Abstract

National and international standards are an important part of quality resources that are available to academics and their students. The main resource for accessing published standards is British Standards Institution (BSI), via the BSI online subscription service and online shop. Amid concern that teaching of standards is not common and that these resources are under-utilised, research was undertaken to identify where teaching about standards is taking place. The aim of the research was to identify the range and scope of the teaching about standards and standardization. It also attempted to identify the level or depth of understanding required from the students. A survey of academics, students and employers demonstrated that British, European and International Standards can play a key role within selected areas of education. In some disciplines their inclusion in the course is mandatory, e.g. in building construction and performing risk assessments of equipment. Where not a requirement, other courses successfully encourage students to understand and apply specific standards and principles to their design and project work, in topic areas such as quality management and user-computer interface design. Assessment practice is a key part of learning and the academics surveyed indicated how this fitted into the learning activity, e.g. by expecting students to develop an understanding of standards and to reference them in all assessed work.

Students taking part in the research also suggested that they were actively engaged with one or more standards and that their understanding was measured through an assessed activity. Employers indicated the importance of students’ knowledge, understanding and appreciation of relevant standards in the right context, emphasising their desire for standards to be included more widely in the curriculum.

The research led to the creation of a number of recommendations for BSI to enable them to provide a better service to the field of Higher and Further Education and to enable a greater number of academics and students to become more involved in the standardization field.

Acknowledgement

This research was commissioned by British Standards Institution (BSI). This research was produced in association with the Department for Business, Innovation and Skills as part of its ongoing programme of support for standardization. The full information is available in the report: Employable Knowledge: Benchmarking Education about Standardization in the UK.
Introduction

The need for students to be engaged with the standardization field is important for a range of stakeholders: for students’ future employment; for employers to maintain the quality of their workforce; and for society in general, which depends on the quality provision provided by standards.

This need has been identified by a number of standards bodies including DIN, the German Institute for Standardization, who described in the German Standardization Strategy (2009) the need to integrate standardization in higher education: This document, available online at http://www.din.de/sixcms_upload/media/2896/DNS_2010e_akt.pdf, states:

“The strategic importance of standardization and the benefits of active involvement in standards work need to be incorporated into curricula to a greater extent in order to introduce prospective specialists and decision-makers in industry, politics and society as a whole to standardization at an early stage. Professional and vocational training courses and academic programmes alike should incorporate standardization in their curricula, particularly in the natural sciences, engineering and management fields. One prerequisite for this is the development of strategies and action plans for an increased integration of standardization in higher education.”

Following concerns that knowledge of standards is undervalued in education, this study set out to explore and learn from examples of good practice where standards have been integrated into teaching practice in higher and further education, and to highlight barriers and strategies for improvement. In this paper, we particularly address the issue of the quality and depth of knowledge within a student centred framework of the learning process.

During 2013 and 2014 research was carried out by Middlesex and Loughborough Universities into the range and scope of teaching of standards in Higher and Further Education for BSI. The main aim of the project was to identify where teaching about standards is taking place, in what disciplines and at what level. More detailed questions included access to standards, experiences of the benefits and barriers of teaching standards and questions on the required changes to enable academics and students to make the most of standards.

BSI is the National Standards Body of the United Kingdom, creating and publishing standards. It provides UK education, industry and other stakeholders with access to and influence on standardization, both in the European arena (with CEN – the European Committee for Standardization, CENELEC – European Committee for Electrotechnical Standardization, and ETSI – European Telecommunications Standards Institute) and internationally (with ISO – International Organization for Standardization, and IEC – International Electrotechnical Commission).

BSI, ISO, CEN and CENELEC published standards are paid-for resources and cannot be freely accessed online. Students, academics and librarians from Higher and Further Education can interact with different parts of BSI via different online and offline links. Often, but not always, a subscription membership is held by the library resources of the University or College giving the registered student and academic free downloads of selected standards.
Methodology

The research was carried out using online questionnaires, interviews and workshop discussions. Information was obtained from current and previous academics, educators, students, librarians, and employers of new graduates, across a range of academic disciplines and employer occupations.

Central to the sampling strategy was the identification of academics likely to include standardization in their teaching. This included those already in contact with the BSI education group and academic contacts known to the research team for their teaching on standardization. Additionally, the research team linked to academic and further education librarians to help identify academics making use of the BSI online (BSOL) subscription. Students were identified with the help of these academics and librarians. Employers were identified through a number of routes including student careers services, BSI committee members and representatives of professional bodies.

The industry survey covered some similar questions to the academic survey, to identify the source of the informant and industry sector. Subsequent questions invited a comparison between the required level of knowledge of standards, the actual level of knowledge demonstrated by students and subsequent staff training. An open question was included on required changes.

Finally, the student survey was developed to assess their experiences of the teaching of standards and availability. Suitable questions were initially piloted with students having recent teaching about standards. A quiz was added to further explore their knowledge of standards.

All three surveys were prepared and distributed using Survey Monkey. Analysis of the results was supported by Survey Monkey tools to provide spreadsheet data, response summaries, and individual survey results.

In addition, two workshops were held, one at Loughborough University with the Design School staff who had taken part in the survey with the addition of one student, and one at BSI London. This workshop was attended by five librarians and four students, with one academic respondent who presented an example of good practice in relation to teaching about a standard.

Survey Response profile

The results of the three surveys were captured electronically. The total number of respondents from each group was as follows:

<table>
<thead>
<tr>
<th>Survey group</th>
<th>Fully completed</th>
<th>Partially completed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>45</td>
<td>18</td>
<td>63</td>
</tr>
<tr>
<td>Industrial</td>
<td>19</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>Student</td>
<td>95</td>
<td>13</td>
<td>108</td>
</tr>
</tbody>
</table>
Academics

The academics originated from 24 UK universities (Higher Education (HE)), and two Further Education colleges (FE). Five of the universities were overseas. The largest group response was from Loughborough University where 12 Design School academics completed the survey. There were 4 surveys returned from each of the Universities of Bath and South Bank, London. In most cases (two thirds), there was only one contribution per university.

The academics were asked to indicate their areas of interest using the domain and topic lists used by BSI. This question was completed by 57 people. There was strong support from engineering (44%), design (25%) and manufacturing (23%). Support from ICT (16%) and information management (9%) were lower than expected. Notably low representation was achieved in relation to business services such as Corporate Social Responsibility (CSR), customer service, facilities management, commerce and finance and data protection. This lack of response may be due to the sampling strategy used although the higher proportion of responses from engineering, design and construction demonstrated traditional standards strongholds.

One third of the academics who responded participated in the development of new standards and just under half the academics said that they followed the development of new standards.

Students

The students originated from 15 universities with particularly strong representation from Brunel University, and good representation from Middlesex, Greenwich, Brighton, University College London, and Loughborough Universities. The students were from different programmes and analysis of their course titles indicates strong representation from various aspects of computing, engineering and design.

Employers

Of those starting the survey by giving personal details, 15 were from the UK, 6 were international. Half had an active role in standards development and nearly three-quarters said that British and International standards were very or extremely important to their business sector.

The employers showed interests in manufacturing, engineering, construction industries, but none had declared interests in commerce and finance, ICT and telecoms, data protection or facilities management. In general, interests were limited to one or two sectors.

Findings

The survey tools particularly sought information on teaching levels, access and content of the standards. These are used as themes to analyse the results of the three target groups: the academics, students and employers.
Experience of academics

Positioning of Standards

The survey of academics set out to examine the depth of teaching about standards through a series of questions that reflect the simple pedagogic hierarchy common to student centred learning approaches which progress from remembering, understanding, applying, analysing, evaluating through to the highest level, creating.

<table>
<thead>
<tr>
<th>Teaching level classification</th>
<th>Yes</th>
<th>No</th>
<th>Other (please specify)</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do your students have to show that they can remember the content of individual published Standards? e.g. BSI, EN and ISO</td>
<td>30%</td>
<td>51%</td>
<td>19%</td>
<td>47</td>
</tr>
<tr>
<td>Do your students have to show that they understand and can apply individual published Standards, for example, by solving a work related problem or conducting an evaluation?</td>
<td>58%</td>
<td>29%</td>
<td>13%</td>
<td>48</td>
</tr>
<tr>
<td>Do you require your students to find and critically evaluate published standards as part of their studies?</td>
<td>38%</td>
<td>53%</td>
<td>9%</td>
<td>47</td>
</tr>
<tr>
<td>Do you enable your students to be involved in the creation of standards as part of the standardization process?</td>
<td>6%</td>
<td>81%</td>
<td>13%</td>
<td>48</td>
</tr>
<tr>
<td>Do you specify the individual Standards which the students should be aware of?</td>
<td>81%</td>
<td>9%</td>
<td>11%</td>
<td>47</td>
</tr>
</tbody>
</table>

As shown in table 2, half the students were not required to show that they could remember the content of standards.

As one academic reported:

“They have to demonstrate awareness of the content, without necessarily specifically quoting the standard”

Being able to show understanding and apply a standard is more consistent with academic practice in higher education. More than half the academics indicated that students needed to show understanding and could apply the standard, and more than a third required the students to find and critically evaluate published standards. One specifically mentioned the need to understand the theoretical context:
ISO9000 is used for comparison between other quality management theories and students are required to analyse the pros and cons of the standard and how it is applied in practice.

However, only 6% (3 people) involved the students in standards creation, as the highest level of critical thinking.

**Access to Standards**

There was an apparent lack of knowledge about whether standards were available within the educational institution and the means by which students could access them without breaking copyright rules.

**Information about Standards**

Some comments indicated that not all academics knew which standards were most suitable for their subject and curriculum. One suggestion was for BSI to create a list of relevant standards for the different parts of the curriculum in conjunction with the professional bodies for each main discipline.

**Issues raised by academics**

Overall, the depth of teaching on any particular standard depends on the role of the standard and its status within the academic context. Simply raising awareness without inclusion in assessment will result in the standard having little impact on student learning. Many of the examples of teaching practice indicated that engagement with one or more standards is encouraged through practical assignments, and analysis of the content in relation to theoretical models and other academic literature. One example of this was risk management of computer systems. Most often the academics report that students are directed to a specific standard; however, there are also instances, for example in design, where the student may be expected to search out relevant content. It appeared rare for academics to direct their students to the process of standardization, commenting on standards in development or examining the research underpinning the creation of new standards.

The teaching of standards in FE and HE depends on the interest of the academic in standards and in their availability. If academics do not request standards there is no reason for libraries to provide them. If standards are not available at an Institute academics are less likely to teach them. For example, a short vocational course focused on a single standard in the timber industry. The industry-based students, however, were not eligible for free access to the standard under the terms of the college subscription to BSI.

**Experience of students**

In contemporary teaching practice, emphasis is given to student centred learning and the successful achievement of defined learning objectives. Teaching delivery at least in technical subjects still largely consists of a mixture of lectures and practical work, with progress determined through assessed assignments and exams.

**Positioning of Standards**

In considering how standards were integrated into their learning activities, some students reported using a standard in a very specific context:
“Used standards thoroughly for third year dissertation. Specifically to do with timber testing and grading.”

“We studied ISO 31000 (Risk management) and were examined on the subject of risk management.”

“We were tasked to find set standards relevant to our own chosen products; in my case, a shower radio. We would then look in detail at how the product has been designed to meet the criteria of each standard.”

In most cases students reported that awareness or knowledge of standards was included in the assessment process (85%) or as part of assessed coursework or an exam (38%).

Access to Standards

More than two thirds of the students had full text electronic access to standards, while a further 14% accessed an electronic summary via the teaching resources. 14% reported having been given a printed summary in class, but only 3% received a printed full text copy in class. More than a quarter agreed with the statement that the standards were difficult to find in the library resources.

Information about Standards

The students identified the need for information about standards in conjunction with the text of the standards being used.

Issues raised by students

The students raised the following issues:

• The students showed reasonable levels of understanding the importance of standards to industry, and personally to improving employability.

• The students acknowledged the requirement to find standards in relation to project work.

• The students identified the need to understanding content of standards, but needed more help with structure and content.

• The students preferred to be able to apply standards in a practical context.

• The students appreciated the international context of standards.

Experience of employers

The survey of the employers aimed to discover the level of knowledge of Standards that employers would ideally like graduates and college leavers to have and to what extent this was achieved. The employers were primarily engaged in various aspects of engineering, construction and manufacturing but also included interests in customer service, information management, health and safety and security. Nearly three-quarters rated standards as very or extremely important to their business sector and half of them participated in the development of national or international standards.

When asked about requirements for prior knowledge of standards ten people indicated that good or very good knowledge of standards was required but seven of these indicated that students had a
lower level of knowledge or no prior knowledge of relevant standards. All of the employers involved in recruitment or employment indicated that on the job guidance was given to enable new employees to gain sufficient knowledge of standards and half provided in-house training courses. Three quarters offered company policy handbooks that included information about relevant standards and half provided a physical copy. Only two employers had access via BSOL.

**Positioning of Standards**

Employers generally seemed to find that students were willing to learn about standards, but felt that this should have been addressed previously by educators. This would require curriculum designers and planners to work with industry to map and prioritise standards within the curriculum and teaching practice.

**Access to Standards**

Employers seemed to rely more on physical copies of relevant standards than on online access via BSOL. None of the employers who replied to the survey appeared to have any knowledge of students’ access to standards, or the possibility that students might have free access via BSOL.

**Information about Standards**

Employers expressed concern over the students’ apparent lack of understanding of the importance of standards. This was stated most clearly by one employer who wrote that there was a need for a ‘clear explanation of why standards are important: legal, safety, commercial aspects’ and another who stated that what was required was ‘teaching them why standards are important as part of the studies.’

**Issues raised by employers**

The main issues raised by employers were the cost to themselves in providing training to supplement the knowledge of new graduates, the need for students who were working on international projects to know about relevant standards and the value put on knowledge about standards in various fields of employment.

**Conclusions**

Taking a student-centred learning approach, the aim of Further and Higher Education is to develop the student’s knowledge, skills and competences. Working with standards has a place in this, not as a rote learning exercise but as a way of understanding a field of work. Standards appear to be used in some courses in the areas of engineering and technology which have traditionally engaged well with standards, but less so in business and other softer areas.

Students reported learning about standards through practical assignments and final dissertations. Such early research activities encourage the student to engage with existing standards within the disciplinary context. From the academic perspective, higher level research is a fundamental activity in higher education engaging Masters, PhD and the academics in creating new knowledge and theory. This potential appears to be undervalued, more than one academic complaining about lack of recognition for their standards activities. In seeking to understand the world of academia, there
appears to be much scope to escalate engagement with standards as a valid research activity leading to the creating of new, standards with a strong theoretical and evidence-based foundation.

The study concluded with recommendations to BSI about how to maximise the use of standards in education:

• BSI needs to link with both the Higher Education Authority (HEA) and funded research councils to work to embed standards in all elements of academic practice. This piece of research should take notice of the way in which PhD students, as academics of the future, can be encouraged to work with standards. The split in the academic world can be identified by the different activities of the HEA for leading policies on teaching and the Research Councils for leading policies on research.

• Professional associations and skills councils have a key role in defining curriculum requirements. Research should establish connections to the activities of these bodies particularly in the areas of science and technology. This would reinforce and reinvigorate the connection between standards and science and engineering community.

• BSI should analyse its available data of the main (best selling) standards and create a map which links these standards to relevant curriculum areas. This would result in a prioritised list of standards and topics to promote to the academic community.

• Further investigation is needed into academic areas such as Business and other softer areas where there is currently low or no usage of standards. This research should focus on areas where existing standards are known to be used in the commercial world but not integrated into teaching practice.

• Practical research is required with a small group of academics in each of the main sectors to see what specific resources they want and to collect examples of relevant material that already exist (e.g. teaching materials and exercises). Academics are likely to be prepared to have this material disseminated on behalf of BSI (if they received appropriate acknowledgement). This could lead to the development of a BSI portal for educationalists to access teaching materials.

• Standards have an international, global remit. Best practice in the teaching of standards should be shared internationally.