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Royal Society of Chemistry: Higher Technical Qualifications in chemistry and related subjects.

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Executive summary

Methods

This report follows a literature review phase and presents findings from 51 qualitative interviews with employers, providers and learners of Higher Technical Qualifications*.

Providers' needs

- The sector is volatile, with providers describing how they responded to changing conditions by switching, tweaking and considering new HTQs.
- The reported cohort sizes were usually small and could fluctuate considerably year on year, with projected demand sometimes not materialising in enrolments.
- Individual cases suggest employer engagement is important in making new HTQs viable. However, communication between employers and providers was not always established.
- Other than problems with attracting learners, there don't seem to be wider systemic or infrastructure issues that are a major barrier to provision, and delivery looks to be effective.

Learners' journeys

- Learners of HTQs choose them because they need a more accessible learning route or have a preference for a more applied, rather than academic, qualification.
- HTQs have diverse and mixed cohorts and tend to bring together learners from a wide range of work and educational backgrounds, genders and age groups. Qualitative evidence indicates that HTQs are more inclusive for non-traditional learners compared to university degrees.
- Accounts of employers, providers and learners suggest HTQs are used to achieve a triple purpose: as an entry route to a variety of industries; to achieve progression and promotion within their current workplace or sector; and to progress into science-based undergraduate courses. HTQs currently seem to be more successful at facilitating the last two outcomes, as school leavers with no relevant work experience sometimes have a poor understanding of the diversity, or specifics, of careers these qualifications can lead to.

Employers' perceptions

- While most employers indicated that they did not have a shortage of applicants for technician-level roles, many did mention areas of deficiency in those that they eventually appointed. They wanted technicians to be well-rounded, including having professional and soft skills.
- Although awareness of HTQs was low amongst some employers, their general impression was that such qualifications give learners competencies needed to succeed at work. They expected technical qualifications to teach more than technical skills alone.

*By Higher Technical Qualifications (HTQs) we mean post-18 qualifications at levels above A-levels, Highers and equivalents, but below degree level. HTQs include a range of qualifications, such as HNCs and HNDs, Foundation Degrees and Diplomas.

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Executive summary

What needs do HTQs serve?

This research gathered primary and reported evidence of learners' journeys that demonstrate a range of ways in which HTQs are used as building blocks to progress on educational and professional paths. HTQs can lead learners with diverse educational and work backgrounds closer to accessing higher education. Although far from everyone uses this route to progress to HE, this route does not close off any doors, and puts learners with different backgrounds and intentions in a position where new options, including higher education, become open to them. However, more could be done to help learners with no work experience or exposure to industry to use this qualification as an entry route into applied-sciences sectors.

How successful are HTQs?

Compared to an academic route that leads from school to university, learners are less exposed to the technical route. Outreach opportunities to make learners consider HTQs are often neglected. Qualitative evidence from all respondent groups, as well as from the literature review, suggests this is the main barrier to making HTQs more popular among learners and employers.

No significant issues in their design or delivery were identified in this research. However, accounts of learners and employers highlight that the work-experience element makes such qualifications more attractive. While apprenticeships are well-positioned to respond to this need, classroom-based qualifications with a practical focus can be made more attractive by incorporating workplace-based modules.

What would be the impact if HTQs didn't exist?

Qualitative evidence firmly indicates that these qualifications serve a distinctive need not met by university degrees. Importantly, they don't necessarily compete with them from a learners' perspective, but can be used to facilitate progression toward further learning. Providers' and learners' views align here in painting a positive picture of how these qualifications serve the needs of learners facing additional barriers (such as lower SES, history of migration or disrupted education) specifically and contribute to a wider goal of widening participation. They can help learners to reimagine their relationship with education, and without them some learners would risk being left out or self-excluded from further educational opportunities and careers in science.

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BACKGROUND

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Background and research objectives

Background

The Royal Society of Chemistry (RSC) commissioned Shift to explore the experiences, motivations and journeys of learners undertaking higher technical and applied qualifications in Chemistry and related subjects in England and Scotland, with a view to shaping the direction of future policy work in this area of education. Additionally, this research aims to provide the RSC with the insight to appropriately advocate for the development of technical skills for the chemical sciences.

This report follows on from other research studies that looked more widely at Higher Technical Qualifications (HTQs), which formed part of the Department for Education's review of Higher Technical Education. In preparing a response to a connected consultation, the RSC identified a knowledge gap regarding how these qualifications served the chemical sciences, as well as providers and learners in our subject area. Therefore, it was crucial for the RSC to gather evidence and information about the challenges faced by this sector and the needs of learners and providers to shape their policy work in this area.

This research focused on the classroom-based HTQs at level 4 and 5 in England and level 7 and 8 in Scotland.

Research objectives

The research focused on these key questions:

Who are the learners studying HTQs and how did they come to study these qualifications?

To what extent does studying these HTQs prepare learners to enter the chemical sciences labour market?

What are the outcomes for learners studying these qualifications and what do they intend to do with their qualification?

With exploration into the following subsidiary questions:

- How do providers choose which HTQs to offer and are they adequately prepared? What are the difficulties in provision?
- Do learners feel they are gaining the skills, knowledge and behaviours that HTQs aim to develop?
- How accessible are the qualifications for learners?
- Do the education providers engage with the RSC?
- Are there any needs of the learners' and education providers' that could be met by the RSC's existing products and services?
- What are employers' experiences of engaging with providers?
- What is employer awareness and perceptions of HTQs?

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Methodology

Literature review

Qualitative interviews

LITERATURE REVIEW

This formed the starting point for the research, taking the form of a blended evidence review that provided an overview of the sector. This part of the research focused on the question of who the learners are and whether HTQs prepare them to enter the labour market. As part of this, Shift focused on qualifications from 2016 onwards (to maintain relevance), in chemistry or applied science and based in England and Scotland. The first phase aimed to develop and test a robust list of key search terms and phrases in order to gather potentially relevant articles. Academic articles, industry reports and policy documents were read and analysed in depth for key findings pertinent to the research questions. This research phase was summarised in a separate report delivered in the summer of 2020.

QUALITATIVE INTERVIEWS

We conducted a total of 51 online and telephone interviews across 3 key respondent groups:

- 21 employers
- 20 providers
- 10 learners

Employer and provider interviews lasted 40 minutes. Learner interviews lasted 25 minutes with a £20 incentive. We aimed to recruit in England and Scotland across a regional spread. These interviews were transcribed and analysed using Atlas.ti. The analysis of these findings forms the basis of this report.

Respondents were approached using a variety of methods.

- Some responded to a recruitment email sent by the RSC and Shift.
- Additional employer and provider contacts were datamined and then called or contacted on LinkedIn to invite them to take part in a telephone interview.
- Learners were recruited through providers, who were asked to forward an interview invitation message to suitable learners.

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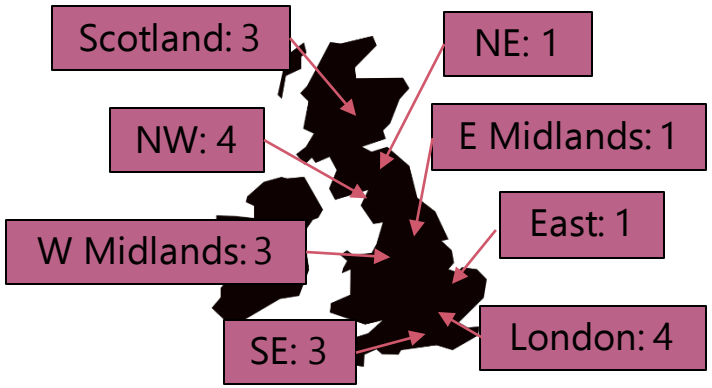
Profile of respondents

PROVIDERS: 20

Institution type
Private training provider: 1
FE college: 14
University: 3
Other: 2

Do they provide HTQs?
Yes: 13
No: 4
Used to: 3

Qualification types
HNC, HND, HNC and HND, Level 3 Applied Sciences, Apprenticeship HNC, Cert and Diploma in HE, Foundation Degree, Diploma

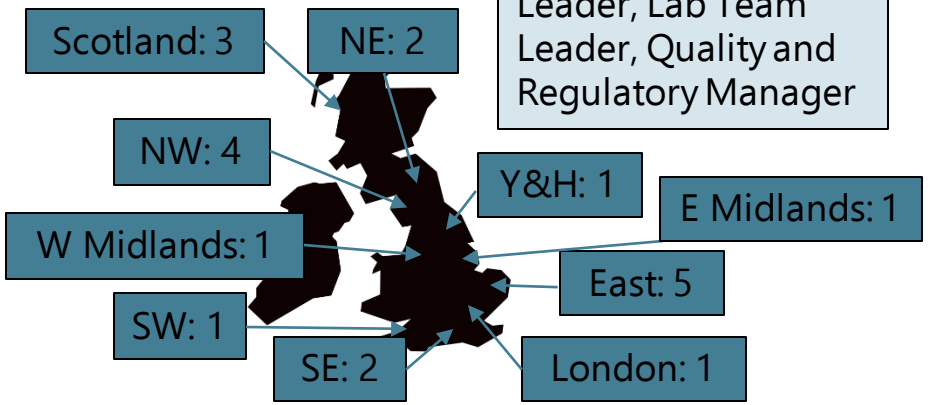


EMPLOYERS: 21

Sector
R&D Labs: 5
University: 2
Chemical manufacturing: 4
Schools: 3
Other manufacturing: 2
Pharmaceuticals: 1
Contract analysis: 1
Nuclear: 1
Utilities: 1
Environmental: 1

Awareness of HTQs
High: 4
Average: 4
Low: 7
None: 4

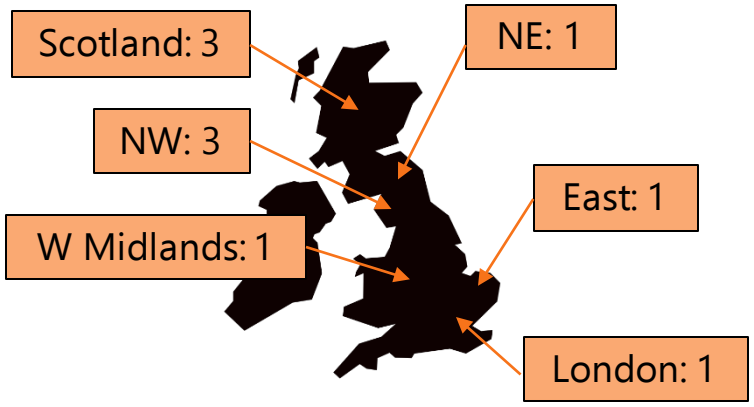
Job roles included:
Technical Manager, Lab Manager, Recruitment Manager, Analytical Science Team Leader, Lab Team Leader, Quality and Regulatory Manager



LEARNERS: 10

Student type
Current: 7
Graduated: 3

Qualification type
HNC: 5
HND: 2
HNC and HND: 1
Foundation: 1
Degree Apprenticeship: 1



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Research limitations

Impact of COVID-19

- This research has been conducted during the COVID-19 pandemic. This has affected our recruitment process and impacted the sample, as well as some of the findings.
- Recruitment of employers has proved very challenging, with offices closed and some of those working in lab settings even busier than usual. We also can't say to what extent the difficulties the companies and sectors were facing impacted on employers' priorities and their willingness to engage in non-critical activities, such as taking part in this research.
- Recruitment of learners has proved even more challenging. Initially we were aiming to talk to 20 learners but we only managed to recruit 10. This might be partially explained by the enrolment being affected at some providers and courses being delivered in a more remote mode, which is likely to have affected communication with learners.

Data limitations

- The HTE landscape is quite diverse, with many qualification types. Due to the small sample and some qualifications being more popular than others, not all qualification types were represented in the sample and this research did not cover differences between different qualifications at level 4-5 in England and 7-8 in Scotland in great detail.
- We used the Pearson HNC/HND in applied sciences (chemistry path) as a sample qualification shown to respondents. Some of their feedback cannot be generalised to other HTQs.
- The bulk of evidence around learners' journeys comes from provider and employer interviews, with individual interviews with learners used to illustrate key trends.
- As is often the case in qualitative research, we need to be mindful of perspectives that were not included in the project – people who did not want to be involved might have included learners dissatisfied with their HTQs, providers facing serious challenges to delivery, or employers unaware that HTQs might be relevant to them.

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EMPLOYERS' NEEDS

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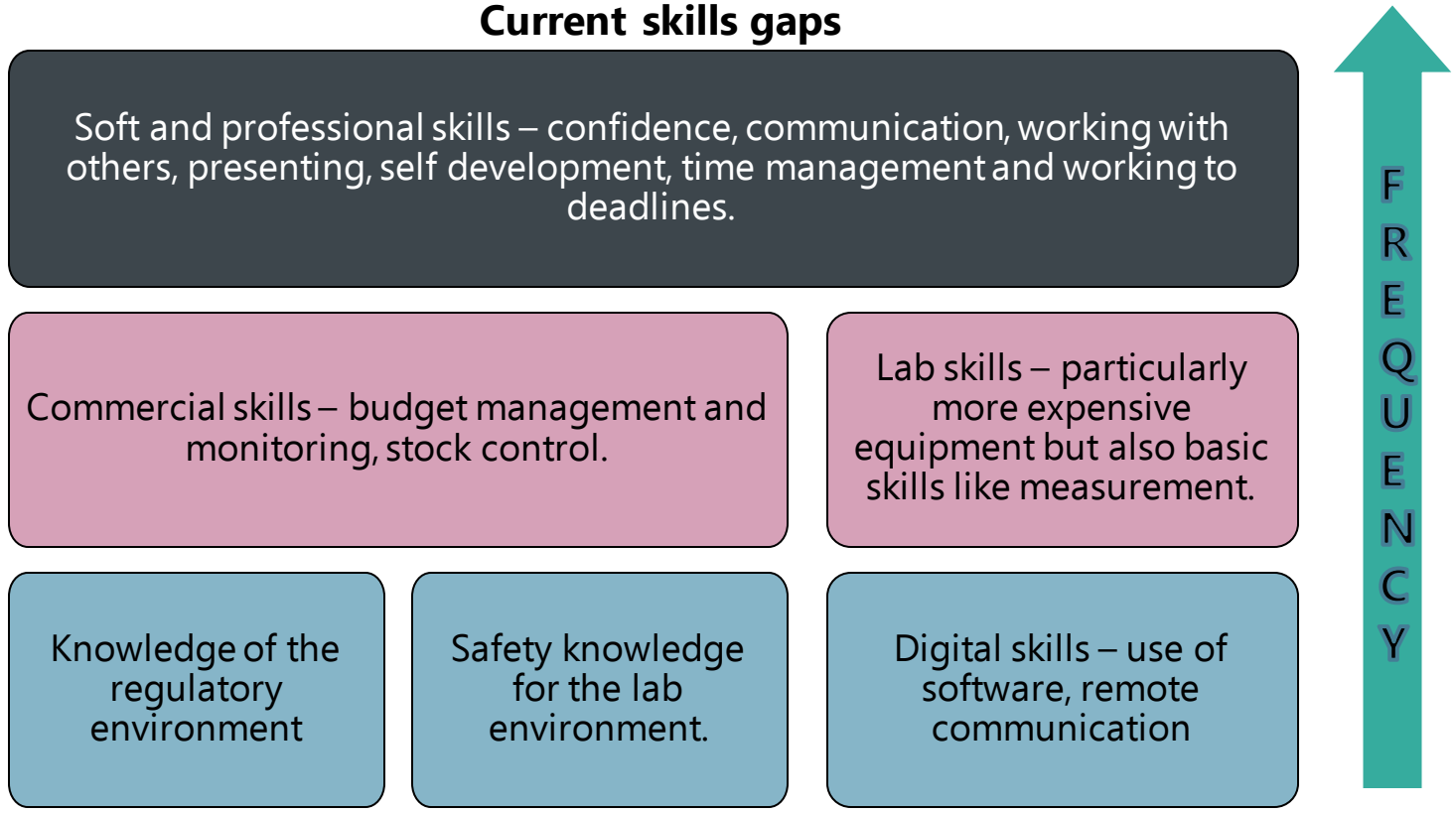
Employers pointed to soft skills as key weaknesses in current entry-level employees

While most employers indicated that they did not have a shortage of applicants for lab technician and entry level roles, many did mention areas of deficiency in those which they did appoint. It was notable that soft skills areas were really prominent here, mentioned approximately 4 or 5 times as often as any other area. In many cases, these skills were felt to be particularly deficient in younger workers, including those who were taking a pathway following degree-level studies. These are summarized in the diagram below.

In general, there was a great demand for actual work experience in new entrants, which suggests HTQs are more attractive if they include a workplace-based element. There was less consensus around important **future skills**, but those mentioned included:

- A good understanding of sustainability issues and materials, green chemistry
- Good IT and digital skills – including both programming and understanding the IT infrastructure of the lab and modern equipment.
- Communicating across disciplines (the T model of skills that promotes a broad generalist area of knowledge accompanied by a specialism area).
- Artificial Intelligence and robotics.
- Data handling.
- Safety and cleanliness in the lab (this may be partially COVID-related).



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Employers' awareness of qualifications at this level was very low

Awareness of HTQs (level 4-5 in England / 7-8 in Scotland) was low. Only 7 of our 22 employers interviewed were strongly aware of level 4-5/7-8 qualifications, often because they had experienced this route themselves or via the qualifications being embedded within apprenticeships. Other respondents admitted to having very little understanding of these qualifications. In general, employers tended to be far more aware of routes they had used themselves or ones that were more widespread – university degrees or A-levels/Highers.

Familiarity was also very low
Even those aware of the qualifications were in many cases not familiar with their content:

"I knew that they existed, but I didn't appreciate where they fitted in to the whole pathway. We'd look for a bachelor's degree minimum, and we never considered any HNC or HNDs."
Employer, R&D Laboratory, Operating Officer, NW England

Given that these employers were invited to be interviewed about qualifications at levels 4-5/7-8, awareness in the general population of employers might be even lower. They were more well-informed about BTEC at level 3 and A levels (or Highers in Scotland), and all were strongly aware of degree-level qualifications.

Communication around higher technical qualifications appeared limited
While some had received communication from local providers around work experience opportunities, in general there appeared to be little communication between these employers and providers. In some cases, this was because communication with providers was siloed within a different department, such as one that dealt solely with apprenticeships. None had actively sought information, though one admitted to checking on a qualifications table to see what level an HNC was while recruiting.

What do employers need to know about HTQs to gauge their relevance?

Questions from employers really illustrated their lack of knowledge around what these qualifications involved:

- What level of practical experience do learners get?
- Who are these qualifications accredited by?
- Are they RSC accredited?
- How are they assessed?
- Are they part-time or full-time?
- Are they more vocational than degrees?
- What content have learners studied?

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Despite employer engagement being key to a viable qualifications market, communication between employers and providers seemed inconsistent

Few employers had been asked to consult on the design or delivery of qualifications. For those who had had more contact with providers, the communication was focused on providing work experience for HTQ learners or apprenticeships. When asked if they would be interested in the **design and delivery** of HTQs, employers' responses highlighted **three benefits of involvement**:

- The benefits for staff in having the **opportunity to talk to learners** about how they have used their degree and share insight into the workplace environment.
- Access to the apprenticeship levy and **relevant apprenticeship** courses in their area.
- To gain an increased **understanding of what knowledge and skills** learners gain from these qualifications.

Employers' involvement tended to be focused on providing workplace-based learning or offering study leave. Employers who exclusively recruited graduate technicians, or who did not recruit technicians on a regular basis, were unlikely to be informed about HTQs offered locally.

"But if we do become involved in it then we would certainly want to get involved in delivering those courses and setting the curricula."

Employer, R&D Laboratory, East

Some providers reported communicating and collaborating with local employers. The following are some of the ways providers encouraged that engagement:

- Monthly meetings with learners and reviewing marked work.
- As guest speakers at the provider.
- Guiding the qualification design through annual forums and regular meetings.
- Driving the material for work-based study projects.
- Providing work placements for learners as part of their qualification.
- Influencing providers' decisions over what qualifications to offer.

It appeared that employers' buy-in was helpful im making the qualifications more viable and improving demand from learners. The companies also experienced benefits by ensuring educational offer was **tailored to specific local industry needs**. Even those employers with limited current engagement with providers **were intrested in getting more involved.**

"They take something that is relevant to them in the workplace, and the lecturer will go through broad skills for that and specialise in each student."

Provider, FE college, North East

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Employers tended to offer on-the-job training or took on apprentices and demonstrated a preference for qualifications that combined work and study

Although some employers only hired technicians at degree level and beyond, employers overall preferred to recruit technicians with basic practical skills and knowledge and further shape their training through in-house methods or recommended qualifications alongside their work.

In house

- Professional development linked to appraisals.
- Targeted training based on individuals' needs.
- Training based on unique skill sets required by the company.
- Informal on-the-job training.
- Established internship process including training.
- Management skills training.
- Sending employees to short topical courses.
- Coaching in lab skills with the team of chemists.

Apprenticeship

- Collaboration with a local provider to provide on-the-job training.
- Having an apprenticeship embedded into their recruitment process.
- These apprenticeships included HTQs and degree apprenticeships.

Recommended qualifications

- Employers were often keen for technicians with qualifications level 5 and below to continue studying part-time whilst working to achieve level 6 and beyond.
- Those with apprentices are open to sending them on to complete a degree.
- A few employers recommended the RSC Chartership programme for graduates as a way to demonstrate that they were working to recognised standards within the industry.

Effects of the pandemic

- Generally, COVID-19 had encouraged employers to make better use of online training, e.g. around health and safety, but had not significantly changed the approach to training provision.
- Some found that it had made the upskilling of technicians harder because they were less able to go into the lab. However, this was still something they felt they had to prioritise.

"We recommend [RSC Chartership] because it gives our new graduates a structured route to gaining a really, really good internationally recognised qualification. So Chartered Chemist is internationally recognised and it provides … assurance that our scientists are working to those standards."

Employer, R&D Laboratory, Analytical Sciences Team Leader, East of England

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Employers valued technician candidates with workplace experience alongside practical lab experience

Those who hired technicians tended to recruit through local apprenticeship schemes or job adverts for graduates. Some used agencies to fill part-time technician roles. Whilst employers often did prioritise work experience, education level and professional skills were also key factors:

Workplace experience

- Overall, workplace experience and evidence of lab skills was **highly valued** amongst employers.
- Those who prioritised workplace experience sometimes preferred candidates with lower qualifications that they could train to match their **specific needs in-house**.
- HTQs would provide a valuable option to fit this requirement.

Qualification level

- Some who hired graduates would not hire them without some **relevant experience or having done a placement year**, whilst others preferred to hire chemistry graduates who could complete technician responsibilities on top of their other work.
- Qualifications that focused more on lab skills and practical experience were prioritised in many cases.

Professional skills

- Those with strong in-house training schemes tended to prioritise candidates with the right **interpersonal skills** over qualification level.
- Evidence of strong professional skills could make up for a lack of work experience.

Sometimes, employers felt that certain **graduates** were less suited to work as technicians because they:

- **Lacked practical experience.**
- **Expected to be more involved in the research** rather than technical roles.
- Were more likely to use a technician position as a **springboard to start their career** and would leave after a year or two.

Those who favoured recruiting apprentices or school leavers highlighted the following reasons:

- They could **retain them at the company longer.**
- It was easier to train younger candidates for the specific needs of the company.

'What you don't want to do is get somebody who is like right, I'm going to do the technician role for a couple of years, I'm ambitious enough, I want to be in the senior lead.'

Employer, Chemical Manufacturing, Technical Director

"Yes, I do prefer experience over qualifications for technical roles. Especially in the more senior roles, it's something that you kind of develop into."

Employer, University, Lab Manager

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PROVIDERS' NEEDS

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Providers introduced and discontinued HTQs regularly

We spoke to providers who were: currently offering HTQs; considering offering them; or had offered them in the past. Most providers were further education colleges, but we also spoke to universities and a private training provider.

The providers we spoke to were offering the following qualifications:

- Apprenticeships including a level 4 / 5 HTQ, linked with local companies.
- Full-time or part-time classroom-based HNC/D.
- Foundation degrees

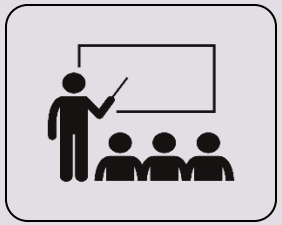
One FE college in Scotland offered certification of modules from HNC level 6 rather than offering the whole course.

Course subjects included:

- Chemistry.
- Applied sciences.
- Natural sciences (with a chemistry route).
- Forensic science
- Biomedical science.
- Laboratory Technician apprenticeship.

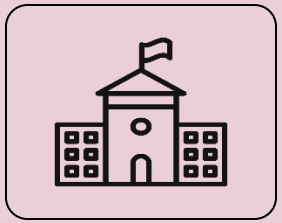
The sector appeared to be volatile

We heard that the sector was highly volatile, with providers saying they introduced, discontinued, tweaked and researched new HTQs regularly.



The cohort size was small

- The cohort size on the courses were usually small – ranging from 3 to 18 students – because demand was fairly low.
- Providers commented that the number of students interested could fluctuate considerably year on year.



Some competitors offered alternative qualifications

- Usually providers thought there were 1 or 2 other providers near their institution also offering HTQs, but sometimes their awareness of competitors was low.
- Competitors close by tended to offer different types of level 4-5/7-8 qualifications from each other, e.g. apprenticeship or a foundation course.

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Senior management teams would decide if new qualifications were feasible

We asked providers how and why they decide to introduce new science qualifications. The general process / considerations are outlined below:

A need for a new qualification is identified. Employers or learners may request them.

→

Science departments collectively or Heads of Department research qualifications and make a business case.

→

Local employers are contacted to see if they would like to be involved with the new qualification. **This stage wasn't always completed**, but there was better qualification demand when it was.

→

The business case is brought to the senior management team who assess the feasibility and approve the request.

What do the senior management team consider?

- What qualifications will suit their learners? Do they want to continue with education or go into the workforce?
- Will it help create a learning pathway taking learners from level 3 onwards?
- How will they recruit learners?
- Are the structures already in place? Do they offer apprenticeships or other science qualifications already?
- Do they have the right equipment?
- Do they have the right staff expertise?
- Are there local employers who are willing to support this qualification?
- What type of qualifications do local employers need and want?
- Can they partner with other local universities or colleges to help deliver the qualifications or create an educational path?

Impact of the COVID-19 pandemic

- Most providers said COVID-19 wouldn't change what qualifications they currently offered because they had adapted well to delivering qualifications online and with social distancing in place.
- Whilst some providers thought employers would be reluctant to take on apprentices or offer work experience, others said that because the chemical industry had remained open they foresee minimal changes.

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Providers wanted employers to be more involved in developing HTQs

There were considered to be two main stakeholders involved in the process of introducing new qualifications – employers and learners. Communication between employers and providers was minimal in most cases, unless the provider was offering an apprenticeship. Employers told us that they currently don't receive information about qualifications from providers, but that they would like to. Providers were generally not collaborating with professional bodies such as the RSC, with the exception of when they wanted to get their qualification accredited.

Employers

- Providers wanted employers to be integrated into the process, but they sometimes reported **underdeveloped networks** with local industries.
- The reliance on employers to help deliver apprenticeships (and vice versa) created an **effective channel to discuss industry skills gaps** and needs and they helped develop the curriculum.
- Some respondents reported having meetings with local employers to understand their needs.

Learners

- Current learners helped to initiate the process by requesting qualifications that they wanted to take.
- FE colleges in particular wanted to create a **learning pathway** for their students by having qualifications that build on each other from level 3 to level 5 or 6.

Professional bodies

One respondent working at a university said they discussed their science qualifications with the RSC to ensure they were up-to-date in the industry, although other providers seemed unaware that this was an option, even when they were RSC members themselves.

"We have an industrial based steering committee, so experts from various companies and industries would meet from time to time and they're really looking at the strategic directions that we should take."

Current provider, University, London

"We've taken some of our students from level 1 to level 2 to level 3 so the chances of them staying on with us at level 4 would be quite high because they've had a lot of success with us."

Potential provider, FE college, East Midlands

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HTQs could prepare students for industry or university

Providers introduced HTQs because they viewed them as attractive qualifications that could prepare learners for both industry and university. Although HTQs served diverse purposes, providers were usually motivated by one of the categories more than the others.

What drives providers to introduce HTQs in chemistry or related subjects?

Focus on preparing learners for work

Some providers introduced HTQs to:

- Prepare learners for industry by teaching practical laboratory skills and theory.
- Allow learners who currently work in the chemical industry to advance their career.
- Combine with apprenticeships to offer valuable work experience and job opportunities.

Focus on keeping learners in education

Other institutions introduced HTQs:

- As an alternative route to achieving a science BSc, by creating a pathway from school to bachelor level with more teacher contact time, smaller classes and reduced fees.
- To provide the entry requirements for university courses for learners who didn't achieve the right A-levels/Highers.

Focus on meeting local employers' needs

Providers reported that they offered HTQs to appeal to employers, because:

- Employers had reported that graduates lacked practical laboratory, work-based and soft skills that HTQs can help them develop.
- The qualifications could be combined with apprenticeships that helped employers mould learners into the scientists they needed.
- Employers can get funding through the government levy for apprenticeships, which makes HTQs affordable.
- They can offer employers the chance to develop the courses and pick modules relevant to their industry (e.g. nuclear).

"The thing with most of our HNDs is they are usually just stepping stones, most of the people who graduate with the HND will automatically go on and do a top-up degree year, so they'll end up leaving the university with a BSc. It provides access to university for students who may not otherwise get in." **Current provider, University, West Midlands**

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A major barrier was a lack of demand from learners and employers

We spoke to providers who had stopped offering or switched away from HTQs. The main reason was a lack of demand leading to small cohorts, which were not financially viable. Lack of demand was often the result of poor awareness amongst learners and employers, and underdeveloped relationships with local industry, other colleges and universities. Outlined below are identified barriers preventing providers from running HTQs:

Lack of demand

- Lack of student demand to keep the courses running.
- Lack of employers approaching providers about possible qualifications.

Lack of awareness

- Lack of awareness among employers of what HTQs are.
- Learners lack awareness of what they could achieve after doing a HTQ.
- Some providers had little knowledge of relevant employers in their area.

Prioritising other levels

To some universities, HTQs sometimes appeared not to align with their institutional strategies, which focus on degree-level qualifications.

"There wasn't the demand to run it, it wouldn't have been profitable for us to run it with the number of students that were doing it, so we decided not to offer it anymore."

Lapsed provider, FE college, NW England

Degree is the default

Providers thought that **getting a degree** was increasingly seen as the only route into science by employers and learners, which made demand for other qualifications low.

Other route to work experience

Providers often ran **apprenticeships** instead of classroom-based HTQs because that was what employers wanted. Employers can get funding from the government levy for apprenticeships and they are more integrated with the workplace environment.

"If a lot of our employers were saying, 'look this is what we want you to do', then I'm sure we'd consider it. But that's not a message we're getting."

Lapsed provider, University, NW England

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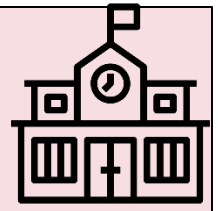
Introducing and discontinuing HTQs – case studies

Outlined below are two case studies from interviewees working at a FE college and a metropolitan university. They demonstrate why HTQs can be introduced and discontinued.

Case study: FE college



What do they offer?
Level 3 science qualifications.

What are they introducing?
They have recently introduced a HNC Laboratory Technician apprenticeship.

Why did they introduced it?
Local employers expressed an interest in sending their employees on the course and collaborating on the apprenticeship element. Level 3 learners wanted to continue their education at the college.

What barriers have they faced?
Learner uptake has been poor so far and only six signed onto the course this year, which doesn't make the course financially viable.

"We thought we had enough interest from learners studying at level 3 to introduce a level 4 qualification but we have been offering the HNC apprenticeships for five or six weeks now and the numbers haven't materialised. We only have six learners."

Current provider, FE college, East of England*

Case study: metropolitan university

What are they discontinuing?
This is the last year they will offer the FdSc in chemical science (aligned to the level 5 Laboratory Scientist apprenticeship standard).

What are they switching to?
As a university, their strategy has changed to focus on degree apprenticeships rather than level 4 & 5 HTQs.

Why are they switching?
They have an employer advisory board that supports the change. Apprenticeships were a more appealing option because of this employer buy-in. Employers felt degree apprenticeships would attract stronger candidates who want to complete a degree.

"Now employers are sort of committing that they're going to put these people through a full BSc programme. That they're going to come out with an equivalent qualification plus the workplace experience to [just] going into university. You maybe get more of the high-flying academic, higher academic calibre candidates considering this option."

Lapsed provider, University, NW England

* *Quote reconstructed by Shift based on interview notes.*

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There were minimal problems delivering HTQs

Most providers found that they had the right expertise and facilities to delivery HTQs effectively.
There were several small barriers for providers who manged to attract viable cohorts of learners.

Staff expertise

- There was an expectation amongst some providers that at least one member of staff running the course needed to have a **PhD**.
- This higher level of qualification meant that the teaching would be more **expensive** and they would need more learners on the course to compensate.
- Some providers had a **limited number of chemistry specialists**, making lesson cover difficult or limited the number of optional modules they could offer

Facilities and equipment

- Where falling short, providers sometimes sourced equipment from **other local colleges and universities**.
- Some providers had to have lessons with learners on different courses (maths, biology, chemistry, applied science) to **combine small cohorts** and free up the laboratory space.
- Those having the necessary expertise and facilities sometimes chose to offer a wider applied sciences coverage, instead of focusing on chemistry alone, to attract more learners and open the door to more higher level courses.

COVID-19 pandemic

- Despite the reduced numbers of learners, providers said that they were **still able to deliver their HTQs** during the COVID-19 pandemic.
- They adapted by **teaching online and social distancing** during laboratory/ practical work.
- Providers didn't tend to see any major long-term impact of COVID-19 on how they will run the qualifications.
- However, those qualifications cannot be delivered fully online so this might become an issue if COVID restrictions continue in the long term.

"*Fortunately, I have a very resourceful team who have got lots of contacts and I think that there may well be a couple of practical things that we have to go elsewhere to complete, but we can return the favour with equipment that we've got that they haven't. We try to work collaboratively with other colleges.*" **Current provider, FE college, London**

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Differences between Scotland and England - provision

- We were interested in uncovering any potential differences between Scotland and England that might affect the provision and demand for HTQs. It must be noted that this research included far fewer respondents from Scotland than England, limiting making generalisations that can be deemed representative of the whole nation. However, having collected the experiences from participants based in different regions, and within the wider context of the literature review, in this slide we make a cautious commentary around potential similarities and differences and their prominence within the qualitative phase.

- It should be stressed that providers in Scotland and England alike did not tend to mention significant structural issues affecting the provision or delivery of HTQs. There are differences between the educational systems, but also some point of alignment that affect the HTQ landscape in both countries in similar ways, including:
    - Popularity, and continuous policy-makers' endorsement of, bachelor-level degree as a default educational option.
    - Renewed interest in higher vocational qualifications (emergence of Degree Apprenticeships in England and Graduate Apprenticeships in Scotland) created a technical route leading to a degree-level qualification in both Scotland and England.
- Scottish providers we interviewed ran viable HTQs, with established relationships with local universities or employers. However, we have insufficient data to conclude that this is generalisable across all Scottish providers.
- One Scottish provider mentioned a barrier to delivery did exist around requirements for learners to visit a working laboratory, but that was changed following action by the SQA.
- One Scottish provider mentioned not having access to support from a network of other colleges offering HTQs in Chemistry. This might potentially be an issue for other Scottish providers as there have been lots of FEC mergers in recent years in Scotland.
- We collected anecdotal evidence from a learner and a provider in Scotland describing successful progression from an HTQ to the second year of a university course. Ensuring more learners progress from college to universities without unnecessary duplication of credit is an area of priority for the Scottish government and something that might be encouraged.
- Employers' buy-in was an important factor contributing to the viability of offered HTQs. There were differences here, but they tended to reflect regional, smaller scale differences rather than being indicative of national policies or industry trends.

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LEARNERS' JOURNEYS

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HTQs attract and serve the needs of diverse learners

While the qualitative research doesn't allow us to present a generalisable mapping of learners' demographics, the insight from interviews paints a picture of diverse and mixed cohorts. HTQs appear to bring together learners from a wide range of work and educational backgrounds, genders and age groups.

Gender

Providers we interviewed tended to report an even gender split, or even slightly female-dominated HTQ cohorts.

Ethnicity

Employers and providers suggested cohorts tend to reflect the regional make-up of the local population, which is impossible to generalise on a national scale. Anecdotal evidence suggests HTQs are attractive and more accessible to recent migrants.

SES

Accounts of providers and learners suggested that HTQs are attractive to those from poorer families who might be reluctant to pay university fees or travel far from home to study. A couple of learners mentioned that the educational background of their parents also played a role in choosing a more vocational route.

Age

Providers reported that HTQ cohorts tend to consist mostly of school leavers under 20, with a minority of mature learners in their 20s, 30s or sometimes 40s. Interestingly, most courses seem to successfully cater to this mixture of learners at various ages learning together. This addition of more mature learners means that classrooms tend to bring together individuals with diverse industry experience, which can enhance peer learning.

Education

Interviews suggested that HTQs attract some learners that were more likely to have struggled in their educational history, which can include not thriving at school, dropping out of further education or self-excluding themselves from educational opportunities by developing a perception of not being academic or having lower ability.

"It's sometimes amazing how well groups of eighteen year olds and forty year olds will all get on very well through a shared experience. It does generally work very positively".

Lapsed Provider, FE College, NW England

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HTQs' design and delivery appeared to be appealing to less traditional learners

Interviewees felt that the practical, applied nature of HTQs, as well as their more flexible mode of delivery and lower cost and entry requirements (compared to university courses) made them more accessible to and supportive of non-traditional learners.

Alternative learning style	Applicable outcomes	Lower entry barrier	Higher aspirations
Frequently, providers commented on how HTQs can be a good fit for those who may not fit into the ordinary, academic and theoretical style of learning. Even though HTQ learners still were gaining knowledge and theory, they were also given alternative ways to build competences; in a more practical, investigative or independent way.	Providers and employers commented that, due to being more practical and applied, HTQs helped instil confidence in learners. For example, students could see the overlaps between what they did in practicals and in their workplaces, which gave them confidence that they had the right skills to use at work.	Quite often, HTQ learners would combine work and learning. A part-time learning mode was popular and HTQs were generally considered a good option for those who worked alongside studying. Some also commented that sometimes learners considered HTQs a more affordable option compared to the debt associated with going to university.	HTQs can provide a more accessible route to HE for learners who feel less confident about their educational attainment. They can serve as a bridge between school and bachelor level or a stepping stone even for those who entered HTQs just wanting to work. Successfully completing a level 4 (level 7) qualification can change learners' attitude towards further study and open new educational possibilities.

"The idea of doing an integrated course and doing a practical course appeals to a lot of learners who don't necessarily fit into the standard educational landscape. And that means that there are a lot of people who are currently dropping out of education and are not seeking alternative pathways … until we can encourage them back into education at all it's not even on the horizon. [We need] to make sure that they are continuing learning and they've got a pathway ahead of them and then showing them these kinds of options."

Potential provider, College, SE England

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There seemed to be numerous circumstances that would make potential learners consider HTQs the right option for them

The motivations behind choosing HTQs can be divided into two categories – those associated with the need for a more accessible learning route and those associated with a preference for a more applied qualification. The list below presents various circumstances that were mentioned in the interviews as moments in which individuals considered HTQs the option to address their needs, aspirations and limitations.

Those who benefit from a slower, or more accessible learning route

- Those with poor A-level / Higher results or struggling in the school system.
- Those perceiving academic or theoretical learning as a poor fit.
- Those not confident they would manage at university.
- Migrants with diverse prior attainment and learning histories.
- Those dropping out from university or switching subjects.
- Those reluctant or unable to pay unversity fees.
- Those who lack entry requirements to go into science degrees.

Enrolling in HTQs

Those with a preference for an applied or technical route

- Those completing BTEC and similar technical lower-level courses and wanting to continue with more practical learning.
- Workers who have joined a local company that encourages them to do higher technical level apprenticeships.
- Those in jobs not related to chemistry who feel the need or have the interest to pursue some formal study in chemistry.
- Career-changers with experience or qualifications in other subjects.
- Those who can get the government levy funding to fund their HNC study and also work in their company part-time.
- Those working in industry for some time who want to upskill or require formal training or deeper scientific knowledge.
- Those in non-technical jobs who access funding to take on higher technical courses to achieve career goals within the science industry.

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Higher technical qualifications can support diverse learning journeys

Accounts from students, employers and providers paint a diverse picture of how and why learners enter these qualifications. The 5 routes outlined below exemplify a range of ways in which HTQs are used as building blocks to progress on educational and professional paths.

College route
For those who feel comfortable in a college environment and want a continuous learning journey, e.g. progressing to HNC from BTEC.

College level 3 → College level 4 → College level 5

Upskilling route
For those who have been working in industry for years and now feel the need to upskill to progress to higher, more specialised roles.

Job
Level 4 → Level 5

Apprentice route
For school leavers taken onto training schemes by employers and encouraged to continue learning while working at the company.

School → Internship / Apprenticeship → Job
Level 4 apprenticeship → Level 5 apprenticeship

Access to university route
For school leavers missing grades necessary to get straight into university degrees or intimidated by making the jump from school to university.

School → level 4

Return to education / career-change route
For those who spent years outside of formal education or dropped out, had a range of jobs in other fields and now want to improve their career prospects.

School → Job → Job → Job
level 4 → level 5

Interestingly, all those routes can lead to higher education. Depending on learners' paths and outcomes, they can enter from level 4* directly into 2nd year of degree, take a slower path through level 5 onto 1st year, or even into a final, top-up year. Those who prefer to stay on a more practical route can progress into degree apprenticeships.

- 1st year of university
- 2nd year of university
- Degree apprenticeship
- Top-up degree

*Due to the limited space on this visualisation, equivalent levels in Scotland were not listed. Level 4 translates to level 7 and level 5 translates to level 8 in the Scottish system.

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Where and how learners get exposed to HTQs

Compared to an academic route that leads to university, learners are less exposed to the technical route. Those who get to hear about it tend to either already study a lower technical qualification or work in a setting where those courses are endorsed to employees. Other channels exist but as will be shown on the next page, these opportunities to expose learners to HTQs are often neglected.

Employer

Employers' recommendations can be an effective way to attract learners, but it's mostly used for apprenticeships. It works especially well when colleges visit workplaces and they have an established relationship with employers.

School

Some teachers might recommend HTQs to those with poor A-levels/Highers to give them an alternative pathway to university, or present it as an option to those who don't want to do a degree. Anecdotal evidence suggests this is not done often.

College

We've heard of some instances of learners on lower-level courses enquiring whether the college can provide a higher qualification for them to continue on. Wider outreach activities vary by provider but some advertise HTQs at exhibitions, events and science festivals.

Peers

Seeing colleagues at work being happy with their courses, or getting a recommendation from a friend who's doing a similar qualification, can convince learners it can work for them as well.

Own research

Some learners discover HTQs when they start doing research if their educational path does not go to plan, for example, when they didn't get the necessary entry requirements to enter university or had been interested in pursuing a different subject.

"Because we offer lower-level courses we've got a stream of students that will come through that way, that maybe weren't sure that they wanted to do science. But then joined and enjoyed it and they've just sort of stuck with it. They might not quite be clear on what career they want to do, or even if they want to go to university. But they enjoy the learning aspect of it." **Current provider, FE College, Scotland**

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Interviewees felt that HTQs could be better advertised to learners, especially those who are not convinced a bachelor's degree would work for them

Accessible and technical nature of HTQs is attractive to learners

- ✓ HTQs are for some learners less intimidating than a bachelor's degree.
- ✓ Some education leavers prefer to do something that will give them a direct route into industry.
- ✓ Some providers commented that doing hands-on science in labs is attractive to learners.
- ✓ Flexible delivery mode attractive, making it easier to fit around work or family responsibilities.
- ✓ More vocational route is perceived by some as better for learning while earning (contrasted with the university route, which is more associated with accruing debt).

But low awareness / familiarity with this type of qualification serves as a barrier that prevents more learners from enrolling

- ✗ Even though HTQs can be more affordable than degrees, they can still be considered a big commitment of time and money, as learners are unlikely to manage full-time work alongside doing the qualification.
- ✗ Some educators we spoke to felt the technical route does not tend to be encouraged by schools. Teachers and careers officers might not have enough knowledge about HTQs and not all schools receive information from colleges.
- ✗ The provision of HTQs can be patchy in some regions, so learners would have to relocate to study.
- ✗ Universities don't tend to advertise level 5 to learners even if they do have them, because they focus on longer honours degrees that generate more income.
- ✗ Students might lack understanding around scientific routes they can pursue after the HTQ.
- ✗ Some learners want a fuller and more social university experience. They also tend to be more familiar with the university route.
- ✗ Some providers think, in some regions, there is not enough relevant industry base to hire holders of those qualifications.
- ✗ Not all employers receive information from providers about HTQs so are less likely to endorse them.

"I don't think they're widely advertised enough for students... A lot of them aren't aware these kind of things exist, so a lot of students that are really interested in science would probably be really well suited to these roles, but think the only thing you can do is do an A level and go to university, so I think advertising and marketing is the thing that's most lacking."

Head of Chemistry, Secondary School, NW England

"The duration of it allowed me to really see if that is what I wanted to study and that is the route I wanted to go down, rather than committing to quite a few years of study and a lot of debt if I went full-time. Five years of study if I was continuing part-time, but majorly so it was the fact that I was able to earn whilst I did it as well."

HNC graduate, London

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HTQs open doors to work and further study, but there needs to be more clarity about what career outcomes are possible

As discussed previously, HTQs can lead learners with diverse educational and work backgrounds closer to accessing higher education. Of course, not all of them have that intention; some use it primarily for work purposes and others choose it as an alternative to academic education. This route does not close off any doors but puts learners with different backgrounds and intentions in a position where new options, including higher education, become open to them. However, more could be done to help learners with no work experience or exposure to industry to use this qualification as an entry route into applied sciences sectors.

Entry into industry

Employers, providers and learners suggested HTQs are used as an entry route to a variety of industries:

Food	Nuclear	Polymer industry	R&D
Forensics	Healthcare	Manufacturing	Engineering
Pharma and biotechnology	Environment	Waste and water treatment	Utilities

However, school leavers sometimes have a poor understanding of the diversity, or specifics, of careers these qualifications can lead to, what types of jobs they can have, or how these can develop into a progressive career path. More could be done to help those without industry experience understand what career outcomes HTQs can give them.

Progression and promotion in a current role

Compared to entry into industry, HTQs seem to be more successfully used by students already employed to achieve progression / promotion within their current workplace or sector. This brings benefits to both learners and employers:

"All of the employers that we work with put these people into the programmes so that by the end of it, they'll have somebody who is well trained and they've moulded them into the scientist that the organisation wants."

Current private training provider, West Midlands

Further study

HTQs are also successfully used by learners to progress into science-based undergraduate courses. It's worth noting that these learners might not have clear ideas about the exact career they want to progress into at that point, but HTQs give them clarity about immediate next steps – getting the entry requirements necessary for the next level of qualifications.

"In my experience, just under 90% of our learners go into university. … if you either didn't sit the right combination of highers or sat highers but didn't get the grades you needed for progression to university. … that's definitely why the learners are mainly with us. So, they use that as their route to university.

Current Provider, FE College, Scotland

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In their own words

"We get some good progression. In the past we have had a student who did a level 3 apprenticeship with us, then he did a HNC and a HND and then he topped it up to a BSc and he came out of college with a full chemistry degree. He was the sort of student who was a really nice lad but wouldn't have coped in a university with hundreds of other students, he was in a small cohort and because we'd seen him since he was 16 or 17 we knew him really well and we could see his development and his progression. He got a first class degree in the end so that's fantastic. I don't know if he would manage in another university."

Current provider, FE College, NW England

"They usually carry on in the organisation that they've worked in and they progress, I know there is one of our former students who has got a managerial role within the company that she worked for, the same company that she did her apprenticeship with. We've got one person who is still at the same company and she progressed on and did her degree, she's still doing her degree this year, this is her final year of her degree, she was an excellent student, she was a level 3 apprentice and then she did her HNC with the company and then progressed to HND and then the degree."

Current provider, FE College, NW England

"I've been able to get to where I want to be within the company which I don't feel I would have been able to do had I gone to uni first [Interviewer: What do you think would have been the barrier there?] "The lack of experience in the fact that I wouldn't have any, you know, lab knowledge. Also, the fact that I don't think for me personally uni would have sat well with me. I don't think that I would have done as well if I'd just been studying."

Foundation & Apprenticeship graduate – currently studying BSc in sciences, NW England

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Graduated learner: Katherine – Apprentice route

- **22-year-old White British female.**
- **NW England.**
- **Finished Fd in chemical science combined with a level 5 laboratory scientist apprenticeship.**

Educational background

While at school, Katherine applied for undergraduate degrees, but had already decided before she got her A-levels that it wasn't particularly a route she wanted to take. She was disenchanted with uni as her mum couldn't find a job despite having a degree. She feels the uni route is pushed too much in schools and it's just not for everyone. Katherine decided that apprenticeships were more for her as opposed to a full-time uni degree.

Expectations and motivations

She started looking at a range of different apprenticeships and found the qualification on the government website. She wanted to gain the experience alongside the qualification as she was worried education alone wouldn't be enough to get a job in sciences. The fact that she'd be able to get a foundation degree alongside apprenticeship work experience was the main motivating factor. She wanted to be earning a wage instead of getting in debt. She didn't have specific expectations about what job roles this qualification would lead to, but it was associated with the company she'd heard of in the field she was interested in. Getting into this company mattered more than the course.

Experience

It was flexible, as she got 20% of her contracted hours to do uni work, but that could be any time during the week. She's less keen on the fact that it took her 3 years as part of an apprenticeship, opposed to a typical foundation degree that lasts a year She's happy with the qualification overall but found that some of the things she learned in the foundation part weren't very applicable. She doesn't think employers care much about foundation degrees, but it can be a good stepping stone to getting a bachelor's degree, which is more recognised.

Learning outcomes

Katherine has gone on to do the level 6 in the same apprenticeship scheme and a top-up BSc in chemical science. She got a permanent position at the company as a quality control lab analyst. She felt the practical and transferable knowledge was most valuable to her because it gave her understanding of regulations, whereas the foundation degree gave her the theoretical knowledge she has used subsequently in her bachelor's degree and may be useful to get more scientific roles in future.

*This learner profile describes a real learner we interviewed, rather than a reconstructed persona. No details, other than their name, were changed.

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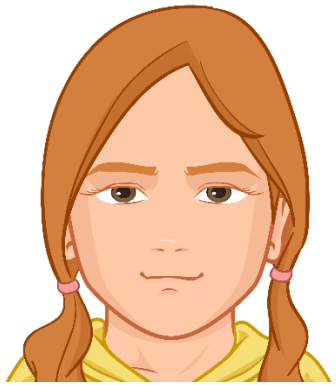
Graduated learner: Rose – Access to university route



- **Young female.**
- **West Scoland.**
- **Completed HNC in applied sciences this summer.**
- **Interested in specialising in Immunology.**

Educational background

- Rose was really interested in science at school and wanted to do nursing. She started studying nursing at uni and then realised she was more interested in the sciences than the nursing practice.
- However, she didn't have the necessary Higher in chemistry to go and study biomedical sciences at university.

Expectations and motivations

- Rose was motivated by her interest in sciences and imagined herself as ultimately studying at university.
- She did a bit of online research and found that studying an HNC in applied sciences at a local college could give her the necessary entry requirements to progress to university. If she got an A, she could even go straight into year 2.
- There were a few colleges offering relevant courses where she lived, but she decided on this specific qualification because it had the combination of biology and chemistry she needed.

Experience

- Rose found herself enjoying the HTQ even more than she thought.
- She was doing around 60% biology and 40% chemistry.
- She now thinks that it's a much more gradual and continuous learning journey than a jump from school straight to university. When she studied nursing at uni, she was the youngest in her class, while she felt much more confident learning in a college, where she felt she could ask more questions. Her class had around 20 people.

Outcomes

- Rose managed to progress from HNC straight into a second year of university. She's aiming to specialise in Immunology and continue to do a master's and maybe even a PhD.
- She feels she learned the skills, especially independent learning and lab techniques, to continue on her academic journey and thinks that the HTQ made her career path much clearer.
- Becoming a school science technician, even though not for her, was a top-of-mind career outcome she associated with completing an HNC.

*This learner profile describes a real learner we interviewed, rather than a reconstructed persona. No details, other than their name, were changed.

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Current learner: Syed – Upskilling route

- **20-year-old Bangladeshi male.**
- **NW England.**
- **Currently studying HNC.**
- **Intends to combine futher education with work in the chemical industry.**

Educational background:

- Syed left school and got a job at a local Research and Development lab as a lab technician.
- Some of his colleagues working at the same level were also working towards applied sciences HNCs and they had really positive things to say about them.
- Syed completed a level 3 EVQ in applied sciences and is now completing a level 4 HNC whilst continuing to work.

Expectations and motivations

- Syed heard about the qualifications from his work colleagues – mainly individuals currently taking the HNC rather than his managers.
- He thought it sounded like a great way to expand his scientific knowledge and improve the skills he uses at work, such as report writing. He expects his qualification will help him move to higher positions in the chemical industry.

Experience

- Syed really likes his HNC and appreciates that there is more contact time and engagement from his teacher compared to what he thinks a university degree would be like.
- It is harder work than he expected and he realises he has a lot more to learn to broaden his scientific skills, but he still feels really positive about the course. He believes getting work experience alongside theory will really benefit him, although he thinks employers recognise university degrees more.

Learning outcomes

Syed hopes to continue his educational journey by taking a level 5 HND and then moving on to a level 6 qualification in applied science, whilst maintaining his job. He thinks 5 years of work experience and a level 6 qualification will make him a desirable employee.

*This learner profile describes a real learner we interviewed, rather than a reconstructed persona. No details, other than their name, were changed.

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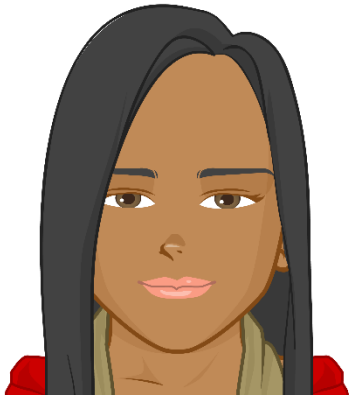
Graduated learner: Delina – Career-change route



- **Female in late 20s.**
- **London.**
- **Finished HNC apprenticeship and progressed to degree apprenticeship.**

Educational background

After her A-levels, Delina started university but decided it wasn't for her at that point in her life. She then worked as a full-time chef for a few years.

Expectations and motivations

Delina felt she needed to get a more 'professional' career started, which she didn't want to postpone into her thirties or forties. She was always interested in pursuing either chemistry or philosophy and when she moved near to a university offering part-time degrees in chemistry, she thought she could do it while working as a chef. But when her friend told her she should consider apprenticeships, Delina realised that would allow her to not only study part-time but also have the qualification paid for. Her friend forwarded her information about a school nearby looking for an apprentice science technician and offering to fund their HNC. Delina thought that with an HNC she could still move onto the chemistry degree anyway as well as get more practical experience.

Experience

The two years of HNC Delina did, were helpful in confirming that she liked chemistry, and what areas interested her particularly (even though she didn't enjoy all modules). HNC felt like less of a commitment, both in terms of time and money, than a part-time degree. She felt 'a bit rusty' having completed a few years ago, so the lower-intensity qualification, split over the two years, allowed her to 'get into her flow rather than try to hit the ground running'.

Learning outcomes

Delina thought the HNC had improved her time management and interpersonal skills, and, compared to finishing a university degree, prepared her better for looking for a job in industry. She felt that if she was trying to get the job in her current workplace (a power station) coming straight out of university she would have felt 'clumsy'. Delina had a perception of university degrees not having a strong practical focus, with students doing lab practicals in a controlled environment only once or twice a week. The school she worked at didn't have facilities to deliver higher level courses so moving to industry allowed Delina to enrol in a degree apprenticeship.

*This learner profile describes a real learner we interviewed, rather than a reconstructed persona. No details, other than their name, were changed.

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Differences between Scotland and England – learners' needs

Factors potentially affecting learners' journeys

- One Scottish provider mentioned there had been discussion with the SQA about HTQs such as the HNC recognising work-based qualifications (SVQs), but this appears not yet to have happened. This respondent thought that this lack of recognition was an obstacle to take up of HTQs amongst some learners with a previous workplace-based learning history.
- Providers in England and Scotland alike mentioned the jump from school qualifications to bachelor degree as too wide for some learners, which made HTQs an attractive stepping-stone.
- Undergraduate degrees in Scotland are currently free to Scottish and EU students. Learner concerns about the debt associated with university degrees, mentioned by providers and learners in England, affect learners in Scotland less. However, one Scottish provider mentioned difficulties in obtaining funding for part-time HTQs in comparison to having university degrees fully funded, potentially diminishing their value as a lower-cost route to higher education here.
- One Scottish provider mentioned Skills Development Scotland as a potential stakeholder in promoting these routes, describing how they can suggest to potential students a learning route in the college sector.
- Another Scottish provider mentioned collaborating with the SWAP agency (the Scottish Widening Access Programme) in that context; describing how they helped getting students without any previous qualifications into university.

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EVALUATING HIGHER TECHNICAL QUALIFICATIONS

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What knowledge areas were considered important by employers?

- When presented with a sample HTQ (HNC and HND in chemistry), employers responded positively to its topic coverage – thinking the balance between breadth and depth was quite well captured in such a qualification, offering a good fundamental chemistry background.
- While such a curriculum was thought to open doors to many industries, different sectors had specific needs that were not always covered by such a qualification. Modularity seemed important in that context – some wanted to swap mandatory and optional modules or wanted to see more specialised subjects covered. It might be useful to give employers a chance to consult on or endorse specific topic areas during qualification design so that learners know in which industries these are useful.

ANALYTICAL CHEMISTRY – most frequently mentioned as key area that has a broad application across industries.

REGULATON AND QUALITY – employers stressed the importance of technicians understanding Health and Safety rules, quality control and following industry and workplace regulations.

LABORATORY TECHNIQUES – some commented that this knowledge was sometimes missing, even among those working for longer in industry. They wanted to see technicians learning about manual pipetting, errors, calibration, sampling and sample prep and understanding lab standards and good lab practice more widely.

MATERIALS – polymer materials were mentioned as useful by some, with one employer thinking there should be a mandatory module introducing materials and their properties.

PERSONAL AND PROFESSIONAL DEVELOPMENT FOR SCIENTISTS – a few respondents stressed the importance of people knowing how to conduct themselves when they get into industry. This included good time management, making clear presentations, handling conflicting demands on resources and a better idea about performance management.

Other topics liked but seen as less critical included: applied science research project, workplace investigation, business knowledge. While project management was seen as nice to have, some thought trainee technicians were unlikely to be managing projects.

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Knowledge areas employers would like added to topic lists covered by HTQs

Employers differed in their views on which branches of chemistry could be optional versus mandatory – suggesting the importance of modularity. However, one respondent raised an issue that too many specialised optional modules means learners need to know quite early what industry they want to go into and, as described in the section on learners, students lack a clear understanding of available career pathways.

What topics areas should be added to the HTQ curriculum?

Green chemistry

Some commented on the need to train people to consider green / sustainable issues as it's now a key part of science.

Intellectual property

It was seen as needed for product development or research roles, as wherever inventions are made, IP will need to be considered.

Formulation

Some industries are reliant on formulation chemistry rather than analytical chemistry and some employers thought it would be useful for those who wanted to work in product development labs.

Advanced physical chemistry

- Thermodynamics and energy storage / transport were considered applicable to modern-day industry (e.g. in batteries and fuel cells).
- Chemical kinetics, especially catalysis, was mentioned as useful across a range of industries.

What modules should be mandatory and which optional?

Analytical chemistry

Most often seen as a mandatory knowledge area.

Organic chemistry

- Some felt a qualifcation with mandatory organic chemistry was too geared toward biotechnological fields and suggested organic chemistry could be optional for those who are interested in this field.
- However, others wanted to keep this mandatory with more options to take modules on pharmacology or pharmaceuticals.

Inorganic chemistry

This was sector-dependent as well. While some felt inorganic chemistry was key and could be expanded, others thought it could be optional.

Environmental chemistry

Some mentioned they would like to see an optional module covering basic principles of sustainability and the environmental impact of human activities.

Nuclear chemistry

Radioactive chemistry was brought up as an option useful to those who would want to work in the nuclear sector.

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Employers expected technical qualifications to give learners more than technical skills alone

Interestingly, employers seemed to focus on cognitive, soft and work-based skills, rather than technical ones when discussing what competences HTQs should help learners develop. They wanted well-rounded technicians with a broad skills set, but some wondered how realistic it was to teach some of those skills in a classroom. They also highlighted that depending on how the core and optional modules were combined, learners who have done nominally the same course might end up with quite different learning outcomes.

Cognitive

- Employers wanted to see learners develop maths skills (numeracy, statistics), analytical skills (including analysis of scientific data) and problem-solving.
- *"Managing people and actually solving problems are kind of the two things that technicians are doing on a day-to-day basis."* **Employer, University, Lab Manager for research, East Midlands.**

Soft

- Interestingly, many highlighted that hard scientific skills are not enough and wanted HTQs to help learners develop softer skills, especially interpersonal ones and related to communication, especially report writing and presenting.
- *"Sometimes there's a bit of polish needed on presentation and report writing … for somebody who wasn't very good at English 30 years ago, I put lots of red pens across new people's reports."* **Employer, R&D Laboratory, Head of Profession for Chemistry & Materials, SE England.**

Professional

- Employers also had expectations that qualifications teach learners how to behave in workplaces – most frequently mentioned competences included time management and teamwork.
- *"Working to deadlines is a big thing for me, for people who are fresh out of qualifications, and how they deal with that and prioritising their time. Also, an appreciation of working with others. Everybody has different styles and different ways of doing it. … It's making sure that people have that awareness as well."* **Employer, R&D Laboratories, Operating Officer, NW England.**

Commercial

- More commercial or business skills were also seen as an advantage when employing technicians.
- *"Commercial skills. It's probably a big failing in science and engineering that people are not more commercially aware. Things like budget management and budget monitoring… I was as guilty of that myself."* **Employer, Pharmaceuticals, Quality and Regulatory Manager, London.**

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Employers often saw the level 4 HNC as highly appropriate for the workplace, sometimes seeing the level 5 as also appropriate for a further study route

While around half of our employers saw these qualifications as being directed at those in the workplace, many of the employers we talked to considered that the qualifications can successfully serve both purposes – in some cases depending on the level at which one was studying, with level 5 in particular seen as a route to further study.

Work-based and further study routes were not seen as exclusive

In some cases, this further study was while the learner was still at work:

"I know that when I was working for a pharmaceutical company, there was somebody who was a technician who did a HNC or HND part-time with work, and he then went on to do a part-time degree, and it was a stepping stone for further education."

Employer, R&D laboratory, Operating Officer, NW England

The qualification's flexibility in offering routes into either outcome was praised by some – the individual could choose what they wanted from the qualification.

Content was seen as relevant and up-to-date

A small number of respondents felt that some of the content was too work-specific for it to be designed for a learner seeking further study, particularly those units on production and commercial elements.

While a few respondents (particularly in schools) felt that some content was not suitable or required for their roles, many employers praised the content of the qualifications as being up-to-date and relevant in the workplace:

"Does the HTQ seem aligned with the changing workplace and industry developments? Yes, I think it does. From the things that you've read out to me it seems pretty much bang up-to-date really."

Employers, R&D Laboratory, Analytical Sciences Team Leader, East of England

For some it looked to provide appropriate content knowledge and, more importantly, the interpersonal and lab skills that they sometimes felt were missing in graduates and other applicants for these roles.

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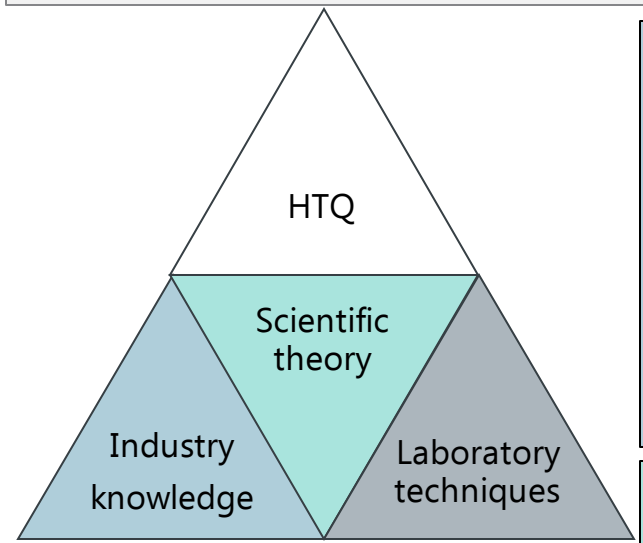
Providers saw HTQs as encompassing theoretical, industrial and technical knowledge

Providers were less likely to focus on specific knowledge areas. Instead they tended to describe HTQs as offering learners **three complementary building blocks of knowledge: theoretical, industrial and technical**. Important topics were thought to depend on the area the student was working in or planning to progress into, mirroring employers' views. However, not all providers were in a position to offer many pathways and module choices – collaboration with local employers and universities might be key to offering coverage that would be attractive and useful to potential learners.



"There are mandatory units that they must all do. But we have optional units, and they can pick what the optional units are and try and match it into things that are better suited to their employer's needs." **Current provider, FE College, Scotland, UG**

Industry knowledge

HTQs were also thought to give learners exposure to different industry fields related to chemistry.

- This could be done by including topics about sectors (e.g. environmental chemistry), organisations and workplace processes (e.g. quality assurance and control).
- Doing practical projects that researched a specific company or industry topic (e.g. researching legislation and quality controls in the context of Brexit, which involved talking to their employer).
- Allowing learners to apply knowledge in an industrial context through engagement with local employers.
- Providing specialist units on business or commercial knowledge (e.g. marketing or business development).
- Giving exposure to workplace regulations, health and safety and quality control through work experience.

Scientific theory

Providers highlighted that learners get a chance to understand the theoretical basis behind the practical work.

- Learning about the principles, fundamentals and the background to different branches of chemistry.
- Gaining the breadth of knowledge and awareness of lots of different areas of chemistry.
- Developing deep knowledge to be applied at undergraduate level or honed within the workplace

Laboratory techniques

This theoretical and industry knowledge was also complemented by technical knowledge, which many providers considered a key learning area of HTQs. Learners gained solid practical experience of working in a laboratory setting, developing necessary techniques.

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Providers thought HTQs give learners competences they need in order to succeed at work and in further learning

Providers thought HTQs cover the skills that learners need to succeed in applied sciences careers. They also tended to agree that learners are generally successful in developing those skills. The key skill areas they thought HTQs should and do focus on covered soft, practical and cognitive skills, which were consistent with employers' views.

However, a couple of providers mentioned that it's not always easy for learners to identify the competences they're learning (especially the behavioural ones). Sometimes they become aware of them when they progress to further study or workplaces and the tasks feel familiar.

What providers felt was the purpose of HTQs depended on the context of their provision

HTQs were used both as standalone courses in a college or university context, as well as within apprenticeships, where HNCs and HNDs were particularly common. In both those contexts, providers considered the qualifications to be valuable and offer something unique to particular student groups.

For providers offering them as a **standalone qualification**, HTQs often served the purpose of getting more learners access to university courses. They did this by reducing the cost of entry to university for those who were able to get into second year courses subsequently, but also through offering a slower route to uni to those for whom a jump from level 3 to level 6 is too big or they lack confidence. They also offered a route for those who preferred coursework to exams.

Providers often reported that once in university, these students were **highly successful**, particularly in lab skills. Many had high proportions of their learners go on to undergraduate study and some of our providers also reported their students going on to do PhDs. It was notable that this was not the case for one respondent offering an HTQ in biology, the majority of whose learners went to work in the NHS.

Those offering these qualifications **within an apprenticeship** felt they offered a lower-cost option to obtain a similar level of qualification to a degree, while earning alongside it. In addition to this, providers again felt that these qualifications gave learners relevant employability skills, including understanding of how to apply what they learned in the workplace, problem solving, and technical lab skills. However, very few saw these qualifications as exclusively work-focused.

"I mean, it's quite clear in SQA's documentation. They actually do serve two purposes. One is for the academic progression route, but the other is preparing them directly through to employment. You know, we're trying to reflect the amount of practical skills that they do have. And that means they've also developed things like good problem solving skills, time management, organisation, all of those. Because they've had so much practice at working in a lab. It's viewed as the same level as a first year university programme. But actually, we ask a lot more of our learners than they would if they were sitting in the equivalent university programme."

Current provider, FE College, Scotland

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RECOMMENDATIONS FROM RESPONDENTS

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Employers were keen for RSC to promote HTQs and act as a bridge between stakeholders

Employers often mentioned a feeling that the RSC was doing a good job currently and a couple mentioned their support of the RSciTech in this respect. However, it is worth remembering that our sample is probably biased towards those with a higher level of engagement with the RSC. It was clear that they felt that there was a great deal of work to be done if HTQs were to get wider recognition and use. Employers felt that there was much that could be done to promote the qualifications more widely and educate managers about them. In some cases these are actions directly for the RSC, in others the RSC may have a role in encouraging and lobbying other actors e.g. awarding bodies, government and providers. Some of these suggestions refer to areas in which the RSC has made a decision not to involve themselves, for example the direct provision of HTQs. Endorsement and support may be one possible approach here.

Promote HTQs

- Help to raise awareness and understanding in the RSC community, including among employers, providers, schools and prospective learners.
- Encourage inclusion of HTQs in career guidance at all levels.

Act as a bridge

- Sponsor discussions between government, employers and providers.
- Continue to give learners and providers information, highlighting the breadth of employer types that employ technicians.

Facilitate

- Give more support to help students get industrial experience.
- Facilitate collaboration between employers and providers by endorsing HTQs within apprentice-ships.

Provide

- Become a provider, delivering HTQs online.
- Run courses on professional development for scientists.

Accredit and endorse careers

- Facilitate understanding of career paths available for technicians.
- Showcase their role within various sectors.
- Promote role models.
- Work to make professional registration and chartership in science more valuable.

Fund

- Lobby for government funding for the work experience element.
- Fund technician training.

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Providers also wanted RSC to promote HTQs more strongly

Providers were more likely to speak not just of actions that the RSC could take, but of those they would like to see from other stakeholders to encourage further take-up of HTQs. As with employers, providers felt that the RSC had a role to play as a bridge between different stakeholders in this area.

Promote HTQs

- Provide information about HTQs for prospective learners and employers through relevant channels, such as their website, to promote awareness.

Act as a bridge

- Liaise with other institutes that promote technical learning.
- Input into the development of qualifications.

Accredit and support careers

- Accredit qualifications.
- Make potential career paths for technicians clearer.

Suggested actions for other stakeholders

- Employers to talk more about HTQs.
- More tailoring to specific industries.
- Status of BTEC needs to be improved.
- Recognition from big employers in the HE sector, Water industry, Healthcare and Pharma.

"Outreach is one of the main things. By outreach, I mean outreach to employers and learners too. It's all about increasing the awareness of HTQs to employers."

Current private training provider, West Midlands

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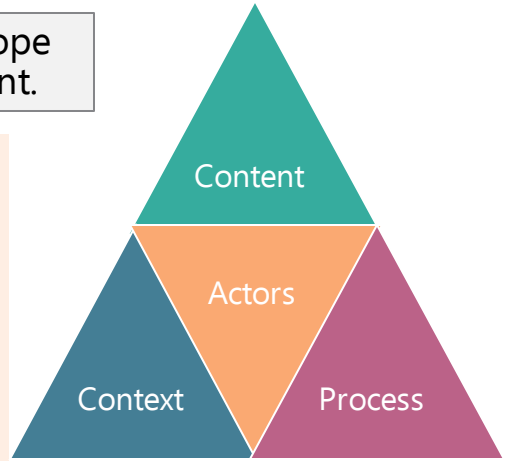
Conclusions

Our conclusions are shown using a simple policy triangle. They should not be read as directives for RSC, but we hope that interpreting key findings in light of policy content, process, context and actors might be a useful starting point.



What **actors** can participate in and influence the formulation and implementation of future interventions?

- Schools – there is potential for schools to become more active advocates of HTQs.
- Employers – they are currently more incentivised to endorse apprenticeships than classroom-based HTQs.
- Universities – they have less of a need to prioritise sub-bachelor qualifications.
- Accrediting bodies – Pearson's HNCs and HNDs seem to be most recognised and attractive to employers and sometimes treated almost as synonymous with HTQs by providers. They might be helpful collaborators in shaping the sector's future.
- Professional organisations – RSC could consider leveraging their educator and employer networks to facilitate buy-in of all stakeholder groups and endorse the technical pathway.

What should the **content** of the policy interventions focus on?

- Low awareness of teachers, learners and employers seems to be the main barrier to HTQs becoming more successful.
- This presents an opportunity for policy interventions to focus on outreach to schools and learners, endorsement of technical career paths and promotion of the technical education route.

How could policy interventions around HTE be positioned within a wider policy **context**?

- HTQs appear to have an important role to play in the context of widening participation. But they are used by small numbers of learners.
- Policy interventions could contribute to scaling up the demand and provision, helping more learners benefit from accessing this educational path.

How open is the political landscape to the **process** of implementing policy interventions around HTE?

- Policy-makers have previously prioritised degree-level education. Our research suggests this has negatively impacted on the perception of the attractiveness of the technical route.
- However, there is currently significant active interest in this education sector from policy-makers, especially in England, which may help policy recommendations and endorsements be received more favourably.

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