materials that had context, and were real and relevant to learners.)

47% confirmed that the CPD had supported in the creation of new curriculum, with whole subject areas also being revamped to reflect new knowledge and skills acquired through the NEF CPD activities. Through understanding more about industry practices, college lecturers were able to translate industry needs into real programmes that had currency and purpose.

37% of respondents identified that the CPD engagement had helped them to 'develop hands-on practical activities' thereby improving the courses that they taught by making them readily understandable to the learner through practical application. The direct use of 'resources from the CPD' was stated by 35% of respondents as one of the ways their courses improved. An important aspect of NEF CPD is to inspire STEM teaching staff to use the practical elements in order to 'adopt to new teaching styles', and this area of improvement has been recognised by 27% of respondents.

The majority of respondents reported that the CPD activities also helped to inform provision and course content; provided case studies and



**Figure 6**  
How NEF CPD activities change or improved teaching

supported delivery. The survey and depth interview responses indicated that improvements had been far-reaching, particularly in the development of new curriculum that was based on new and emerging technologies (Composite Materials in Engineering and Building Services and Renewable Energy being just two of the 15 new courses whose development was inspired by STEM staff who had undertaken NEF technical CPD).

“

*“Learners are generally more engaged, they understand the importance of industrial design methods and the impact they have.”*

– Michael Pender  
Hertford Regional College

*“The significant thing is that the learning they [the learners] receive is connected to real life scenarios.”*

– Andrew Smith  
Tyne Metropolitan College

“ ”

*“One of my team did a secondment 3 years ago via NEF into the industrial automation services where, with a local university he developed a new 24 vault electronic system for cars, rather than a 12 vault system and he used this experience to develop his teaching and materials.”*

– Karen Gallagher  
Derby College

*“I can show students how the future will go and to shape their careers.”*

– Peter Dryden  
Newcastle College



## 8 IMPACT ON THE STEM LECTURER

---



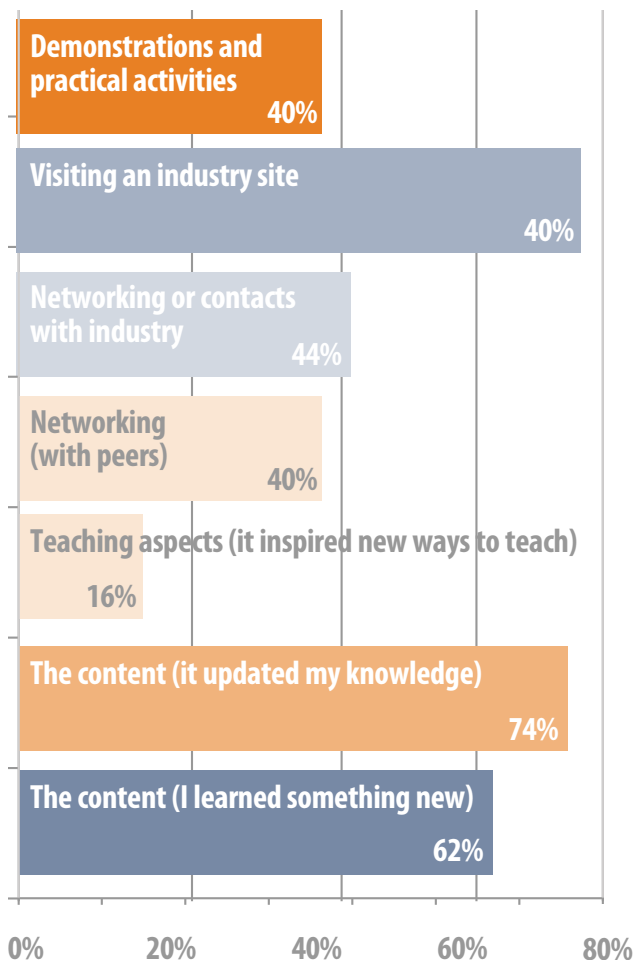
65% of respondents identified that undertaking the NEF STEM CPD activities had impacted 'the way they taught'.

When assessing impact, 46% claimed technical expertise had improved, 40% stated their professional teaching had improved and 14% claimed that their personal ability had been improved. However, in the depth interviews a consistent word used was 'Raised Confidence' reflecting this personal attribute had been improved through NEF CPD engagement.

From the structured interviews, the overarching driver to attend a NEF CPD activity was to gain an awareness and understanding of industrial practice. The respondents associated the activity with industry connections, and the opportunity to develop capability from such engagement (in terms of new resources, amendments to curriculum etc.).

Benefits to the lecturer are shown in Figure 7 and have been categorised into Industrial Experience, Networking and Technical Knowledge Updating. The overarching benefit from both the IFS and the Masterclasses has been the opportunity to visit an industrial site, with the majority (76%) of respondents confirming this. Under the Industrial Experience, the 'demonstrations and practical activities' had 40% of respondents seeing this aspect as an impact benefit. Technical Knowledge Updating in both 'the content – it updated my knowledge' and 'the content – I learned something new' secured strong responses with 74% stating having benefitted from 'updated knowledge' and 62% reporting that they had 'learned something new'. The impact of networking with industry was more highly valued (44%) than





**Figure 7**

Aspects the NEF CPD events that have been most beneficial

networking with peers (40%). Networking overall was mentioned in the interviews, with consistent emphasis on this being a benefit from the CPD activities.

### 8.1 Impact on the STEM Learner

From the 95% of respondents who found the NEF CPD programmes to be beneficial, 59% confirmed

that learner engagement had been directly impacted positively.

In the context of the survey 'learner engagement' was focused on learner retention and achievement with the idea being improvements to STEM courses would help in ensuring learner retention and achievement. With almost two thirds of respondents confirming learner engagement had been impacted, the correlation between the positive impact of NEF technical CPD programmes on the lecturer and the effect on learner engagement can be identified. Clearly, the CPD experiences have given STEM lecturers the vitality to produce enhancements to their curriculum, thus providing contextualised learning that is real and relevant to their learners, and which is supported by case studies and links to industry.

A fifth of respondents identified that 'student recruitment' had been impacted positively as a result of their CPD engagement. When this response was drilled down further through the interview stage, it became apparent that there was some 'word of mouth' promotion being conducted amongst learners who were already undertaking these improved courses and their peers considering enrolling in the same courses. It is noted that having provision that is stimulating, industrially relevant and meets labour market need has had an effect on student recruitment in some STEM programmes. However, the degree of this viral effect cannot be easily quantified through this study.

57% of respondents confirmed that the CPD programmes had helped them to develop 'stronger links with industry', and as a result the STEM lecturers have been able to inform and guide learners in career options and progression

---

choices, thereby helping to maintain a healthy STEM pipeline into industry and higher education.

Engagement in NEF CPD programmes, particularly Masterclasses often resulted in lecturers receiving practical teaching resources and kits, such as industry standard software provided in the Industrial Automation Masterclasses (at SMC/Omron) or the 'Mbed microcontroller' kit provided to participants on the Mastering Technology Masterclass (at ARM), and these materials and resources are packaged to be used immediately back in the classroom or workshop. The responses have shown that the use of up-to-date materials, knowledge and resources has made learners experiences more enjoyable, and this has impacted positively on the learner's capability to stay on the course and to achieve.

## 8.2 Impact beyond Teaching and Learning Improvements

The research study sought to qualify the impact of the NEF CPD programmes beyond teaching and learning. The areas identified were: knowledge exchange, industry links and collaboration with colleagues. Respondents were asked to state whether these areas had been impacted positively by their attendance on technical CPD programmes, and more than one area could be selected.

61% of respondents confirmed that knowledge exchange with industry had increased, with the focus of the knowledge exchange being on consultancy and bespoke advice services. In the telephone interviews, it was found that the aspect of 'renewed confidence' had an important role to play in interacting professionally

with employers. The technical CPD also provided lecturers with a validation of their own technical knowledge and expertise, and made many respondents more assertive and assured in dealing with consulting and bespoke training development. Associated to this was the response that almost a quarter of respondents claimed that full cost recovery courses had increased as a consequence of their technical CPD programme engagement.

57% of respondents claimed that their 'links with industry' had improved, particularly around attracting and handling invited speakers, organising and visiting companies, engaging companies in student projects and securing industrial placements for both learners and staff. The aspect of collaboration with colleagues was identified by 57% of respondents as having been impacted as a result of their CPD experiences. When this was investigated further through the interviews, a consistent acknowledgement was made of the 'need to share and tell others about their experiences'.

Although superlative expressions were not encouraged, a continual number of respondents spoke of 'life changing experiences', when describing their CPD engagement (especially the Industrial Fellowship Scheme), and stated that they wanted to 'keep the momentum and the buzz' when they returned to the college. Given these responses, it is therefore in keeping that respondents would have seen their collaboration with colleagues increase and improve.

These responses show the consequential impact of CPD participation, indicating that the reach of impact goes further than improving the content and style of teaching (65%).

### 8.3 Impact on Evaluation and Reflection

Evaluation and reflection is an important aspect of CPD and in all of the NEF CPD programmes, there is a requirement for feedback and reflection. In the IFS, STEM lecturers are encouraged to consider what changes could they make to the practical, technical elements of the provision they deliver, and in Masterclasses, a session is always included on feedback and reflection, looking specifically at improvement to pedagogic processes to improve their teaching practice. 61% of respondents confirmed that they had reflected on the learning gained through the CPD programmes, and much of this reflective practice had progressed into actual knowledge exchange with peers, which further assisted many cases of new curriculum being shaped.

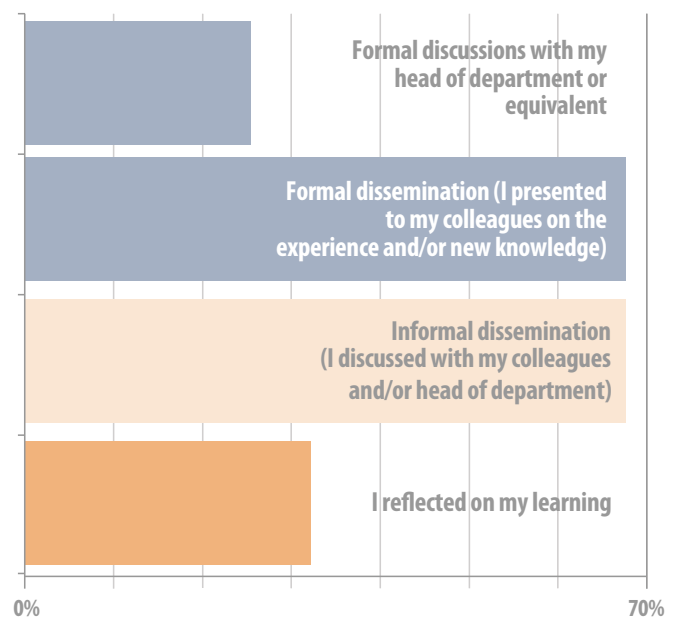
### 8.4 Impact on Knowledge Exchange and Embedding

Respondents were asked to consider how the CPD programmes had impacted their capability to exchange and embed new knowledge and practice, and whether their experiences had improved this capability. 61% stated that they had reflected on their learning, and this reflection had encouraged them to look at ways to disseminate and embed the knowledge further. 69% of respondents confirmed that they had informally shared the knowledge they had learned with their colleagues and/or heads of departments.

A reasonable level of knowledge embedding had been achieved in the respondent group, with 31% stating that they had produced teaching materials and notes that their peers

could use and adapt as a result of their CPD participation. A fifth had formally presented to their department on their CPD, through a formal presentation or cascade activity.

Although there were a good percentage of respondents who confirmed that they had informally shared their CPD knowledge with colleagues (69%), the degree of formalised knowledge exchange and embedding processes to cascade knowledge and teaching practices to their peers was still in need of improvement, as highlighted in Figure 8.



**Figure 8**  
How knowledge learnt from NEF CPD activities was shared and embedded

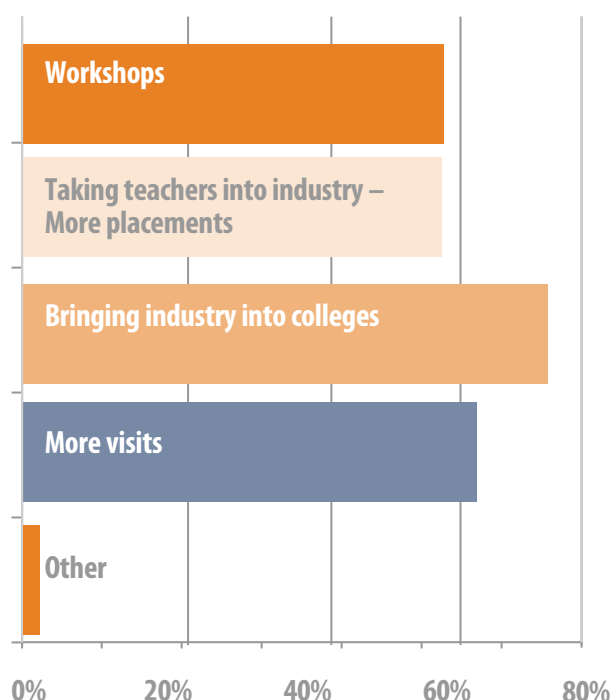


The theme of knowledge embedding was taken forward, with respondents asked to select as many activities that they associated with supporting embedding knowledge and teaching practice amongst their peers as shown in Figure 9. Refer to Figure 9. 76% of respondents confirmed that 'bringing industry in to build colleges' would be the key activity to support knowledge embedding following NEF CPD activities.

When this response was drilled down further in the interviews, reference was made to guest lectures delivered by industrialists from local

companies that could support the embedding process. Bringing industry into build upon the STEM lecturers acquired knowledge to assist in curriculum design was also cited many times in depth interviews.

Other activities that respondents highlighted to improve knowledge exchange and embedding included more visits to industry (60%); practical workshops (58%) and industry placements for teachers (58%). The emphasis on industry placements highlighted the continual expectation for programmes that linked colleges with industry like the Industrial Fellowship Scheme.



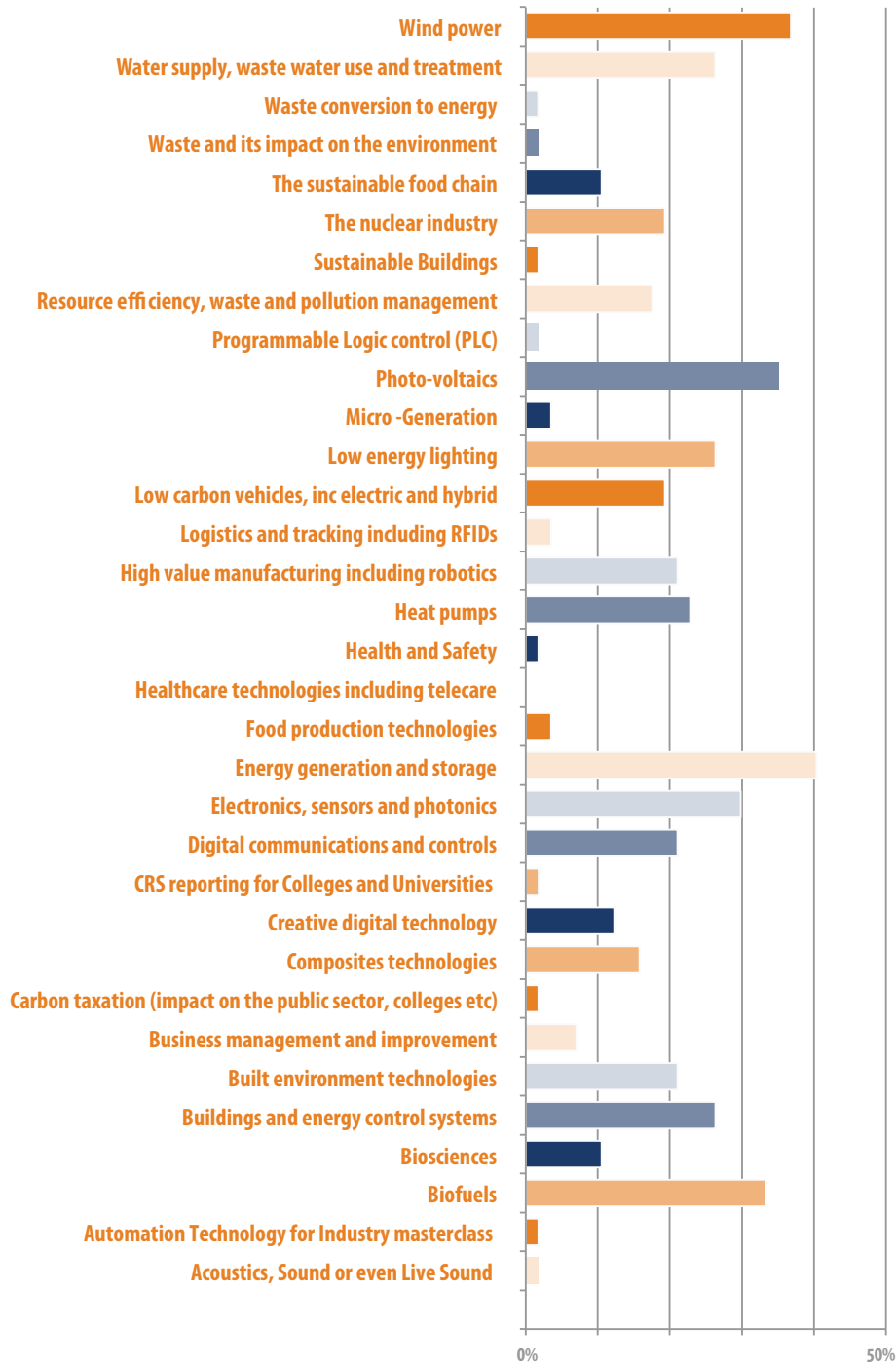
**Figure 9**

Activities and programs that would support lecturers to embed knowledge into teaching practice and amongst their peers



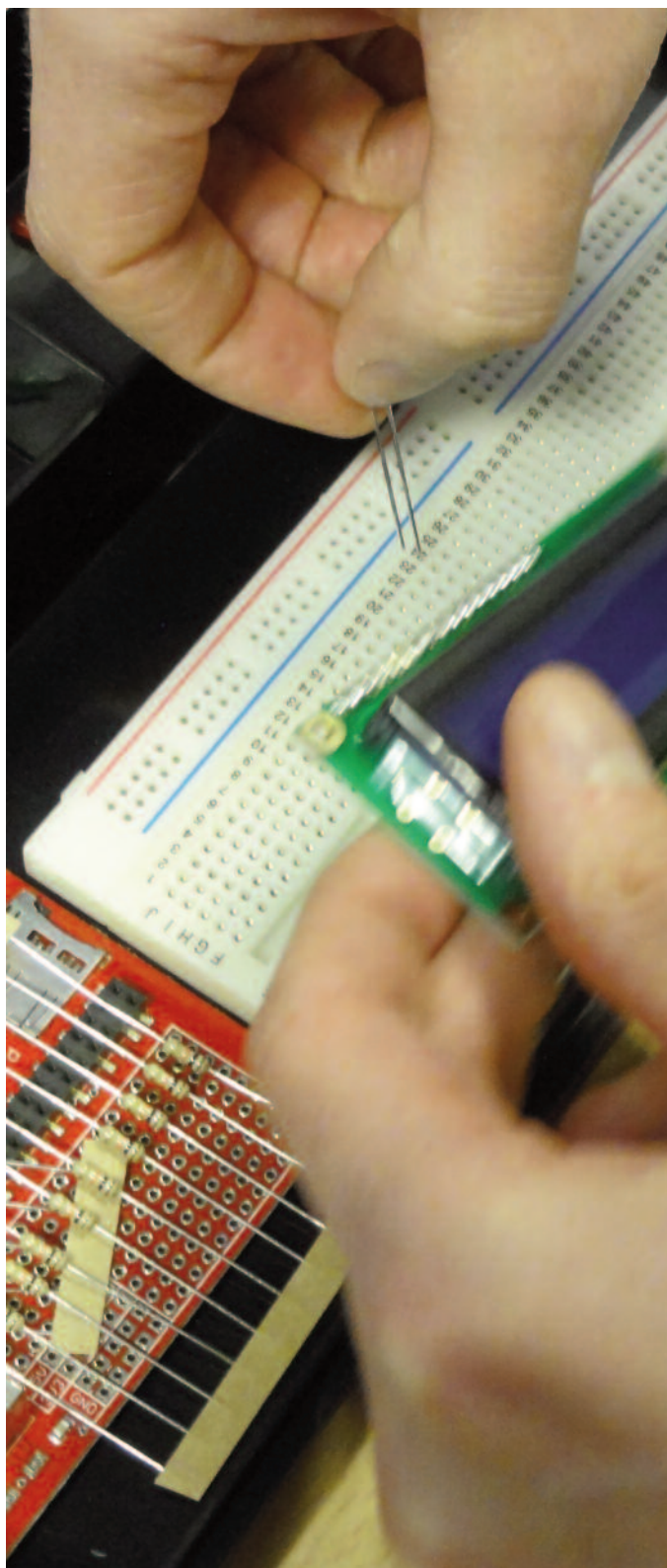
*"They [the NEF Masterclasses] have definitely improved or updated my knowledge. It has increased my knowledge base which has affected my general teaching."*

– Steve Keating  
Darlington College



**Figure 10**  
Additional CPD topics that would be of interest in the next 24 months

## 9 FUTURE CHANGES IN STEM

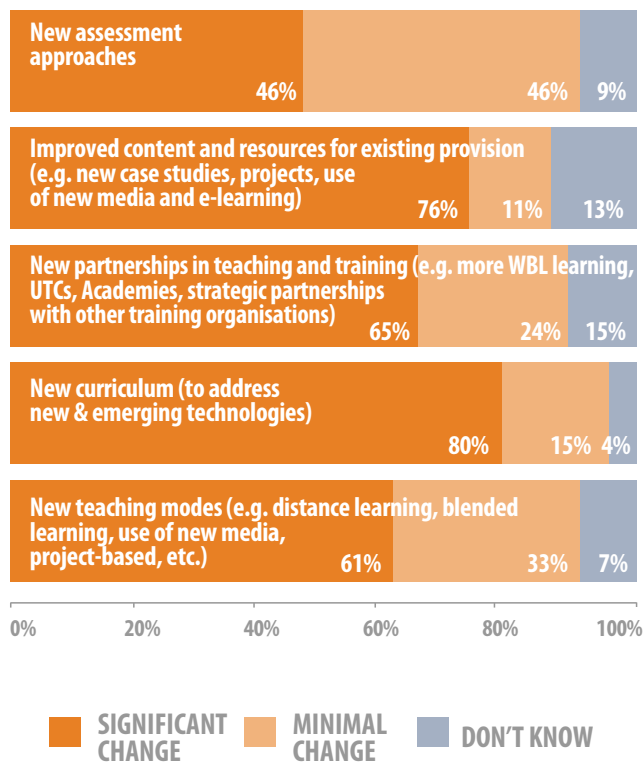


Respondents were asked to consider what changes would occur in their STEM provision over the next two years. In the initial development of the question, the test group responded with a number of areas, however the resounding theme was 'new'.

The most scored areas from the test group areas were introduced as areas of change and respondents were asked to consider the degree of change in these areas, as shown in Figure 11.

80% of respondents confirmed that there would be change in developing 'new curriculum' to address new and emerging technologies, and associated to this, 76% identified that there would be changes to 'improve content and resources for existing provision'. In the light of the emergence of University Technical Colleges, the Employer Ownership of Skills programme and the drive for more Apprenticeships, 65% of respondent stated that they anticipated change in the development of 'new partnerships', and in line with these developments also anticipated changes in 'new teaching modes' (61%), such as more e-learning, use of new media virtual environments, social media platforms, and mobile learning applications.

The area that respondents did not think would change so much was in the area of 'new assessment approaches' (46%) indicating that assessment approaches are more fixed than some other aspects of the curriculum which is perceived to be more dynamic.



**Figure 11**  
Anticipated changes to STEM provision in the next 24 months

“I used the same format [for reflection back in the college] as used at the end of Masterclasses. [Ofsted] Inspectors thought it was out of this world.”  
– Anonymous

### 9.1 New STEM Subject Areas requiring Support

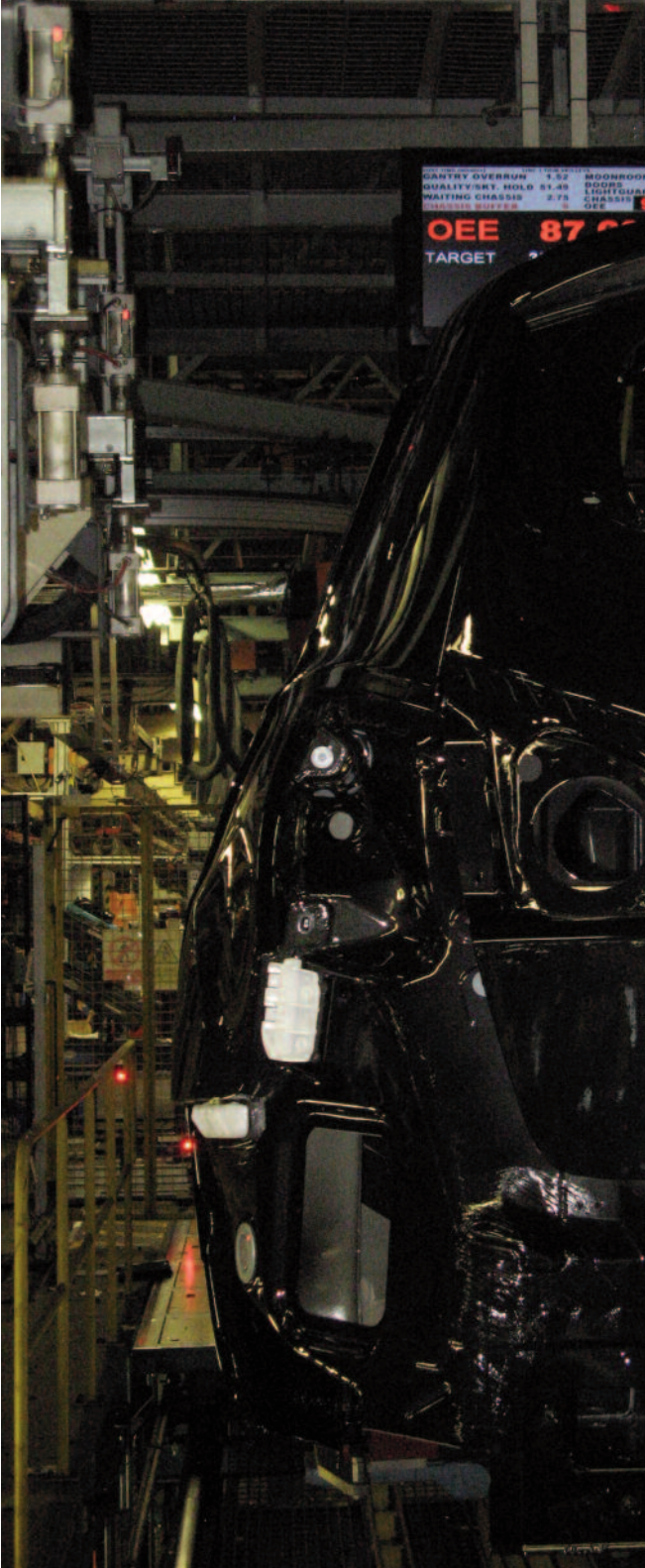
Respondents were questioned on what CPD topics they would like to see in the next 24 months. A number of new topics were suggested building upon both the responses from the test group and from previous feedback collected at Masterclasses and Briefings and from IFS Fellows in the past. There was also an ‘other’ option which enabled respondents to include free text responses. These responses and the stated topics are included in Figure 10.

Just under half of respondents highlighted Energy Generation and Storage (40%) as an area where they would like to see new CPD activities. Second in top responses was Wind Power (37%). Photovoltaics (35%); Biofuels (33%); Electronics, sensors and photonics (30%); Buildings and energy control systems (26%); Low energy lighting (26%); Water supply, waste water use and treatment (26%) and Heat pumps (23%) all received considerable interest from respondents. Once again, the new and emerging technologies and green themes were dominant in these responses. Topics such as ‘sustainable food chain’ and ‘sustainable buildings’ indicate an appetite for CPD that looks to establishing resource efficiencies and effective re-use in the future.

It is important to note that these topics reflect current perceptions of STEM need by staff in Colleges, and although many topics may be still viable to help colleges in areas of demand in new and emerging technologies, cognisance should be taken of the changes in policy pertaining to the ‘green’ agenda and the shrinkage of skills demand in some sectors.

## 10 CONCLUSIONS

---



The majority of respondents reported clear benefits as a result of attending NEF CPD activities. In particular, respondents benefitted from visiting an industry site as well as networking and making contacts with industry and peers.

NEF CPD Programmes have also had a positive impact in terms of providing demonstrations and practical activities as well as developing technical expertise of lecturers, inspiring new methods of teaching and informing the delivery of current and new courses. The results also indicate a broader impact of the CPD in terms of improved teaching practice, sometimes recognised by Ofsted as best practice, and the longer term impact of new and improved curriculum and the colleges' strategic direction in STEM.

The majority of improvements made as a result of attending NEF CPD activities were made to courses in Engineering, Manufacturing and Technologies, and, Construction, Planning and the Built Environment. Improvements were also made to courses in Science and Mathematics, Information and Communication Technology and Agriculture, Horticulture and Animal Care.

The results also imply a positive impact of the NEF CPD events on informal information, advice and guidance (IAG) for learners as well as helping learners to understand the bigger picture, inform their careers and address training gaps.

Reassuringly, the majority of respondents reported planning their CPD activities (with the aim to support the development of the technical curriculum or to address an identified need).



However, a minority of respondents did not plan their CPD. This is an area of particular concern that warrants further investigation.

The majority of respondents chose to engage in a CPD activity based on Topic. Relevance to their subject areas and Price were also important deciding factors.

Encouragingly, the majority of respondents confirmed that participation in the CPD received senior management support. Findings showed that senior management were more likely to support a CPD activity if it helped improve technical knowledge, enhance college reputation, was readily available, was funded and enabled staff to teach at a higher level. The majority of respondents reported that their managers were aware of NEF and were highly supportive of their engagement in NEF CPD programmes.

The aspect of sharing and embedding the knowledge learned to others was also addressed, with the majority of respondents confirming that they shared informally the knowledge with their colleagues and/or heads of departments. Many also stated that they had reflected on their learning, and this reflection had encouraged them to look at ways to disseminate and embed the knowledge further. Only some respondents stated that they had produced teaching materials and notes as a result of their CPD experience that their peers could use and adapt. Less than a quarter of respondents formally presented to their department on their CPD, through a formal presentation or knowledge cascade activity.

The majority of respondents felt that bringing industry into colleges would support knowledge embedding following NEF CPD activities. Other activities identified as important in terms of supporting knowledge embedding included: organising more visits; workshops and industry placements for teachers.

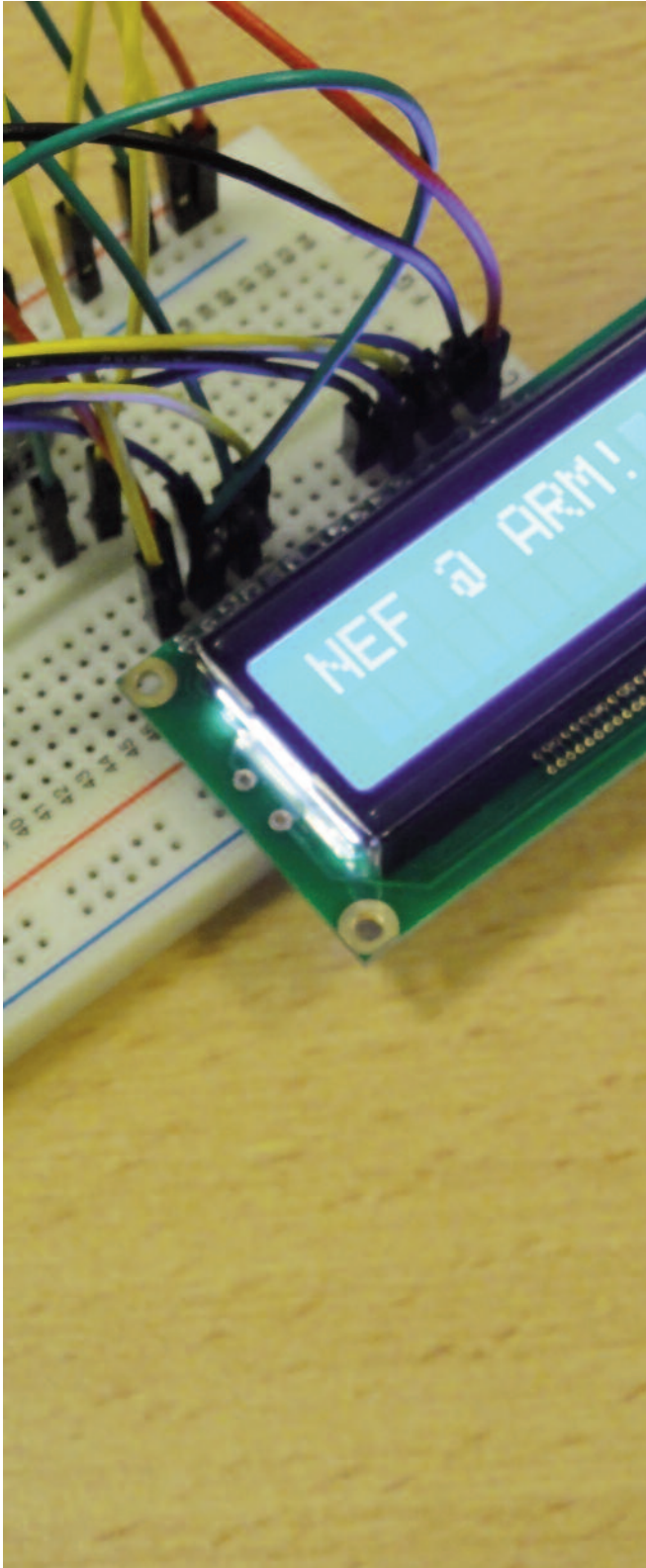
Respondents were asked to identify the CPD topics that they would like see in the next 24 months. The most popular CPD topics include Energy generation and storage; Wind Power; Photo-voltaics; Biofuels and Electronics, Sensors and Photonics.

The findings from this study will be used to inform the development of new NEF CPD programmes. In addition, NEF aims to continue:

- supporting STEM departments to update their technical knowledge
- fostering improved teaching and learning practice
- delivering opportunities to identify new curriculum areas
- supporting colleges in adding value to their CPD offer through guidance in CPD planning, and
- enabling the cascade of knowledge and best practice through widening their STEM offer beyond their educational offer.

## 10 RECOMMENDATIONS

---



The outcomes of this research study will help to inform and shape new CPD programmes that the NEF will be developing.

Already NEF is ensuring that the Industrial Fellowship Scheme has objectives and outcomes aligned to departmental or college-wide aims. Team planning and cascading of CPD is actively encouraged to spread activity, opportunity and impact.

In particular, the research highlighted that there is still work required in helping STEM staff plan their CPD, as over a third still stated they did not formally plan. Planning of CPD is important to qualify impact, as without planning, clear aims, objectives and anticipated outcomes cannot be assessed. NEF will look to provide support in CPD planning and in helping STEM staff with methods to get the best out of professional development activities.

Given the focus on 'new curriculum', NEF will look to work with colleges to help determine their STEM CPD needs, extensively engage business and industry to build topical, leading-edge Masterclasses, informative Briefings and facilitate opportunities for Industrial Fellowships, as well as explore other CPD activities that bring industry into the classroom more, and where companies directly shape curriculum offers.

In the research, a key area of weakness was a lecturer's ability to exchange knowledge and embed formally what they had learned through their CPD experiences. This lack of ability not only impacts on their peers, but affects the college's capability to engage with employers and drive full cost recovery opportunities leading to income

generation. NEF has already started to build new programmes to address this deficiency, to turn lecturers into natural knowledge exchangers, confident to engage with learners or company representatives and support senior manager's able to provide the structures to encourage intuitive innovation flows where continuous improvement is the result.

# APPENDIX A: List of courses and qualifications taught by respondents that have been supported

---

## Science and Mathematics (SSA 2)

### Level 1

- BTEC Applied Science

### Level 2

- BTEC First Diploma in applied science
- NVQ in Nuclear Decommissioning

### Level 3

- Access to HE Science
- AS/A2 Chemistry
- BTEC Forensic Science
- Higher Biology (SCQF Level 6)
- Higher Human Biology (SCQF Level 6)
- International Baccalaureate Chemistry
- National Diploma in Applied Science
- NVQ in Nuclear Decommissioning

### Level 5

- Foundation Degree in Life Science Laboratory Technology
- Foundation Degree in Nuclear Decommissioning
- HND Applied Biological Sciences

## Agriculture, Horticulture and Animal Care (SSA 3)

### Level 5

- Foundation Degree in Agricultural Management
- Foundation Degree in Ecology Conservation Management
- Foundation Degree in Sustainable Engineering

### Level 6

- BSc (Hons) Agriculture

## Engineering, Manufacturing and Technologies (SSA 4)

### Level 1

- City and Guilds CAD parametric modelling
- Electro-tech (Electrical Installations)
- Performing Engineering Operations Electronics
- Vehicle Repair IMI
- Light vehicle (14-16 QCF)

### Level 2

- BTEC Engineering
- BTEC Motorsport Technology
- BTEC Workskills
- CAD
- City and Guilds AutoCAD City & Guilds 2D
- City and Guilds Certificate in Plumbing

- City and Guilds Electronics
- City and Guilds Electrotechnical Technology
- Diploma in Engineering
- Electro-tech (Electrical Installations)
- ICT Functional Skills
- NVQ Aeronautical Engineering
- Performing Engineering Operations
- Performing Manufacturing Operations
- Subsidiary/Extended Diploma Electrical / Electronic Engineering
- Vehicle Technology
- Apprenticeships
- BTEC Motorsport Technology
- Light vehicle maintenance (16 plus)
- Electro-technical - Science Principles (16-18 Full -time)

### Level 3

- Advanced Engineering Apprenticeships using BTEC Diploma in Engineering (Mechanical & Manufacturing Engineering and Electrical & Electronic Engineering)
- Automation and Control
- Automotive Engineering Composites
- BTEC Diploma in Engineering
- BTEC Extended Diploma in Engineering
- BTEC Motorsport Technology
- CAD
- Certificate in Mobile Air Conditioning
- City and Guild Electrical installation
- City and Guilds Certificate in Plumbing
- City and Guilds Electrical Installation
- City and Guilds Electro Technology
- City and Guilds Heating and Ventilation
- City and Guilds PLC's
- Construction and Applications of Digital Systems
- Diploma in Automotive Maintenance and Repair
- Diploma in Electrotechnical Technology
- Diplomas Manufacturing and Operations
- Electrical/Electronic Engineering
- Electro-tech (Electrical Installations)
- Environmental Technologies
- Extended Diploma Mechanical Principles
- Mechanical Manufacturing Engineering
- Motor Vehicle
- NVQ Aeronautical Engineering
- Programmable Logic Controllers
- Subsidiary/Extended Diploma Electrical / Electronic Engineering
- Unit 20 Engineering Primary Forming
- Subsidiary/Extended Dip In Engineering

### Level 4

- Combinational and Sequential Logic
- Electrical Electronic Manufacturing
- HNC Manufacturing
- HNC Mechanical & Manufacturing (Electrical & Electronic Engineering)
- HNC Operations
- Motor Vehicle Maintenance and Repair
- Vehicle Repair IMI
- OUVS Foundation Degree Motorsport Engineering

### Level 5

- Diplomas in Electrical Power Engineering - Wind Turbine
- Foundation Degree in Computer Aided Engineering
- Foundation Degree in Integrated Engineering
- Foundation Degree Manufacturing and Electronics
- HND Manufacturing
- HND Engineering
- HND Manufacturing and Electronics
- OUVS Foundation Degree in Motorsport Engineering
- Robotics HE unit

### Level 6

- BEng Sustainable Energy Technology
- Diplomas in Electrical Power Engineering - Wind Turbine

### Construction, Planning and the Built Environment (SSA 5)

#### Level 1

- Certificate/Diploma in Access to Building Services Engineering
- City and Guilds Plumbing course
- City and Guilds PV Installation & Maintenance
- Electrical Technology
- Part L energy efficiency Building services

#### Level 2

- City and Guilds Electrical Technology
- City and Guilds Plumbing course
- Diploma in plumbing and central heating
- Domestic Installers
- Part L energy efficiency Building services

#### Level 3

- City and Guilds Electrical Technology
- City and Guilds Plumbing course
- Diploma Building Services

- Diploma in Plumbing and Central Heating
- Environmental Tech - Renewables-Solar Thermal
- Installing Electro-Technical System
- Renewable Technology Course

#### Level 4

- Motor Vehicle Maintenance and Repair

#### Level 5

- Engineering
- Foundation Degree Building Services
- Foundation Degree in Architectural Technology with Sustainable Design
- Foundation Degree in Civil Engineering & Transport
- Foundation Degree in Sustainable Construction

### Information and Communication Technology (SSA 6)

#### Level 3

- A Level ICT
- BTEC IT

#### Level 6

- BEng Sustainable Energy Technology
- BSc (Hons)Information Technology
- BSc (Hons)Interactive Design
- Foundation Degree Internet Media Design

### Arts, Media and Publishing

#### Level 3

- Acoustics Analogue & Digital Audio Principles
- Extended Diploma Music Technology
- Functional Music
- Keyboard Music

#### Other

- Broadcast Journalism Film & Video
- Multimedia Production
- TV Technology

# APPENDIX B: Courses that have been improved or developed as a result of engagement in the NEF CPD Programmes

---

## Science and Mathematics

### Level 2

- BTEC First Diploma in applied science
- NVQ in Nuclear Decommissioning

### Level 3

- NVQ in Nuclear Decommissioning
- BTEC Applied Science (Forensic Science)

### Level 5

- Foundation Degree in Nuclear Decommissioning

## Agriculture, Horticulture and Animal Care

### Level 5

- Foundation Degree Sustainable Engineering

## Engineering, Manufacturing and Technologies

### Level 2

- City and Guilds Electrotechnical Technology
- Diploma in Engineering
- Subsidiary/Extended Diploma Electrical / Electronic Engineering
- Apprenticeships – Motor Vehicle
- BTEC Motorsport Technology

### Level 3

- Automation and control
- BTEC Diploma in Engineering
- BTEC Extended Diploma in Engineering
- City and Guild Electrical installation
- City and Guilds Heating and Ventilation
- City and Guilds PLC's
- Construction and Applications of Digital Systems
- Diploma in Automotive Maintenance and Repair
- Diploma in Electrotechnical Technology
- NVQ Aeronautical Engineering
- Programmable Logic controllers
- Subsidiary/Extended Diploma Electrical / Electronic Engineering
- Unit 20 Engineering Primary Forming

### Level 4

- Combinational and Sequential Logic
- Electrical Electronic Manufacturing
- HNC Manufacture
- HNC Manufacturing
- HNC Mechanical & Manufacturing Engineering and Electrical & Electronic Engineering)

- HNC Mechanical / Manufacturing Engineering
- HNC Operations
- Motor vehicle maintenance and repair
- Vehicle Repair IMI
- OUVS Foundation Degree Motorsport Engineering

### Level 5

- Diplomas in Electrical Power Engineering - Wind Turbine
- HND Engineering
- HND Manufacturing and Electronics
- Foundation degree in Integrated Engineering
- Foundation degree Engineering Technologies (Environmental)
- Robotics HE unit
- OUVS Foundation Degree Motorsport Engineering

### Other

- All Information, advice and guidance (IAG) section of courses
- Bio Diesel course
- Composite materials in engineering
- EASA part 66 Aircraft maintenance licence
- Green Technology course
- STEM activities related to offshore wind developments

## Construction, Planning and the Built Environment

### Level 1

- Certificate/Diploma in Access to Building Services Engineering

### Level 3

- Environmental Tech - Renewables-Solar Thermal

### Level 4

- Motor vehicle maintenance and repair

### Other

- Biomass
- Building Management Systems and controls
- Building Services & Renewable Energy
- Energy Eff Solar Thermal Sustainability and Renewables
- Grey water recycling
- Ground source
- PV Installation & Maintenance
- Solar PV & Hot water

### Information and Communication Technology

Level 6

- BEng Sustainable Energy Technology
- BSc (Hons) Information Technology
- BSc (Hons) Interactive Design
- Foundation Degree Internet Media Design

### Art Media and Publishing

Level 3

- Acoustics Analogue & Digital Audio Principles

Other

- Broadcast Journalism
- Multimedia Production
- TV Technology



NEF: The Innovation Institute  
10 Bective Place  
London SW15 2PZ  
Tel: +44 (0) 20 8786 3677  
[thenef.org.uk](http://thenef.org.uk)