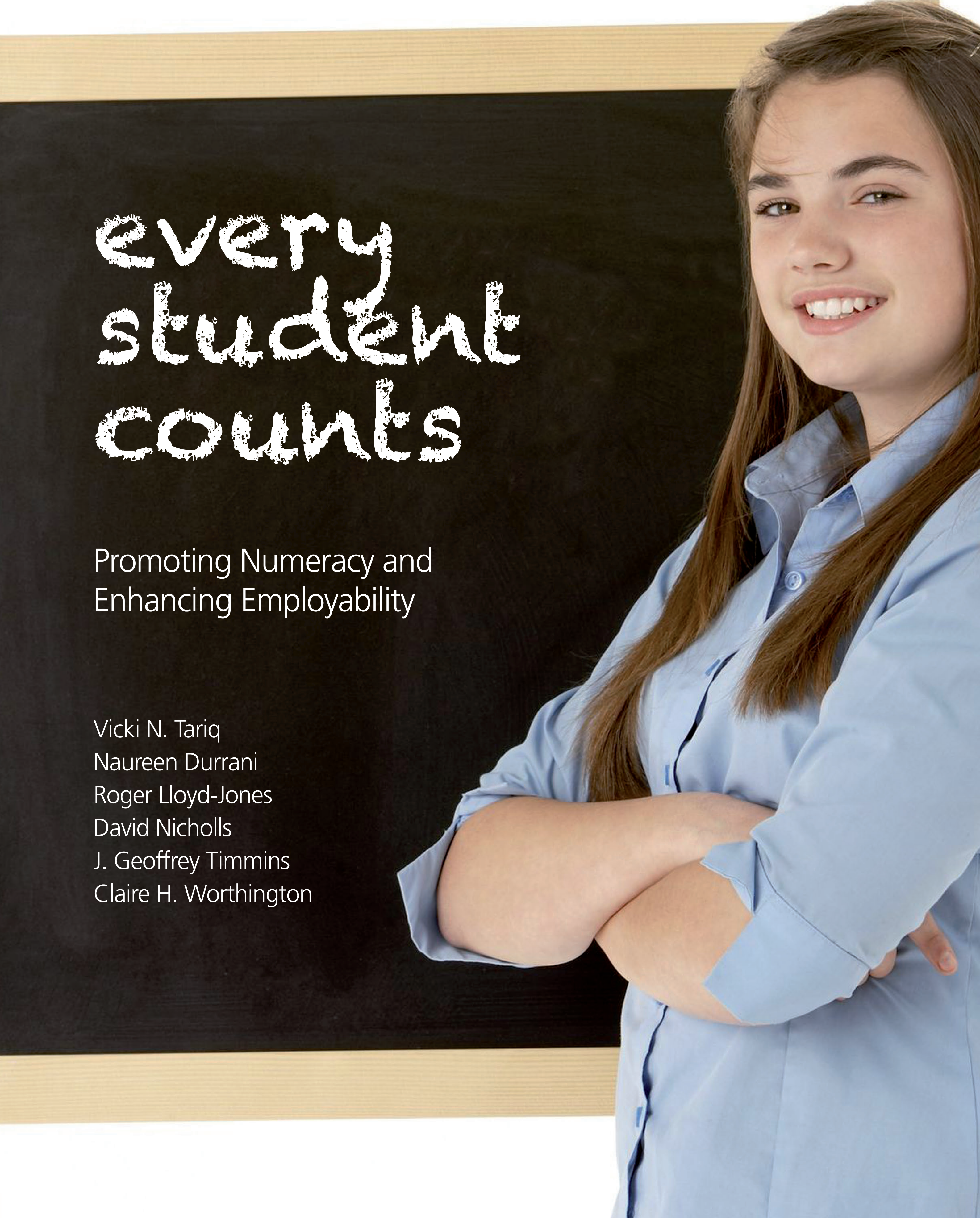

every student counts

Promoting Numeracy and Enhancing Employability

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SHARPENS YOUR THINKING

The Higher Education Academy
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University of Central Lancashire

Every Student Counts

Promoting Numeracy and Enhancing Employability

Final Report

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1. Contents

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- Higher Education Academy History Subject Centre.

3. Executive summary

Aims and objectives

This three-year project investigated factors that influence the development of undergraduates' numeracy skills, with a view to identifying ways to improve them and thereby enhance student employability. Its aims and objectives were to ascertain: the generic numeracy skills in which employers expect their graduate recruits to be competent and the extent to which employers are using numeracy tests as part of graduate recruitment processes; the numeracy skills developed within a diversity of academic disciplines; the prevalence of factors that influence undergraduates' development of their numeracy skills; how the development of numeracy skills might be better supported within undergraduate curricula; and the extra-curricular support necessary to enhance undergraduates' numeracy skills.

Overall approach

This study involved undergraduates and tutors in a diversity of academic disciplines at a post-1992 UK university, and included a collaborative study of national (UK) and international dimensions for history. A multi-method approach was adopted, resulting in the collection of both quantitative and qualitative data. Online- and paper-based questionnaires were complemented with numeracy tests, student focus groups and tutor interviews which provided undergraduates', graduates', tutors' and employers' perspectives on key issues.

Findings

The results of an employer survey highlighted the importance that many employers attach to graduates' numeracy skills and their use of numeracy tests as part of their graduate selection procedures. Contributions to the project made by undergraduates and tutors across a diversity of academic disciplines supported the findings of previous studies in terms of students' conceptions of mathematics, their attitudes towards and approaches to learning mathematics and developing numeracy skills and the nature and prevalence of mathematics anxiety. They also revealed the extent and diversity of existing opportunities for intra- and extra-curricular numeracy skills support across a variety of academic disciplines in a post-1992 university, as well as students' preferred methods of support and potential barriers to increasing support within some areas or disciplines. The findings revealed a general lack of awareness amongst undergraduates and tutors of the importance of numeracy skills to students' attainment of graduate employment. At the same time and encouragingly, in the case of history the evidence suggested that improvements could be accomplished by relatively modest changes to the curriculum. The relevance and susceptibility of historical data to quantitative analysis, the numeracy skills within the profession, and the pre-university mathematical qualifications of history students make such improvements eminently attainable within this discipline.

Achievements

The project generated a substantial quantity of research data, which has been analysed and disseminated in a range of formats and via a variety of forums to the main stakeholder groups, including employers, academic colleagues (in the UK and overseas), undergraduates and graduates (see Appendix 2 of the report for a list of publications and other outputs). In addition, a variety of valuable resources have been identified which support students in the practice and further development of their numeracy skills; these have been advertised via the project's website and the student drop-in support sessions introduced at the lead institution. In addition, a website is being created with the Higher Education Academy History Subject Centre to disseminate 'good practice' in the teaching of quantitative skills within this discipline.

Conclusions

This study revealed that history students can all too easily over-estimate and be over-confident about their mathematical capabilities and tend to resist their incorporation into history degree programmes. Nevertheless, the means whereby the situation may be remedied are present, if there is the will to address the issues identified.

The main overall conclusion is that it is vital universities ensure that their undergraduate populations are equipped not only with the numeracy skills necessary for progression and success within their academic disciplines, but also with those numeracy skills necessary for them to attain graduate employment and to be effective subsequently in their workplace. Assisting undergraduates to develop more positive attitudes towards numeracy skills is also vital as their attitudes can influence their approach to learning and further developing their numeracy skills. The main way in which students' attitudes can be influenced favourably is by making numeracy relevant to their academic disciplines and/or applicable to their future employability.

4. Background

4.1. Higher education and employability

Although the link between higher education (HE) and the UK economy is longstanding (Yorke, 2004), since the Dearing Report (Dearing, 1997) the emphasis of policy has been on the rapid expansion of HE as a means to sustain and enhance the UK's competitiveness in the global economy. Consequently, government, employer associations and other stakeholders increasingly expect higher education institutions (HEIs) to produce 'work-ready' graduates by re-orienting degree programmes towards the fostering of students' employability skills (Association of Graduate Recruiters (AGR), 1995; Universities UK, 2002; Hills *et al*., 2003; Knight and Yorke, 2003). The growing importance attached to graduate employability is evident from the fact that quality indicators used by the Higher Education Funding Council for England (HEFCE) include the proportion of graduates finding employment six months after their graduation (Little, 2001; Mason *et al*., 2009).

This drive towards enhancing employability has arisen in the context of the changing landscape of the labour market, as well as changes within HE itself. In a rapidly changing and increasingly globalised job market, characterised by technological advances and enhanced competitiveness, employers are seeking graduates who are equipped with a range of 'generic' skills in addition to their disciplinary knowledge, which will help them manage their transition from university into the contemporary workplace (Hodgkinson, 1996; De La Harpe *et al*., 2000; Robley, *et al*., 2005; Andrews and Higson, 2008). The importance of employability skills is now even greater since, for the first time, the era of mass participation in HE is coinciding with the UK's experience of an economic downturn and recession (Rae, 2008; Confederation of British Industry (CBI), 2009a). For employers, the possession of a degree remains a mere 'threshold requirement' (Tomlinson, 2008: 51). Nearly two-thirds of graduate vacancies are open to graduates from any discipline, reflecting the fact that employers are looking for certain transferable 'soft' skills acquired during undergraduates' academic studies and periods of work experience (Graduate Prospects, cited in Raybould and Sheedy, 2005). Employers are increasingly constructing employability around notions of personal attributes and skills (Purcell *et al*., 2002; Morley, 2007). For example, according to the CBI's 2009 survey, over three quarters (78%) of the responding 581 firms reported that they recruit graduates on this basis and 82% demanded that universities do more to foster these skills in undergraduates (CBI, 2009b). In addition, skills training has become necessary as small and medium sized enterprises (SMEs) are playing an increasingly important role in the wider graduate labour market (Holden *et al*., 2007), but are less likely than larger firms to invest in training their graduate recruits, due to a lack of resources and the necessary infrastructure (Heaton *et al*., 2008; Hoque and Bacon, 2008).

Students too expect their university education to enhance their career prospects (Hesketh, 2000; Glover *et al*., 2002). In fact, UK graduates not only have higher employment rates than non-graduates (Arthur *et al*., 2008) but the effects of HE attainment on hourly wages show significant and substantial wage premiums for typical graduates even when other factors are controlled (Blundell *et al*., 1997). Students, while recognising the significance of their degree to their future employability, feel the need to add value to and boost their degree credentials through developing employability skills in order to stand apart from other graduates with similar academic achievements (Tomlinson, 2007, 2008). A substantial majority of undergraduates (82%, N = 880) from 20 UK HEIs recently surveyed by the CBI wanted universities to help them improve their employability skills (CBI, 2009a).

While the focus on employability is understandable, defining the term appears as contentious (Harvey, 2001; Knight and Yorke, 2004) as measuring it (Smith *et al*., 2000; Little, 2001). Employability is often conceived as a set of complex and diverse skills, understandings and personal attributes that make an individual more likely to obtain employment and be successful in it (Knight and Yorke, 2004). It is distinct from employment which is dependent upon a number of factors, such as economic climate, geographical location, graduate supply and social structures such as gender, race and class. Whilst enhancing employability improves the likelihood of an individual securing a graduate job, it does not in itself guarantee employment (Brown *et al*., 2003).

The employability or skills agenda has been critiqued widely. While there is general agreement on the importance of employability skills by all stakeholders, the nature and types of such skills remain contested and riddled with multiple definitions, understandings and interpretations (Dunne, *et al*., 1997; Hager and Holland, 2006). Not only is a definitive list of graduate skills non-existent but such skills are often under-theorised and lack any conceptual clarity (Barrie, 2004, 2006). Moreover, graduate skills are context-bound, i.e. their value to employers depends on specific factors such as business sector and size (Greatbatch and Lewis, 2007). The wide inconsistency in the use and interpretation of the skills discourse, even amongst employers, makes it difficult for HEIs to identify exactly the needs of employers (Dawson *et al*., 2006). Furthermore, competition in the job market is dependent upon not only an individual's employability skills, but also on how that individual compares with others, which underlines the limitations of a supply-side policy as a means of extending occupational opportunities (Brown and Hesketh, 2004). Although research evidence supports the view that transferable skills are valued by employers of all sizes in terms of their graduate workforce and, therefore, that they are significant to the potential employability of graduates (Stewart and Knowles, 2000), many have questioned the extent to which employability skills initiatives adopted by HEIs can impact upon the skills performance of graduates in the workplace. While HE certainly has the potential to deliver a wide range of transferable skills in its graduates, it requires HE putting these skills at the forefront of educational provision and developing them contextually in order to highlight to students the relevance of these skills and maintain their motivation to develop them (Kemp and Seagraves, 1995). Even the adoption of a contextualised approach does not guarantee transferability (Washer, 2007) because the employability agenda rests on a shaky assumption *'that certain attributes and abilities are to be developed out of context (i.e. out of the context of employment)'* (Hinchliffe, 2008: 7, original emphasis). A comprehensive assessment of the impact of employability skills development on employment prospects did not find any evidence of a significant independent effect of initiatives aimed at enhancing employability skills by university departments in terms of teaching, learning and assessment; however, the study did find strong positive effects with regard to student work experience on their ability to obtain a job (Mason *et al*., 2009). These findings highlight both the contextual nature of learning and the difficulties involved in the transfer of knowledge between education and workplace settings (Eraut, 2004). Despite the validity of some of the arguments above, the realities of the labour market do not allow graduates to indulge in such a debate; graduates have to provide evidence that they possess the skills valued by employers and demonstrate where in their undergraduate curriculum they developed them (Washer, 2007).

4.2. Numeracy skills in higher education and employability

As a nation, the UK appears more innumerate than illiterate. According to the government's *Skills for Life* survey, there are almost three times as many UK adults (15.1 million) with poor numeracy skills (the equivalent of a grade 'G' or below in GCSE Mathematics) than with poor literacy skills. Half of all jobs in the UK are effectively closed to those whose skills in English and mathematics are below level one, i.e. at a level equivalent to grades 'D' to 'G' at GCSE (Keating, 2007).

Numeracy skills therefore continue to draw considerable attention from government, policy makers, employers and HE providers. Like 'employability', defining 'numeracy' is problematic, since numeracy is not only culturally specific but is bound to changes in time and place as well as to technological developments and social changes (Wedge, 2007). Nevertheless, Evans' definition of numeracy is a useful one:

> *...the ability to process, interpret and communicate numerical, quantitative, spatial, statistical, even mathematical, information, in ways that are appropriate for a variety of contexts and that will enable a typical member of the culture or subculture to participate effectively in activities that they value.*
> *(Evans, 2000: 236)*

Amongst the *'ways that are appropriate'* we might include the use of technology, which is of increasing significance in contemporary developed societies (Kent *et al*., 2007).

Employers, HE providers, professional bodies and government have all voiced concern over the decline in the numerical competency of undergraduates (Bishop and Eley, 2001; Brown *et al*, 1998; Cartwright, 1996; CBI, 2006; Dearing, 1997; DfES, 1998; Hutton, 1998; Phoenix, 1999; Tariq, 2002a, 2002b, 2003, 2008). Numeracy represents one of the skills which the Dearing Report considered 'key to the future success of graduates whatever they intend to do in later life' (Dearing Report, 1997: 133). However, the report observed that only one in three graduates felt their numeracy skills had improved whilst in HE, and it called upon HEIs to do more to produce numerate graduates. Similarly, the Smith Report (2004) noted that employers across a range of employment sectors demanded a mathematically skilful workforce, and it considered an 'adequate supply of young people with mastery of appropriate mathematical skills at *all levels* … vital to the future prosperity of the UK' (Smith, 2004: 12; original emphasis).

Research into graduate skills from the perspective of employers confirms the importance of numeracy skills. For example, a study by Hoyles *et al*. (2002), which investigated the skill needs of employers in seven sectors (electronic engineering and optoelectronics, financial services, food processing, packaging, pharmaceuticals, healthcare, and tourism) found that demand from employers for mathematically literate graduates was growing and that mathematical literacy was seen by many businesses as integral to their competitive strategy and the drive towards efficiency and innovation. Numeracy invariably figures in the top five or ten skills demanded by employers (Bennett *et al*., 2000; Dixon, 2002). Similarly, 'numeracy skills' were ranked as the sixth most important out of a list of 28 employability skills by 98% of directors (N = 500) responding to an Institute of Directors (IoD) survey (IoD, 2007). The Council for Industry and Higher Education's (CIHE) 2008 survey also revealed that 68% of employers (N = 233) considered numeracy to be important, listing it below literacy at ninth in its list of employability skills (Archer and Davison, 2008). In its survey of student employability profiles, the same organisation included numeracy skills or more advanced mathematical skills directly in 31 out of 51 career areas. Rather surprisingly, law and medicine are not in the list but classics and ancient history and health visiting are (Cameron, 2010). Despite the importance attached to numeracy skills, employers of graduates continue to express concerns about the level of numerical competence demonstrated by their recruits. For example, in the IoD 2007 survey, 21% of employers believed that numeracy skills are only 'occasionally' or 'never' demonstrated by graduates (IoD, 2007), and whilst just a small proportion of employers thought graduates lacked the most basic numeracy skills (8%), only 29% were 'very satisfied' with the overall numerical capabilities of their graduate recruits (CBI, 2009b). This dissatisfaction with the numerical competence of graduates is most pronounced in sectors where relatively higher levels of numeracy skills are required. For example, in the financial services sector, an 'acute shortage' of higher level numeracy skills has been reported (AGR 2008; cited in Rae 2008: 754). Similarly, 81% of employers (N = 42) representing the pharmaceutical industry, claimed a skills gap in the higher level maths knowledge of graduates was a major concern for the industry (Association of the British Pharmaceutical Industry, 2008). They reported that UK graduates lack 'the quantitative skills necessary to analyse and interpret data and to have confidence in their analyses', often resulting in applicants being rejected for a position (ibid, p.14). The Nursing and Midwifery Council (NMC) now requires the assessment of numeracy for prescribing as part of the prescribing programme, with a threshold pass mark of 100% (Warburton and Khan, 2007).

Research exploring the perspectives of graduates also confirms the significance of numeracy skills to graduate employment. For example, a survey of former hospitality students graduating from Oxford Brookes University between 1995 and 2002 found that 79% of respondents believed that their numeracy skills were important to their career success (Maher, 2004). Similarly, in a study exploring the work experiences of a sample of 545 respondents graduating in 2005, 51% of graduates indicated they were using numeracy skills in their current job (Chartered Institute of Personnel and Development [CIPD], 2006). Despite the value of numeracy skills to their employability, graduates, particularly but not exclusively those studying the arts, humanities and social sciences, have expressed the view that their numeracy skills were not as developed as their work required or that their degree had not provided them with sufficient opportunities for practising and developing their numeracy skills. For example, in a survey of 880 undergraduates from 20 UK HEIs, nearly a third (29%) reported that they did not feel they had acquired adequate numeracy skills (CBI, 2009a). Similarly, Edwards and McGoldrick (2004) tracked the post-graduation experiences of a sample of 46 students graduating from the School of Social Sciences, Liverpool John Moores University and held consultations with 17 employers regarding their recruitment criteria for graduate-level jobs. The sample of graduates claimed that numeracy, statistics and ICT skills were not given sufficient emphasis in their undergraduate curricula and that this restricted their career prospects. Similarly, the employers identified gaps in the numerical competence of social science graduates. Mason *et al*. (2003) also reported that a much lower proportion of humanities students (15% of design students and 15% of history), compared with those in biological sciences (78%), computer studies (65%) and business studies (42%), expressed the view that their university education prepared them for handling numerical data.

In addition to their role in graduate employability, the numeracy skills of HE entrants have implications for student recruitment, retention and progression. Competence in numeracy skills is vital to the successful completion of undergraduate degree programmes as varied as pharmacy, biosciences, business studies, nursing, psychology and social science. Against this backdrop, there is now a widespread recognition in the UK that many students are mathematically ill-prepared to meet the demands of their chosen academic discipline (Croft *et al*., 2009). This applies not only to mathematics degrees and engineering programmes, but also to business studies, chemistry, physics, medical sciences and other courses with some statistical content (Wilde *et al*., 2006). Empirical research in this area supports such a perception. For example, deficits in the numeracy skills of bioscience undergraduates have been well documented (Phoenix, 1999; Tariq, 2002a, 2003, 2008). Similarly, an acute shortage of numeracy skills amongst nursing students has been reported (Cartwright, 1996; Hutton, 1998; Sandwell and Carson, 2005; Wright, 2005; Jukes and Gilchrist, 2006; Warburton and Kahn, 2007; Dopson, 2008), and a decline in numeracy skills over time has been demonstrated amongst psychology (Mulhern and Wylie, 2004; 2006), pharmacy (Malcolm and McCoy, 2007), and mathematics, physics and engineering undergraduates (Ridgway and Passey, 1995; Engineering Council, 2000).

Reasons for this decline in the numerical competency of undergraduates are complex and multidimensional and beyond the scope of this report. Nevertheless, in an attempt to place this project in context, an overview of contributory factors is provided. Firstly, there have been several changes to the content, teaching and assessment of school mathematics in the UK over the past two decades, many of which are perceived as having been detrimental to student learning and capabilities and to the requirements of HEIs (Cox, 1994; Hoyles *et al*., 2001; Smith, 2004; Atkins and Marks-Maran 2005). These changes have not only limited students' ability to use mathematics in non-classroom situations (Boaler, 2000), but students are also increasingly displaying less mathematical competence (Kitchen, 1999; Lawson, 2003). Secondly, students perceive mathematics as difficult and boring, display negative attitudes towards the subject, and lack confidence in their mathematical ability (Brown *et al*., 2008). Thirdly, the expansion of HE and the resultant increase in student numbers has changed the demographic and social characteristics of students. Entry requirements in terms of pre-university mathematics qualifications have been relaxed or alternative qualifications (e.g. Access, Adult Numeracy, Key Skills, GNVQ, BTEC qualifications) accepted (Batchelor, 2004). Although equivalent for the purpose of admission onto HE programmes, undergraduates possessing these alternative qualifications are often less mathematically able than those with traditional qualifications (Lawson, 2000). Fourthly, negative attitudes towards numeracy and mathematics, often developed in school, are being carried over into HE (Pokorny and Pokorny, 2005), preventing UK undergraduates from practising deep learning approaches towards the development of numeracy skills in their degree programmes. As a result, students avoid practising and/or further developing their numeracy skills while in HE (Mackenzie, 2002). Reversing the decline in undergraduates' numeracy skills will require long term efforts from all stakeholders, including government, policy makers, funding and curriculum agencies, schools and teacher training organisations. However, until such time as their efforts yield real and sustained improvements in the numeracy skills of entrants to HE, all universities can do is implement measures aimed at addressing the problem within their own domain (Croft, 2001).

The contributory factors outlined above have led many employers to lose faith in GCSE Mathematics as a measure of an individual's mathematical knowledge and skills (Henry, 2003). As a result, employers are increasingly using a range of numerical reasoning and computation tests to evaluate their applicants' numeracy skills (CIHE, 2003). Such tests can represent a very real challenge for many recent graduates, particularly (although by no means exclusively) those from academic disciplines where there may have been little, if any, explicit opportunity to practise and/or enhance their numeracy skills within their degree curricula (Croft, 2000; Mackenzie, 2002). Not all subjects can explicitly accommodate numeracy skills within undergraduate programmes of study, yet graduates from *any* discipline may be required to demonstrate a minimum level of numerical competency in order to maximise their graduate employment prospects and to succeed in the workplace, as well as in their everyday lives (Tariq, 2002b). This view has been supported by those teaching in the arts and humanities; for example, Green *et al*., (1983) and Gillespie (1998), highlighted the importance of numeracy skills to arts and humanities undergraduates, as well as to those in science and engineering. In addition, Nicholls (2005b) revealed that the numerical and IT skills of history undergraduates ranked bottom of the list of skills in which they acquired competence whilst at university.

4.3. Importance of numeracy skills in history

E.P. Thompson described history as 'the queen of the disciplines' (Thompson, 1978). By this, he meant not just that all disciplines have their own history but that history itself draws from, and requires knowledge of, a wide range of other disciplines: economics, literature, sociology, law, languages, politics, archaeology, anthropology and so on. Mathematics can just as readily be included in this list; indeed, certain branches of history have made systematic use of quantitative and statistical approaches, most notably econometric history.

The Dearing Report (1997) designated numeracy as one of the key skills that should feature among the outcomes of all UK higher education programmes. This proposal was not welcomed by all historians; while quantitative techniques certainly feature in the discipline, they are by no means universally valued within it. Moreover, even historians who use these techniques harbour concerns about their students' limited understanding of mathematics and about their lack of interest in, and often antipathy to, applying their existing mathematical skills, let alone to developing new ones (see below).

Recognising these limitations, the Quality Assurance Agency's (QAA) benchmark statement for history, first published in 2000 and then in a revised form in 2007, is far more permissive. It does not include numeracy among the generic skills that history undergraduates might be reasonably expected to acquire. However, it does recognise that some branches of the discipline might incorporate methodologies taken from other disciplines and makes the 'strong recommendation' that, where appropriate, provision should be made in undergraduate history courses for developing at least one from a list of several additional skills, which includes numeracy and quantitative methods (QAA, 2007). As far as benchmarking recommendations are concerned, then, numeracy need not feature in undergraduate history courses, despite the value that can be attributed to it in terms of historical study, employability and life skills.

Nevertheless, over the years, historians with an interest and expertise in numeracy have provided a good deal of guidance on the types of quantitative techniques that are useful in historical investigation. In some instances, attention has been focused on explaining these techniques, incorporating examples of how they can be applied in historical investigation (Archdeacon, 1994; Darcy and Rohrs, 1995; Feinstein and Thomas, 2002; Floud, 1973; Hudson, 2000). In other instances, a case study approach has been adopted, demonstrating how quantitative techniques can be applied in investigating a varied range of historical themes (Aydelotte *et al*., 1972; Haskins and Jeffrey, 1990; Lorwin and Price, 1972; Wrigley, 1972). For the most part, but by no means entirely, discussion in these works is pitched at a basic level, thereby providing history undergraduates, as well as their teachers, with helpful advice on the types of quantitative investigations they can undertake. Publications in several specialised branches of the discipline also demonstrate the value of applying simple numerical techniques, with historical demographers being to the fore (Drake, 1961-2, 1974, 1982; Wrigley, 1966). The journal *Local Population Studies* contains numerous short articles that employ a varied range of quantitative approaches that undergraduates and others can readily apply in analysing demographic data. Rather less has been written specifically about the teaching and learning of quantitative techniques in undergraduate history, although some instructive and welcome examples have been offered, dealing with the types of source material that can be used and the investigative approaches that can be adopted (Charlton, 1977; Freeman, 2010; Johnson, 1993; Rodger, 2009; Rosner, 1993).

Further guidance on using quantitative techniques in historical investigation has featured in books and articles dealing with ICT, with one historian depicting computers as 'the handmaiden' of quantitative history (Anderson, c.2008). Coverage embraces the uses to which ICT can be put in studying history, including database and spreadsheet applications. Again, much of the discussion is pitched at a level that requires fairly basic numerical understanding, a key aim being to demystify the terminology and concepts that ICT usage involves. The trailblazing volumes published by the Association for History and Computing during the late 1980s and early 1990s mainly present case studies, but also incorporate learning and teaching sections (Denley and Hopkin, 1987; Denley *et al*., 1989; Mawdsley *et al*., 1990). Other works, however, focus specifically on learning and teaching matters, including classroom approaches (Lambe, 2003; Lloyd-Jones and Lewis, 1994, 1996, 2000; Perkins *et al*., 1992; Spaeth, 1996; Spaeth *et al*., 1992). Yet others are aimed at a more general audience, but the approaches covered nonetheless have application in teaching history undergraduates (Cameron and Richardson, 2005; Davis *et al*, 1993; Greenstein, 1994; Mawdsley and Munck, 1993; Schick, c.1990; Trinkle, 1998). In addition, there is a specialist volume on the use of databases in historical research, again aimed at a wide audience, including undergraduates (Harvey and Press, 1996).

Useful though much of this guidance on quantitative methods has been, it has not persuaded the majority of history tutors, or their students, about the value of numeracy as a key skill. Indeed, the contributions relating to ICT usage may well be valued more with regard to 'soft' ICT skills, such as word processing, internet use and presentational skills, than to quantitative approaches. While such skills are certainly important for history undergraduates and assist them considerably in their studies, it cannot be assumed that where ICT features in their courses it involves quantification.

The publications dealing with numeracy in undergraduate history courses have aired the advantages that incorporating a numerical dimension can bring, particularly in fostering historical understanding (Floud, 1973; Hudson, 2000). However, in recent decades, numeracy has also become strongly linked with employability issues, as noted above. The 1980s began an economy-driven shift towards a more 'enterprising' curriculum that led to the eventual incorporation of the skills agenda in external and internal quality assurance and validation procedures. This shift was encapsulated in the Dearing Report and, subsequently, in the government's decision in 2001 to make 'employability' a performance indicator for higher education (HEFCE, 2001). The new paradigm incorporates the development of a range of key or transferable skills, numeracy amongst them, in degree-level courses and history has not been immune to it.

Despite the benefits that numerical techniques can have for history undergraduates in terms both of their historical studies and their future job prospects, other dimensions of the history curriculum have been accorded much higher priority. This point is well-illustrated by the decline that has occurred during recent decades in the provision of degree-level courses in economic history, where quantification in one form or another is standard fare. Since the 1980s, economic historians have commented on this decline, at all levels of education, charting its course and reflecting on the means by which it might be halted (Coleman, 1987, 1995; Daunton, 1985; Harte, 2001). Only two UK universities now have distinct economic history departments, namely the London School of Economics and Glasgow University, with stand-alone undergraduate programmes in economic history. Nor is this trend confined to the UK, as is evident from a recent study charting the decline in economic history provision in Canadian universities (McCalla and Day, 2003). Likewise, in the USA, the number of college history departments with an economic historian fell from 54.7% in 1975 to 31.7% in 2005 (Cohen, 2009). These developments are not confined to history, as a recent report on the social sciences has demonstrated (Newman, 2009).

In the UK, the sharp decline in economic history provision occurred in tandem with a rapid increase in the number of undergraduates studying history overall and created acute dilemmas for economic historians. Should they move into management / business / economics departments, where quantitative approaches were the norm, or re-locate to history departments, where an emphasis on quantification was far less likely? Those who chose to move to history departments experienced two problems. Firstly, they faced the marginalisation of economic history within the broad curriculum. This was partly the result of increasing optionality within history programmes, which opened up a much wider range of choice and led both students and teachers to shift away from the economic dimension as quantitative applications became increasingly sophisticated and complex and, for many of them, frankly impenetrable. The reciprocal of this trend has been the advance of social and cultural history (Burke, 2008) which tends not to regard quantitative analysis as integral to historical study. A downward spiral has therefore developed with fewer students being taught the subject, leading to fewer lecturers entering the profession with the necessary background, skills or enthusiasm. The consequence is that history departments are now composed of a majority of staff who prioritise literary, communication and visual skills over the acquisition of numeracy skills and who are often uncomfortable with using, let alone teaching, such skills. Secondly, there have been changes in the content of economic history modules. This is a more subtle set of changes and the evidence is less tangible than for the structural ones. While modules still make reference to the importance of quantification, the tendency is for the numerical material to be pre-packaged and interpretative, with less emphasis placed on direct engagement with quantitative techniques. At the same time, the resort to ICT in many cases has become a substitute for numerical understanding. In short, students may acquire a technical capability and a familiarisation with the 'outcome' of quantification (manipulated elsewhere) but are left with only a superficial understanding of numerical analysis.

What has to be recognised as well is that there is disagreement about the *appropriateness* of particular skills for history students. While the cautious benchmark statement embodied this debate, it was also evident in how the profession responded more generally to the rise of the skills agenda. History, in fact, proved very good at developing most of the skills identified by employers and history lecturers successfully embedded these skills in the curriculum, making learning outcomes much more explicit and encouraging students to be much more reflective about skills and their relevance. The 1990s witnessed a growth in pedagogic initiatives involving the UK's HE historians, led most notably by History 2000, a government-funded project to promote the development of teaching and learning, which inspired numerous conferences, workshops and publications that disseminated new approaches to teaching the discipline (Booth, 2003; Booth and Hyland, 1996, 2000; Timmins *et al*., 2005) But, notably, the skill least developed in all this pedagogic activity was numeracy. A report published by the Subject Centre for History, Classics and Archaeology in 2005 showed that history at university was contributing nothing to what limited ability undergraduates had in numeracy (Nicholls, 2005b). Meanwhile, history graduates reported that there was a demand for numeracy skills in the jobs they had taken and that university had improved their ability in every one of the 'employability' skills *except numeracy*. It was evident as well that history graduates had applied for jobs where numeracy was not a main requirement – in other words, the lack of this skill was limiting their employment opportunities and general 'marketability' (Nicholls, 2005b). At the same time, a study by the National Research and Development Centre for Adult Literacy and Numeracy found that 'embedding' mathematics within practical and vocational training was particularly effective (Keating, 2007). The appositeness of numeracy to a historical training renders it fit for just such 'embedding' but the profession has yet to embrace the opportunity.

In summary, numeracy is receiving limited attention in the university history curriculum, despite its value in enhancing both employability and historical skills and the availability of publications extolling its usefulness. Indeed, with the decline of economic history and the rise of social and cultural history there has been a retreat from teaching numerical and quantitative approaches. Moreover, the situation in history is by no means atypical. Deficiencies in the teaching of quantification can be found across the social sciences, as evidenced by the recent Macinnes report for the ESRC (summarised in Newman, 2009) which found that, on average, students receive only about 12 hours of teaching in quantitative methods across the whole of a three-year degree. It is hoped, therefore, that the research and findings here will have much wider applicability and provide lessons for cognate disciplines. This is the context for the history dimension of this project, for the reassessment of the importance of numeracy in the study of undergraduate history and for the recommendations that are included at the end of the report.

4.4. Factors influencing students' learning in mathematics and their development of numeracy skills

Four factors believed to influence individuals' learning and achievement in mathematics and their development of numeracy skills are their conceptions of mathematics, their attitudes and approaches towards learning mathematics, and levels of mathematics anxiety. Undergraduates' conceptions of the nature of mathematics feature prominently in the literature on students' learning of mathematics (Crawford *et al*., 1994, 1998a, 1998b; Mji, 2003) and have been found to be related to their experiences of studying the subject, the ways in which they approach mathematical learning, and their learning outcomes in the subject (Crawford *et al*., 1998b). A phenomenographic study, using open-ended questions with first-year mathematics undergraduates identified a qualitative variation in university entrants' conceptions of mathematics (Crawford *et al*., 1994). The results from this study were used by Crawford *et al*., (1998a) to generate items for their 'Conceptions of Mathematics Questionnaire' (CMQ), in which they classified students' conceptions into two broad mutually exclusive categories, namely 'fragmented' and 'cohesive'. Fragmented conceptions were characterised as those in which mathematics is perceived as a fragmented body of knowledge and is described in terms of numbers, rules, formulae and equations. Conversely, cohesive conceptions were characterised as those in which the students identified mathematics as a set of complex, logical systems used to obtain insights which help us understand the world (Crawford *et al*., 1998a).

Crawford *et al*. also modified Biggs' 'Study Process Questionnaire' (Biggs, 1987) to develop an 'Approaches to Learning Mathematics Questionnaire' (ALMQ) which identified two approaches, namely 'surface' and 'deep' (Crawford *et al*., 1998a). Each approach comprised two sub-scales, 'intention' and 'strategy'. A surface learner's 'intention' is to fulfil assessment tasks and to avoid failure by adopting a repetitive 'strategy' and by memorising specific facts and accurately reproducing them. Conversely, deep learners show an 'intention' to understand what is being learned through critical engagement and use of a 'strategy' that focuses on concepts applicable to solving the problem (Crawford *et al*., 1998a). The study found that students differed in their approaches to learning mathematics according to their conceptions of mathematics; students having fragmented views of mathematics adopted a surface approach, while those expressing cohesive conceptions adopted a deep approach (Crawford *et al*., 1998a). Both the CMQ and ALMQ were reported to be valid and reliable instruments (Crawford *et al*., 1998a) and have been used extensively in studying students' conceptions of mathematics, primarily with mathematics undergraduates (Crawford *et al*., 1998b; Alkhateeb, 2001; Mji, 2003).

An 'attitude' is a learned dispositional tendency to respond to certain situations, persons, topics or objects in a consistent and habitual manner (Aiken, 1970). Because attitudes involve an engagement or avoidance dimension, positive attitudes towards mathematics facilitate students' learning of the subject, while negative attitudes hinder students' learning (Ifamuyiwa and Akinsola, 2008). There is a dynamic interaction between students' attitudes towards mathematics and their performance in the subject (Barkatsas *et al*., 2009; Shaw and Shaw, 1997), with students who hold more positive attitudes towards mathematics tending to perform better in the subject (Hammouri, 2004; Papanastasiou, 2000).

Mathematics anxiety is a feeling of tension or fear that interferes with the ability to manipulate numbers and solve mathematical problems in everyday life and academic environments (Richardson and Suinn, 1972), and is often aroused when individuals are required to perform mathematics in timed and high-stake situations (Ashcraft and Moore, 2009). Studies investigating the relationships between mathematics anxiety and other affective constructs, academic outcomes and motivational factors link it to low scores on mathematics achievement tests, as well as negative attitudes towards, and the avoidance of, mathematics (Hembree, 1990). Mathematics anxiety also appears to be a good predictor of grades in mathematics and course-taking decisions (Eccles and Jacobs, 1986).

Gauging students' conceptions of mathematics, the prevalence of mathematics anxiety and students' attitudes towards mathematics is essential if strategies aimed at enhancing undergraduates' learning in the subject and supporting the development of students' numeracy skills are to prove effective.

4.5. Supporting the development of undergraduates' numeracy skills

During the 1990's HEIs realised that some students who had reached the required entry standards were abandoning engineering degrees because of inadequacies in their mathematical skills. This led to initiatives such as HELM (Helping Engineers Learn Maths) to provide support for these students. This was initially restricted to universities with strong backgrounds in engineering. As it became apparent that all students could benefit from access to maths support a wide variety of initiatives emerged, ranging from the establishment of central university-wide maths support centres (e.g. at Loughborough, Coventry and Cardiff universities) through to small ventures run by one person (e.g. at Portsmouth University). Although funding for such initiatives has been primarily via external sources, such as SIGMA, some proposals have received internal institutional funding. There has also been some excellent work in developing online support materials and making these available universally. Whilst some of these are discipline-specific (e.g. METAL for Economists), many are more generic in nature (e.g. *mathtutor*).

At the University of Central Lancashire (UCLan), for a number of years maths support was offered several days a week at lunchtime drop-in sessions; these were provided by lecturers from the 'Mathematics Department' and were geared more towards science students than business and humanities students. However, this provision was withdrawn some years ago due to changes in the department's priorities and has not been replaced. When this project started in 2007 online materials were available to support general study skills and within these there were some rudimentary pages on numeracy. The units tasked with providing study support and careers guidance ran workshops on study and employability skills, including psychometric tests, and individual lecturers did their best to support students. However, there was no obvious and clear route via which students could obtain numeracy skills support, with regard to either their academic discipline or their future employability. This is something that the current study aimed to address.

5. Aims and objectives

5.1. Aims

The original overall aims of the project were two-fold:

1. to explore the numerical knowledge and skills required within the disciplines of history, bioscience (including nursing) and business studies, and how they might be better developed within curricula;
2. to identify the generic numeracy skills required by graduate employers, and how their development might be better supported across all disciplines.

However, in an attempt to engage as many UCLan undergraduates and tutors as possible in the project, the number of academic disciplines examined was extended beyond the original ones listed above. This expansion of the original number of disciplines was important in order to obtain data from as large a number and diversity of students as possible for two reasons: (i) to enhance the validity of any evidence-based conclusions from a research perspective, and (ii) to help justify any recommendations concerning institutional development, e.g. the provision of central university support facilities and services.

5.2. Objectives

In each academic discipline, the objectives were:

1. to identify the range of undergraduates' pre-university mathematics qualifications;
2. to assemble empirical data on the nature and level of numerical knowledge and skills required of undergraduates, including national and international data for history;
3. to identify and evaluate current practices in teaching, learning and assessment for enhancing numeracy in relation to subject benchmarks;
4. to identify the learning support needs of undergraduates and, where appropriate, propose changes in curricula and/or teaching and assessment strategies to improve their numeracy skills and promote progression in numerical competency;
5. to trial and evaluate materials and methodologies developed. However, limited time and staff resources permitted only some of the many generic resources available to be evaluated.

In relation to generic numeracy skills, the objectives were:

6. to survey employers to establish the numeracy skills demanded of graduates in relation to different types of employment;
7. to identify practices that might be adopted for developing generic numeracy skills across the HE sector;
8. to recommend strategies for implementing the practices identified in objective 7 above, using UCLan as a model.

In relation to the project as a whole, the objectives were:

9. to evaluate the approaches used and the potential for adopting project findings across the HE sector;
10. to disseminate the project findings, internally and externally, though various media, using external partners where appropriate.

6. Methodology

6.1. Overall approach

A multi-method approach was adopted, resulting in the collection of both quantitative and qualitative data. The use of a variety of methodologies and data collection instruments enabled data to be cross-checked, reduced bias and helped establish the data's validity (Cohen *et al*., 2007). Such triangulation minimised the artefacts of method, whilst using quantitative and qualitative data from students, tutors and employers permitted the issues being investigated to be studied from more than one perspective, providing a greater insight and building a richer picture. Copies of the data collection instruments used (i.e. surveys and tests) are available in pdf format from the project website at www.uclan.ac.uk/information/services/ldu/every_student_counts.php.

Initially, questionnaires were used to collect data from employers, students, tutors and graduates. Although questionnaires are efficient tools for collecting a broad range of data, they often have limited value in addressing the 'why' behind participants' views (Cohen *et al*., 2007). In order to examine the latter in more detail, follow-up interviews were held with individual tutors and focus group sessions were conducted with volunteer students to provide an in-depth understanding of issues surrounding numeracy skills. Focus group and interview schedules followed the themes contained in the questionnaires, but were semi-structured, allowing participants to discuss issues not raised previously. Interviews and focus group sessions were either recorded or notes were taken; recordings were then transcribed and their content analysed by coding and categorising the content of the transcripts and identifying key themes.

Students, tutors and employers all participated on a voluntary basis; the submission of completed questionnaires was accepted as informed consent. All participants were provided with an explanation of the aims of the study and their role. Since ethics approval for the study required that students participate on a voluntary basis, the sample of participating students was inevitably self-selecting. Students also participated in the focus group sessions voluntarily, with each providing informed consent. Since all participants were self-selecting volunteers, and were free to withdraw from the project at any time, any conclusions and inferences drawn relate to the samples and may or may not be generalisable to wider target populations.

6.2. Undergraduates', tutors' and employers' perspectives: a multi-disciplinary, comparative study within UCLan

6.2.1. Employer survey

An online questionnaire was designed, piloted and delivered using Bristol Online Surveys (BOS).[1] The questionnaire comprised 16 items, 11 of which asked participants to select their answer(s) from the options provided. The remaining five questions were open-ended and sought further details with regard to specific issues, e.g. types of opportunities for training in numeracy skills available to graduate recruits, or any additional comments. In addition, demographic information was collected, e.g. type of company/organisation and size of graduate workforce.

Graduate employers contacted to complete the survey, included those listed in (i) *The Times Top 100 Graduate Employers* (Birchall 2007), (ii) the *GET 2008 Directory of Graduate Employment and Training* (Career Research and Advisory Centre, 2008), and (iii) the Prospects.ac.uk website. In addition, the Lancashire Business School Placement Unit at UCLan, and two AGCAS (Association of Graduate Careers Advisory Services) task groups (Employer Liaison Specialist Group, and Product and Services Advisory Group) notified their employer contacts of the survey. Additionally, the Association of Graduate Recruiters (AGR) advertised the employer survey in their newsletter. Locally-based (North-West England) small and medium enterprises (SMEs), i.e. those normally possessing fewer than 250 employees, were also approached through UNITE[2]. Employers were initially contacted by email or telephone, usually via their Human Resources (HR) team, with follow-up communications to encourage participation.

6.2.2. Undergraduate and tutor surveys

Two online questionnaires, one for undergraduates and a second for academic tutors at a post-1992 UK university (UCLan) were designed, piloted and delivered using BOS. Paper-based versions of both questionnaires were also made available as required.

Undergraduate questionnaire

This comprised six main sections:

1. Course experience:

Students were asked

- what opportunities currently existed for them to develop and practice their numeracy skills: a list of 18 items, e.g. 'online self-assessment tests';
- how classes with a numerical focus were organised: 3 Likert items ('never' to 'always'), e.g. 'whole class teaching, such as lectures, practical/laboratory/clinical classes';
- in which teaching and learning activities their numeracy skills were assessed: a list of 12 items, e.g. 'work placements', 'exams';
- to whom/what they would turn for help: a list of 15 items, e.g. 'friends', 'module leader', 'books';
- what further help and support they would like to have: a list of 20 items, e.g. 'more regular testing', 'drop-in sessions';
- about their approaches to learning: 18 Likert items ('strongly disagree' to 'strongly agree') modified from Crawford *et al*. (1998a) and Pierce *et al*. (2007), e.g. 'I try to relate what I have learned to material in other subjects'.

A further 20 Likert items ('strongly disagree' to 'strongly agree') were modified from those used previously by Crawford *et al*. (1998a) and which form the basis of the Course Experience Questionnaire (CEQ) used by Ramsden (1991), e.g. 'Tutors are very good at explaining the numerical components to us'.

2. Supporting Students' Numeracy Skills:

Students were asked

- what opportunities existed outside university for them to develop and practise their numeracy skills: a list of 10 items, e.g. 'home accounts and personal finances';
- what support facilities they thought the university should provide centrally: a list of 14 items, e.g. 'drop-in sessions'
- how they would prefer to further develop and practise their numeracy skills: a list of 10 items, e.g. 'peer-assisted learning', 'small group tutorials/workshops'.

3. Conceptions of Mathematics: The six Likert items ('strongly disagree' to 'strongly agree') were selected and modified where appropriate from Crawford *et al*. (1998a, 1998b), e.g. 'Mathematics is the study of numbers'.

4. Attitude Towards Numeracy Skills: The 20 Likert items ('strongly disagree' to 'strongly agree') were based upon those modified by Doepken *et al*. (unknown) from Fennema and Sherman (1976), Broadbooks *et al*. (1981), Tapia and Marsh (2004), Pierce *et al*. (2007) and Kadijevich (2003, 2006), e.g. 'I've always found maths difficult', 'Numeracy skills are important in everyday life'.

5. Mathematics Anxiety: The 12 Likert items ('very anxious' to 'not at all anxious') were based on those of Alexander and Martray (1989), who used an abbreviated version of Richardson's and Suinn's (1972) Mathematics Anxiety Rating Scale (MARS), e.g. 'Walking into a maths or statistics class'.

6. Self-evaluation of Numerical Competency: Students were asked to self-evaluate their competency with regard to 21 items, on a 5-point Likert scale ('don't know' to 'highly competent'), e.g. 'Handling fractions and decimals'. A 'composite score' for self-confidence in the 21 numeracy tasks was calculated for each student (highly competent = 5, moderately competent = 4, limited competence = 3, not at all competent = 2, and don't know = 1). Thus, the maximum score achievable by an individual was 105 ('highly competent' on all 21 items), while the minimum score was 21 ('don't know' on all 21 items).

In addition, students were asked:

- whether they believed it sufficient for undergraduates to be technically competent without understanding underpinning mathematical concepts (*cf*. employer survey);
- whether they were aware of employers' increasing use of numeracy tests and the nature of such tests;
- how confident they were they could pass employers' numeracy tests.

Tutor questionnaire

This comprised five main sections:

1. Programmes of Study:

Tutors were asked

- what opportunities existed in their programmes for students to develop and practise their numeracy skills: a list of 18 items, e.g. 'online self-assessment tests' (*cf*. student survey);
- how classes with a numerical focus were organised: 3 Likert items ('never' to 'always'), e.g. 'whole class teaching, such as lectures, practical/laboratory/clinical classes' (*cf*. student survey);
- in which teaching and learning activities students' numeracy skills were assessed: a list of 12 items, e.g. 'work placements', 'exams' (*cf*. student survey);
- who was primarily responsible for supporting the development of students' numeracy skills within programmes; a list of 5 items, e.g. 'subject tutors', 'postgraduate demonstrators';
- what approaches their school adopted with regard to developing students' numeracy skills: a list of 6 items, e.g. 'completely embedded within subject-specific modules';
- in which years of the programme opportunities exist for the development of students' numeracy skills: a list of 5 items;
- whether their programmes included a diagnostic numeracy test.

2. Supporting Students' Numeracy Skills:

Tutors were asked

- what types of support strategies they thought their programme should provide: a list of 20 items, e.g. 'drop-in sessions' (*cf*. student survey);
- what they perceived to be the barriers, if any, to adopting a more proactive approach towards supporting students' numeracy skills: a list of 7 items, e.g. 'fear of loss of subject time to accommodate numeracy skills';
- what support facilities they thought the university should provide centrally: a list of 14 items, e.g. 'drop-in sessions' (*cf*. student survey).

3. Conceptions of Mathematics: The six Likert items ('strongly disagree' to 'strongly agree') were selected and modified where appropriate from Crawford *et al*. (1998a, 1998b), e.g. 'Mathematics is the study of numbers' (*cf*. student survey).

4. Attitude Towards Numeracy Skills: The 21 Likert items ('strongly disagree' to 'strongly agree') were based upon those modified by Doepken *et al*. (unknown) from Fennema and Sherman (1976), Broadbooks *et al*. (1981), Tapia and Marsh (2004), Pierce *et al*. (2007) and Kadijevich (2003, 2006), e.g. 'I've always found maths difficult', 'Numeracy skills are important in everyday life' (*cf*. student survey);

5. Evaluation of Undergraduates' Numerical Competency: Tutors were asked to evaluate their students' competency with regard to 21 items, on a 5-point Likert scale ('don't know' to 'highly competent', e.g. 'Handling fractions and decimals' (*cf*. student survey).

In addition, tutors were asked:

- whether they were aware of employers' increasing use of numeracy tests and the nature of such tests (*cf*. student survey);
- how confident they were their students could pass employers' numeracy tests (*cf*. student survey).

Demographic information was also collected from undergraduates and tutors. Each questionnaire was piloted with samples of students (140) or tutors (6).

6.2.3. Undergraduate focus group sessions

Five focus group sessions were held in which 29 volunteer undergraduates representing all four faculties participated. All participants provided written informed consent for their participation, and the audio recording, transcription and use of their data. Demographic data, e.g. discipline, previous mathematics (or -related) qualification, year of study, etc., were also collected from each participant.

The initial plan had been to organise discipline-specific sessions, in order to obtain an in-depth disciplinary perspective on the issues of interest. However, due to problems encountered in getting undergraduates from any particular discipline to gather at one specific time, all sessions were multidisciplinary.

6.2.4. Tutor interviews

Semi-structured interviews were held with six tutors, two each from Health and Social Care (nursing) and Science and Technology (psychology), and one each from Management (business studies) and Arts, Humanities and Social Care (history). Interviews lasted 40 to 60 minutes and, with the exception of one interview, were audio-taped with the interviewees' consent. In the single case where the interviewee's consent for audio-recording was denied, the text of the interview (developed with the help of notes recorded at the time) was forwarded to the respondent for their validation.

6.2.5. Data analysis

Surveys

Data from the three questionnaires were summarised using the BOS statistics facilities and quantitative data exported into SPSS v. 17.0 for further statistical analyses. All responses were anonymous. Responses to open-ended questions were transcribed and the content of the transcripts coded, categorised and key themes identified through an iterative process.

Undergraduate focus group sessions and tutor interviews

All qualitative data were analysed by coding, categorising and identifying key themes within the content, using NVivo 2 software (student focus groups) or Microsoft Word (tutor interviews). Characteristics of categories or concepts were compared across demographic groups, and relationships between categories or concepts were also explored.

6.2.6. Identifying numeracy skills support materials

The overall aim was to gather information about the current situation at UCLan regarding the provision of central support for numeracy skills, e.g. who is responsible for providing it, and where and how well is information regarding such support being communicated to students and colleagues across the university. In addition, some insight was sought into (i) the specific numerical topics in which students require support, (ii) materials already in existence which might assist in providing such support, and (iii) how such support was being delivered in other HEIs.

Current situation at UCLan

Tutors engaged in teaching or supporting students' numeracy skills were identified by cascading information via personal contacts. A sample of seven tutors from the list was contacted with a view to identifying the specific topics students found particularly challenging and the nature and extent of any support provided. In addition, informal interviews were conducted with colleagues from UCLan's student support units, i.e. the 'i' (UCLan's student information centre, offering advice on a wide range of student concerns, including tuition fees and accommodation), 'Futures' (providing advice on careers and employability), 'WISER' (providing support for students' study skills) and the Students' Union.

A workshop, held in the Faculty of Management (March 2009), aimed to emphasise employability issues associated with students' numeracy skills, identify key issues facing the faculty, and provide the opportunity for staff to network with colleagues and share their experiences and concerns. This event was held in conjunction with UCLan's Centre for Research-informed Teaching (CRiT).

During the summer of 2009 (June - August), an undergraduate intern (funded by UCLan's CRiT) investigated the current sources of numeracy support available at UCLan from a student's perspective by acting as a 'secret shopper' and by interviewing other undergraduate interns. A focus group was also held to investigate how undergraduates search for support on numerical topics. The aim was to provide signposts to sources of support for a wide range of numerical work tailored for particular academic disciplines.

Support materials and approaches

Support materials were identified via online searches, MSOR (Mathematics, Statistics and Operational Research) conferences at Lancaster (2008) and the Open University (2009), a workshop at Anglia Ruskin University (December 2008) and a visit to Loughborough's Mathematics and Statistics Learning Centre (MSLC) (July 2009). Opportunities were taken to canvas Management students' views on these support materials, during the researcher's own teaching sessions and during central university support sessions (1 hour/week) provided by this project during its final year (2009/10).

6.3. National and international audit of History: undergraduate, graduate and tutor perspectives

6.3.1. Overall approach

For the history strand of this project, numerical competence is defined as the capacity to understand and manipulate a range of basic mathematical skills. The term 'numeracy' is therefore not used in an abstract but a pragmatic way to refer to the skills that history undergraduates might reasonably be expected to have acquired as a result of their school education and which would assist them in their interpretation of historical data. The skills so identified include basic arithmetical calculations (addition, subtraction, long division and multiplication); interpreting statistical charts and tables; calculating percentages, ratios and measures of central tendency; being able to compile frequency distributions; and working with ICT applications, such as spreadsheets and databases. The project has sought to gauge student competency in these skills by way of self-evaluation questionnaires and a numeracy test. It is necessary to stress therefore that the terms 'numerical', 'quantitative' and 'mathematical' are used interchangeably to refer to these basic skill-sets and not to the more advanced skill-levels of someone qualified beyond GCSE level. It is also important to note that, while this project is concerned with identifying a minimum level of numerical competence to which all history undergraduates might reasonably be expected to aspire, it recognises that some students will wish to build on these basic skills and, indeed, will be required to do so if they take modules in economic or business history with significant quantitative elements. In such cases, students would be expected to understand new and more advanced statistical skills, such as linear regression and coefficient of variation. Developing the numeracy skills of history undergraduates to this higher level, however, was not the ambition of this project; its concern was with establishing an attainable benchmark for all, rather than seeking to meet the more advanced needs of those working in specialist areas of historical study.

The overall approach involved obtaining data about and insights into the nature and extent of numeracy provision in undergraduate history programmes, both in the UK and overseas. In so doing, the views of both tutors and students, including former students, were sought. Particular attention was given to perceptions about the value of quantitative techniques in historical study and in the world of work and to competency levels with regard to both understanding and applying them. The aim was to secure a range of perspectives that would not only inform understanding of the key concerns relating to the provision being made, but would also suggest ways in which provision might be enhanced.

In part, gathering information depended on the willingness of tutors and students to respond to questionnaires. Convenience sampling had to be employed and so care should be taken in extrapolating results. However, it was possible to exploit personal contacts for some of the surveys, notably the department and tutor surveys, thereby raising the prospect of achieving high response rates. Moreover, availability sampling was still likely to yield considerable amounts of qualitative information that would inform the project's aims and objectives.

6.3.2. Current student surveys

Surveys were undertaken at UCLan, MMU and SHU to determine the perceptions that single-honours history students had of their own numerical competency. A short questionnaire was prepared, which used a five-point scale for self-rating purposes. The questions focused on numeracy skills that students were expected to have acquired during their school years, such as interpreting charts and calculating averages, and on the experience they had using computer applications with numerical data. The students were also asked about the importance they attached to numeracy skills both in studying history at undergraduate level and in enhancing employability. Given the difficulties of making class time available at levels two and three, and hence of maximising the number of returns, first-year undergraduates (i.e. level one students) only were surveyed. One advantage of this approach was that students' recollections of studying mathematics at school were still fairly fresh in their minds.

6.3.3. Follow-up focus group discussions

In order to examine the issues raised in the questionnaire in more detail, three focus group discussions with level one students were organised at the collaborating institutions, as well as one with level three students during the final stages of their course. The latter group was included to gain insights into whether their attitudes towards numeracy had changed during their studies. Two team members were normally involved in each session, one to chair the discussion and the other to record the key points. The students were encouraged to offer views on various matters, including the circumstances in which numeracy might be usefully included in undergraduate history courses; whether conceptual understanding of numeracy was important to them; the extent to which the inclusion of numeracy in undergraduate provision would influence their choice of modules; their evaluation of its importance to their future employability; and whether, in undertaking practical work involving numeracy, they preferred to operate within a group rather than as individuals.

6.3.4. Numeracy test

A short test was devised to gauge students' ability in applying basic numerical techniques and to assess the self-evaluation that had formed part of the student questionnaire. Similar questions to those in employers' tests were used, but historical data sets were incorporated so that students might appreciate the relevance and value of quantitative analysis to their discipline. As with the current students' surveys, and for the same reasons, the emphasis was on level one students, but the test drew on volunteer participants from a diverse range of UK history courses.

Questions based on four sets of historical data were included and fourteen responses were required. They involved interpreting charts and tables; calculating percentages, ratios and measures of central tendency; and compiling a frequency distribution. In planning the test, the impact on class teaching time and on the staff involved in administering the test, had to be considered. Accordingly, the figures in the data sets were selected for ease of calculation (students did not require calculators) and the test was designed to be completed within 15 minutes.

6.3.5. Graduate survey

An online questionnaire was devised to establish the mathematical qualifications and numerical and ICT skills of graduates in relation to their educational background and employment experiences. The majority of questions were of the optional 'tick-box' variety but with the opportunity, where appropriate, for additional comment. The main purpose of the survey was to obtain graduates' views on the importance that the application of basic numeracy skills assumed in their work and how far, on reflection, they felt that history courses should help to develop particular types of numeracy skills

Three main criteria were used to identify the target sample. Firstly, graduates from universities in the four constituent parts of the United Kingdom were included in order to produce a wide geographical spread and to represent different national (especially Scottish) educational perspectives and practices. Secondly, both old and new universities were sampled, though with a majority of the former to reflect their sector-wide preponderance. Thirdly, it was decided to concentrate on recent graduates, partly because this would probably maximise the response rate but also because it was recent university experience that was of particular relevance.

The graduates were contacted via the alumni offices of their former universities, which forwarded a letter to them on behalf of the project team directing them to the online questionnaire. The graduates of ten universities were contacted in this way. Some graduates were also contacted directly by the project team.

6.3.6. UK departmental survey

A questionnaire was sent to 91 history departments in the UK which offer single-honours history degrees. The purpose was to produce a snapshot of practice in terms of teaching numeracy skills with a view to arranging follow-up visits to those departments that were the most actively engaged. Departmental contacts were identified from *Teachers of History*, a comprehensive list of history lecturers in UK higher education published annually by the Institute of Historical Research.

The questionnaire was deliberately kept short to maximise the response rate. It consisted of just eight questions. The first was designed to establish if a department was teaching numeracy skills. If not, the respondent was advised to move straight to the last question which invited open-ended comment. Those who answered the first question in the affirmative were asked in the next five questions to flesh out the means by which numeracy skills were being taught and assessed, including the use made of ICT applications. They were then asked to judge whether or not they thought this level of provision sufficient before completing the final, open-ended, question. As a principal aim of the questionnaire was to prepare the way for follow-up visits, the respondents were also asked, as an addendum to the analytical core of the survey, if they were willing to meet with members of the project-team.

6.3.7. Follow-up visits to departments

Departments that claimed in the survey-returns to be active in providing numerical learning for their undergraduate students were selected for follow-up visits. These enabled checks to be made on the questionnaire responses and to secure further details regarding their numeracy provision. Visits were made to 14 departments, seven each in pre-1992 and post-1992 institutions. In terms of geographical distribution, 11 were in England, two in Scotland and one in Wales. Two members of the team were normally present at the interviews and each interview lasted for approximately one hour. Fourteen pre-set questions, copies of which had been sent to the interviewees beforehand, provided the framework for conducting the interviews; one member of the team asked the questions while the other made notes and prepared the preliminary draft report of the meeting. The accuracy of the report was checked and confirmed by both parties. This method provided for a consistent set of reports.

6.3.8. Website survey

History departments in UK higher education frequently mention in their publicity material the cognitive skills that their courses seek to develop, both of a subject-specific and generic nature. A survey was undertaken of those websites publicising single-honours BA history courses to determine how frequently numeracy appeared amongst these skills and thereby obtain a measure of the importance they attached to them. Any course documentation made available on these websites, such as programme specifications and student handbooks, was included in the searches. Module descriptors were also searched, although, since there were a large number, attention was focused on those which appeared to have an economic orientation. Opportunity was also taken to determine whether or not numeracy skills were mentioned in relation to ICT applications and to employability. The website survey was introduced to fill the gaps arising from non-responses to the departmental survey and to check and supplement the information supplied by respondents in the survey and follow-up visits.

6.3.9. Tutor attitude survey

A matter of key concern for the project was to ascertain the attitudes of history tutors to the inclusion of numeracy elements in the courses they design and teach, not least in the wake of the incorporation of economic history in UK mainstream history departments. A further questionnaire was therefore devised to investigate this matter. Given the sensitive nature of the survey and to encourage candid responses, anonymity was guaranteed and fully respected. The questionnaire was also kept short in order to encourage tutors to respond. A paper-based version of the questionnaire was distributed during follow-up visits and at conferences and an online version was also used to permit wider dissemination and ease of analysis.

6.3.10. International departmental survey

Since time and resource constraints did not allow a search to be undertaken of every history department in the world, a selection had to be made. The aims were to assemble as diverse a range of international experience as possible for purposes of comparison with the UK data and to identify examples of good practice. Initially, the focus was on universities in the English-speaking world, especially in North America and Australasia. Subsequently, the survey was extended into mainland Europe, including former USSR countries, as well as into parts of Asia and Africa. The *Universities Worldwide* list was used to find email addresses and each member of the project team took responsibility for different countries.

To gather the information and to facilitate comparison, a questionnaire similar to that used in the UK survey was devised. The majority of responses were completed online in electronic form. However, a hard-copy version was used where personal contact could be made, e.g. at international conferences.

7. Implementation

7.1. Overall

The project consisted of two main strands:

i. a comparison of undergraduates', tutors' and employers' perspectives. This represented a multi-disciplinary study involving undergraduates and their academic tutors at a post-1992 university, and a survey of employers.

ii. a national and international audit of the academic discipline of history, involving undergraduates, graduates and tutors.

The two strands were united in the final year of the project when the implications of findings were examined and recommendations drafted.

Throughout the three-year term of the project, the project team held monthly, minuted meetings, which were often attended by the project's external evaluator. The three historians on the project team also held monthly, minuted meetings to review progress. In addition, a project steering group (Advisory Board) was established and met six-monthly to review progress and offer advice and support to the team.

In some cases, original specific research questions and planned methodologies had to be modified. For example, it proved impossible to gauge the range of UCLan students' UCAS entry points as a possible indicator of the students' general academic abilities (*cf*. Tertiary Entry Rank in Crawford *et al*., 1998a), since UCLan's central records were incomplete. In an attempt to partially address this deficiency, questionnaires included an item which requested information on pre-university mathematics (or -related) qualifications directly from undergraduate respondents.

Completion of the project involved implementing various methods of enquiry, which reflected the strengths of individual members of the project team. Stage 1 (years 1, 2 and 3) of the project focused on collecting and analysing empirical data, while stage 2 (year 3) focused on formulating recommendations aimed at better supporting undergraduates in the development of their numeracy skills, both within academic disciplines (particularly within history) and more centrally within the university (UCLan).

7.2. Undergraduates', tutors' and employers' perspectives: a multi-disciplinary, comparative study

At the outset the decision was taken to use online questionnaires, in order to facilitate dissemination, the submission of responses from participants, and the analysis of data.

Initially, the focus was on capturing employers' perspectives on numeracy skills, since the team anticipated that there might be difficulties in engaging this particular group of stakeholders. The employer survey was designed to help identify the generic numeracy skills graduate employers consider important and to explore the extent to which numeracy tests are used in graduate recruitment. In March 2008, the online employer survey was piloted with 20 employers selected from *The Times Top 100 Graduate Employers* 2007 (Birchall 2007). Since no problems with the design of the survey (based upon respondents' comments and analysis of returns) emerged in this pilot study, the survey (without revisions) was distributed to the remaining employers listed in *The Times Top 100 Graduate Employers* 2007. However, the initial response rate from this source of employers proved disappointing and action had to be taken to try and increase the number of responses. Meetings were held with colleagues at UCLan (whose responsibilities involved 'careers and employability') and the project's external evaluator, with a view to identifying strategies that might assist in more effectively targeting appropriate samples of graduate employers and increasing response rates. As a result, the survey was disseminated to employers listed in the *GET 2008 Directory of Graduate Employment and Training* (Career Research and Advisory Centre, 2008) and via the '*Prospects.ac.uk*' website. The Association of Graduate Careers Advisory Services (AGCAS), the Association of Graduate Recruiters (AGR), UCLan's Employer Advisory Board, the Lancashire Business School's Placement Unit, and UNITE[2] were also approached to help with dissemination of the employer survey.

Following the launch of the employer survey, the undergraduate survey was designed to explore students' attitudes towards numeracy in general and the extent to which they have the opportunity to practise and further develop their numeracy skills as part of their undergraduate programmes at UCLan. The survey was designed in light of the project's objectives, previous studies reported in the research literature, and some of the items contained in the employer survey. The fact that the project's research assistant was based in the Learning Development Unit (LDU) provided an excellent opportunity to identify and establish networks with colleagues who could help in dissemination of the undergraduate survey (both the pilot and final versions). Three colleagues, one each from biosciences, physiotherapy and nursing, provided access to undergraduates in time-tabled classroom sessions held in a room containing personal computers (PCs) so that students could readily access the online survey. All undergraduates were briefed on the aims and objectives of the project and invited to complete the pilot survey. This approach yielded 140 returns for the pilot survey; responses were analysed to help inform revisions. The revised undergraduate survey was launched in October 2008.

While the undergraduate survey was being piloted, work began on designing the tutor survey which aimed to explore curricular requirements and the availability of opportunities for undergraduate students to practise and further develop their numeracy skills as part of their undergraduate programmes. To facilitate a comparison of undergraduate and tutor perspectives, many items from the undergraduate survey were included in the tutor survey, with adjustments to the wording where appropriate. Following analysis of returns for the pilot tutor survey, the questionnaire was revised before being distributed more widely across the university in October 2008.

Implementing the online UCLan student and tutor surveys highlighted some of the difficulties often associated with engaging both students and tutors in such studies on a voluntary basis, particularly (i) during particular times of the academic year when both groups are extremely busy, and (ii) when students are inundated with various other surveys (from local and national sources). This necessitated adopting diverse strategies to target and attract students and tutors; these included the use of plasma-screen and screen-saver messages, messages to tutors via A U Lookout (a weekly email messaging system directed at all staff), messages to students via A U Lookout Student Edition, the involvement and help of the Student Union, Faculty Student Liaison Officers, UCLan's M & M Mentoring scheme, the 'i' (UCLan's central information service for students), Faculty Teaching and Learning Co-ordinators, the Careers Service, Media Advancement and Communications, and the University Central Record System 'Banner'. Significant restructuring within UCLan's academic units and variations in the engagement of students and tutors from different disciplines necessitated the original list of comparator disciplines being extended to ensure sufficient representation of students' and tutors' views.

In an attempt to motivate undergraduates to participate in the focus group sessions and to compensate them for their time, all participants in these sessions received a £20 book token. Particular problems were encountered in recruiting undergraduates from nursing due to their absence from the university whilst on placements. Since nursing represented the greatest proportion of students responding to the survey it was important to engage a sample of nursing students in the focus group sessions. Repeat messages were sent to students in Health and Social Care via the Student Liaison Officer and the Student Union Education Officer, with nursing tutors lending active support to the project; this enabled one focus group session to be conducted in which three nursing and two social policy undergraduates participated.

Achieving the project's objectives required the adoption of a flexible approach with regard to the collection of data and liaising with colleagues within a variety of units, both within and external to the university. For example, in an attempt to enhance tutor engagement with the project, a paper-based version of the online survey was made available. In addition, colleagues based in UCLan's Learning Development Unit, who were in frequent contact with tutors, were asked to distribute the survey whenever they encountered colleagues at meetings and workshops. Similarly, UCLan's Pedagogic Research Forum's meetings and workshops were used to advertise and distribute the tutor survey. However, the number of tutor returns remained low until all tutors were targeted individually via email; a time-consuming task which involved searching the websites of all faculties in order to create a database of tutors' email addresses.

Similarly, in an attempt to increase the number of undergraduate returns, particularly from those students who proved difficult to engage via the online survey, a paper-based version of the student survey was made available and disseminated through CETH (UCLan's Centre for Employability Through the Humanities), Fresh Start (UCLan's scheme to encourage individuals to return to HE), the 'i' and colleagues willing to administer the survey in their classroom sessions. The distribution of a small handbook, '*Numeracy Aid*' (Wills, 2007) to participants was also used to encourage students to engage in the project.

All three surveys (employer, student and tutor) were analysed periodically for the purpose of the internal and external dissemination of findings. Preliminary analyses were also used to identify issues which could be subsequently explored in greater depth through the focus group sessions with undergraduates and the interviews with tutors.

In those academic disciplines where numeracy has a particularly important role to play in student progression and retention, such as psychology, nursing and business studies, finding volunteer tutors for the interviews proved unproblematic. However, recruiting tutors from disciplines within Arts, Humanities and Social Sciences proved difficult and in the end only one tutor from this faculty was interviewed. In addition, the number of tutors able to attend the workshop held in the Faculty of Management was limited by tutors' teaching commitments and the timing of the event.

Due to staffing problems which resulted in limited time and resources, the trialling of support strategies had to be limited to providing centrally available drop-in sessions of one hour per week. Problems were also encountered in obtaining access to all the features associated with the *mathtutor* support materials available online, due to compatibility problems with UCLan's computer network; this resulted in delays in advertising the drop-in sessions. The problems encountered with *mathtutor* are being addressed by the developers and a revised version should be available by mid-2010. Despite the problems encountered, students were shown the *mathtutor* website, their topic of interest was located, the various support options available to them discussed, and it was explained to them that the tests and diagnostic quizzes could be completed at home in order to obtain the full benefits of the pop-up hints and answers (not accessible via the campus network).

The opportunity to engage an undergraduate intern proved very useful, enabling a student's perspective on support materials and strategies to be obtained. Unfortunately, since the intern's project ran over the summer months (June to August 2009), few undergraduates were available for face-to-face discussions with the student intern. Nevertheless, valuable data was collected.

7.3. National and international audit of history: undergraduate, graduate and tutor perspective

At the outset of the project, it was agreed that the history team would hold monthly meetings to plan activities and review progress and that minutes of the meetings would be kept and circulated to other members of the project team. In this way, matters arising could be discussed within a wider framework and linkages made between the different project strands. To assist with the management of the project, each team member assumed responsibility for particular elements of the survey work.

Devising the questionnaires aimed at current students and at UK history departments occupied the early stages of the project. Both had been trialed in an earlier, small-scale survey in which two of the history team had been involved. In the light of this experience and with guidance from other members of the project team, some minor amendments to the questionnaires were made. The 'current student' survey was undertaken in the partner institutions, the aim being to obtain information from undergraduates at an early stage in their university careers. The history department questionnaire was initially sent to one contact in each department, usually the head, and produced returns from around one-third of them. In order to obtain a more comprehensive picture, the questionnaire was re-sent, this time to personal contacts or to an alternative member of staff listed in *Teachers of History*. The Royal Historical Society also kindly agreed to circulate the questionnaire to all its members. As a result, some departments returned more than one questionnaire. For the most part, these were mutually consistent. However, there were a few contradictory responses and these were resolved by follow-up telephone calls, emails, or at subsequent visits.

The results of both surveys raised issues that could be addressed at follow-up discussions. In the case of the student survey, these mainly concerned the attitudes students had to the use of quantitative techniques in the courses they were taking and this was explored in the focus group meetings. With regard to the departmental follow-up visits, no particular problems were encountered and on several occasions more than one member of staff was available to meet the project team members. An added bonus of the visits was that examples of numerical work students were undertaking was demonstrated and copies of course materials were supplied.

Following trials in the lead institution, the numeracy test was undertaken with first-year students in the two partner institutions. The follow-up visits were used to persuade other history departments to administer the test. In the event, however, not all the departments who expressed an interest in participating were able to make the necessary arrangements, so that more testing took place in post-1992 than in pre-1992 institutions. In one case, the test was sent to students to complete out of class time; the potential for collusion meant that these results could not be used.

Data protection meant that much of the survey of former history students had to be conducted indirectly through university alumni offices. They acknowledged that available contact details were sometimes out of date, especially for students who had graduated more than two or three years earlier. Accordingly, the number of universities who were asked to participate in the survey was increased to ensure a viable sample.

The website survey produced valuable information but the amount obtained varied appreciably from one institution to another and a good deal of searching was required to ensure that all available detail was gathered. It proved to be a time-consuming activity in relation to the amount of information realised. That a comparatively small number of institutions were involved made the task manageable.

The last survey to be launched was that to the overseas universities. Computer translation facilities helped with language problems, but difficulties were nonetheless encountered. Not all overseas universities offered undergraduate courses in history; in others, online facilities were not well developed; links to websites, or sections of them, were broken; and contact details at departmental level were lacking. There was also a reliance on potential respondents' adequate command of English.

7.4. Project publicity and dissemination of project findings

Throughout, the project team capitalised on any opportunities to publicise the project's aims and objectives, and preliminary results, both within the lead and partner institutions, and more widely across the higher education sector, in the UK and internationally. Project findings were disseminated as they emerged, through conference papers and poster presentations, workshops, and journal and newsletter articles (see Appendix 2).

A project website (http://www.uclan.ac.uk/ldu/resources/NTFS/every_student_counts.htm), established at the start of the project, was regularly updated to keep stakeholders informed of developments.

8. Outputs and findings

8.1. Employers', undergraduates' and tutors' perspectives: a multi-disciplinary, comparative study within UCLan

8.1.1. Employers' perspectives

Profile of responding graduate employers

The 165 companies and organisations that completed the online survey varied with respect to the size of their graduate workforce (Fig. 1), their regional presence (Fig. 2) and the employment sector to which they belonged (Fig. 3). The classification of responding companies/organisations in terms of employment sector was based on the system used by Birchall (2007), but was expanded in light of the Higher Education Statistics Agency's (HESA) Standard Occupational Classification for the Destinations of Leavers from Higher Education Institutions (SOC[DLHE]) (Davies *et al.*, 2003). Employment sectors possessing the greatest representation in the sample included consulting firms (12%), engineering or industrial companies (12%), banks and financial institutions/services (10%), and local and national government (9%) (Fig. 3).

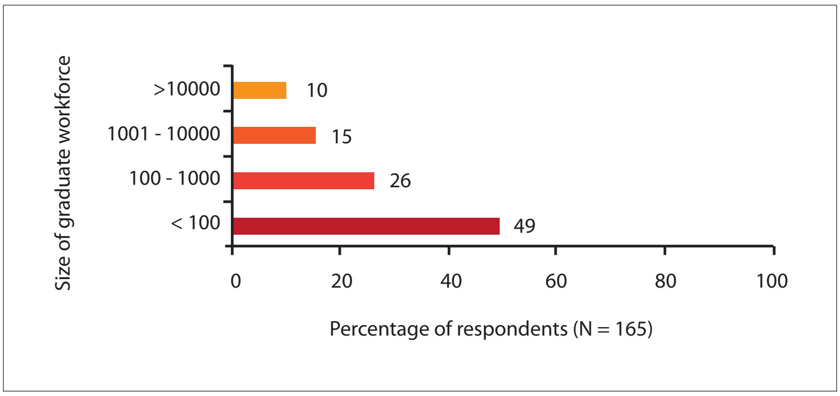


Fig. 1: Percentage frequency distribution with regard to size of graduate workforce

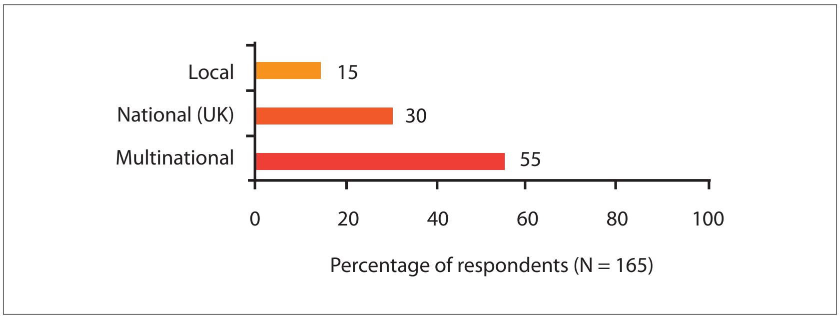


Fig. 2: Percentage frequency distribution with regard to regional presence

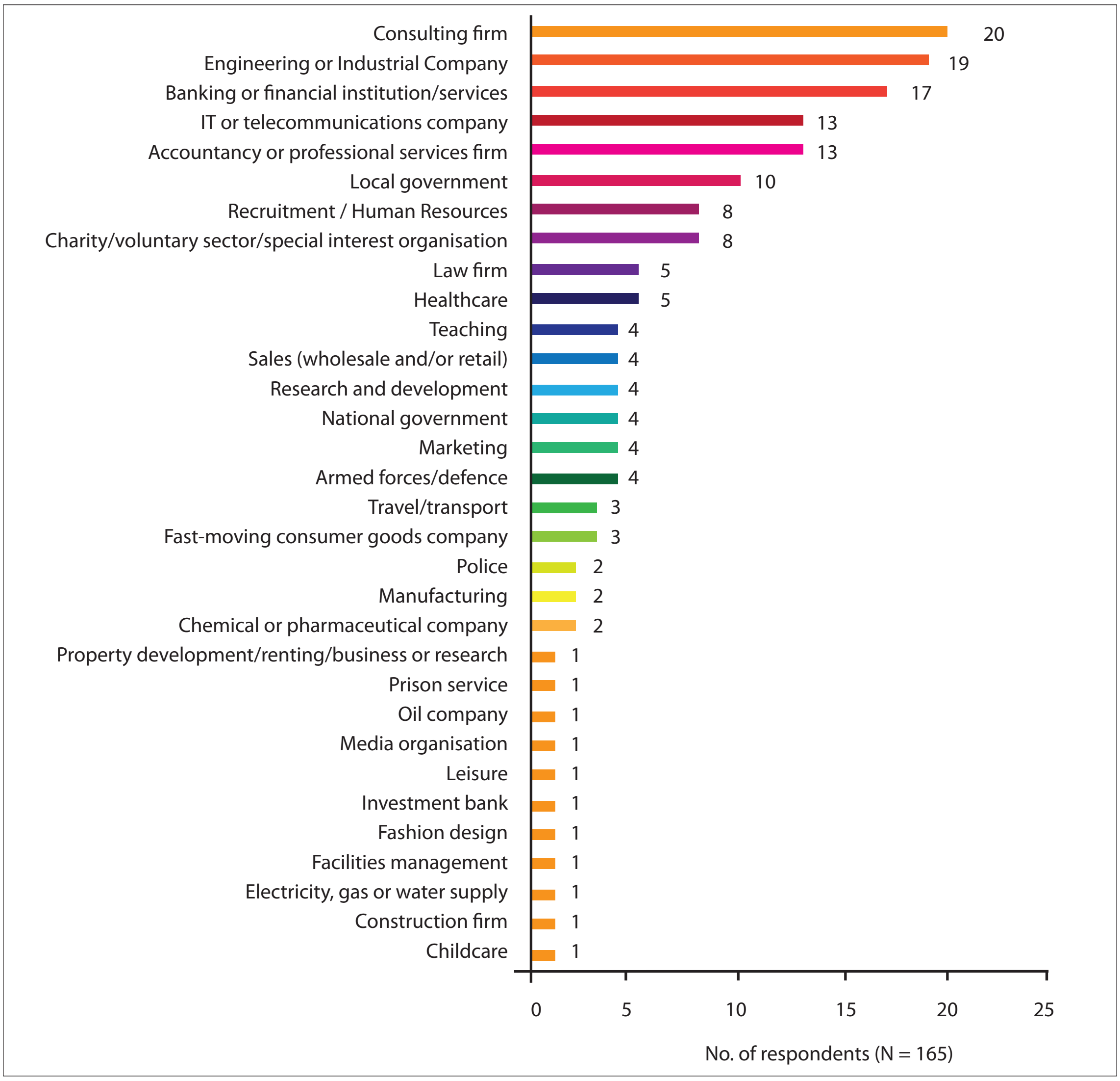


Fig. 3: Frequency distribution with regard to employment sectors

Employers' use of numeracy tests in staff recruitment procedures

Approximately half (51%) of those employers responding to the survey indicated that their company/organisation used some form of numeracy test as part of their staff recruitment procedures. In general, it appeared that the larger the graduate workforce of the company, the more probable that applicants would encounter numeracy tests (Fig. 4). In addition, a greater proportion (58%) of national (UK) companies and organisations in the sample appeared to use numeracy tests, compared with multinational (48%) and locally-based (46%) ones. Although one might initially suspect that locally-based companies employing relatively few graduates may find the development and/or use of numeracy tests less cost effective, the results of the survey do not support this view; for example, of the 11 locally-based companies in the sample that used numeracy tests, five employed fewer than 100 graduates.

Table 1 summarises frequencies in the use of numeracy tests within the range of employment sectors represented in the sample. Examples of employment sectors in which ≥ 70% of respondents indicated that they use numeracy tests included national government, sales, accountancy or professional services, R & D, and bank or financial institution/services (Table 1). In contrast, examples of sectors in which ≥ 65% of respondents indicated that they *do not* use numeracy tests included, IT or telecoms, charity/voluntary sector or special interest organisations, marketing, teaching, and law firms. Such statistics may reflect either the extent to which employees' numeracy skills are important within a particular sector, or the fact that some sectors (e.g. IT or telecoms) require higher levels of formal mathematics qualifications and therefore rely less on additional numeracy tests. The latter is validated by findings in relation to employers' minimum formal mathematics qualification requirements discussed later.

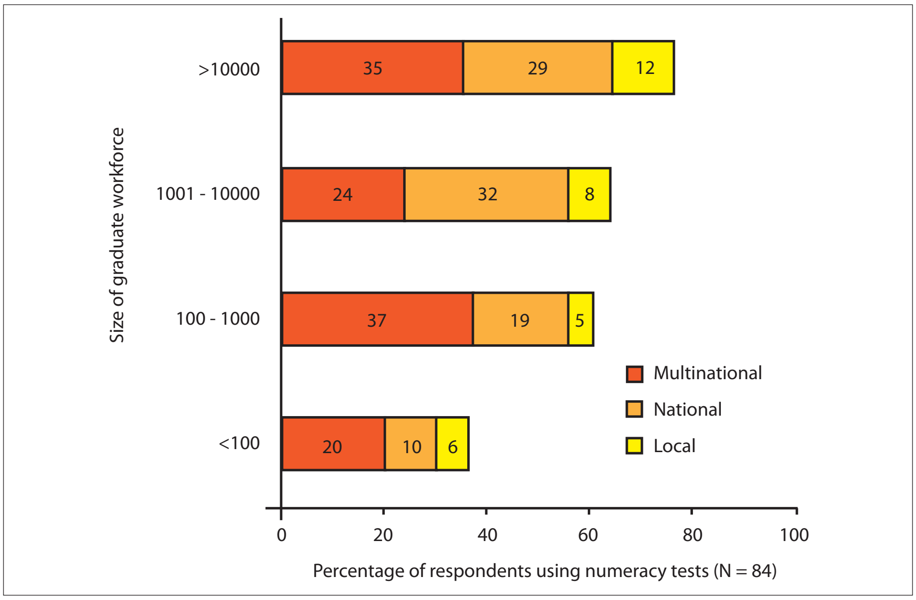


Fig. 4: Use of numeracy tests in relation to size of graduate workforce and regional presence

Table 1: Use of numeracy tests within employment sectors

Employment sector	Percentage of respondents using numeracy tests (N)
National government	100 (4)
Sales (wholesale and/or retail)	100 (4)
Police	100 (2)
Facilities management	100 (1)
Leisure	100 (1)
Oil company	100 (1)
Accountancy or professional services firm	77 (13)
Armed forces/defence	75 (4)
Research and development (R & D)	75 (4)
Bank or financial institution/services	71 (17)
Travel/transport	67 (3)
Local government	60 (10)
Engineering or industrial companies	58 (19)
Chemical or pharmaceutical company	50 (2)
Manufacturing	50 (2)
Consulting firm	40 (20)
Healthcare	40 (5)
Recruitment and HR	37 (8)
Fast-moving consumer goods company	33 (3)
IT or telecoms company	31 (13)
Charity/voluntary sector or special interest organisation	25 (8)
Marketing	25 (4)
Teaching	25 (4)
Law firm	0 (5)
Property development, renting, business or research	0 (1)
Prison Service	0 (1)
Media company	0 (1)
Investment Bank	0 (1)
Fashion Design	0 (1)
Electricity, gas or water supply	0 (1)
Construction firm	0 (1)
Childcare	0 (1)

Employers' responses also revealed that whilst numeracy tests play a role in recruitment to all the Standard Occupational Classification (SOC) categories used by HESA (HESA, 2000), they are used predominantly in recruitment to the types of occupations often associated with graduates' aspirations, e.g. professional, managerial, associate professional and technical, and administrative posts (Fig. 5).

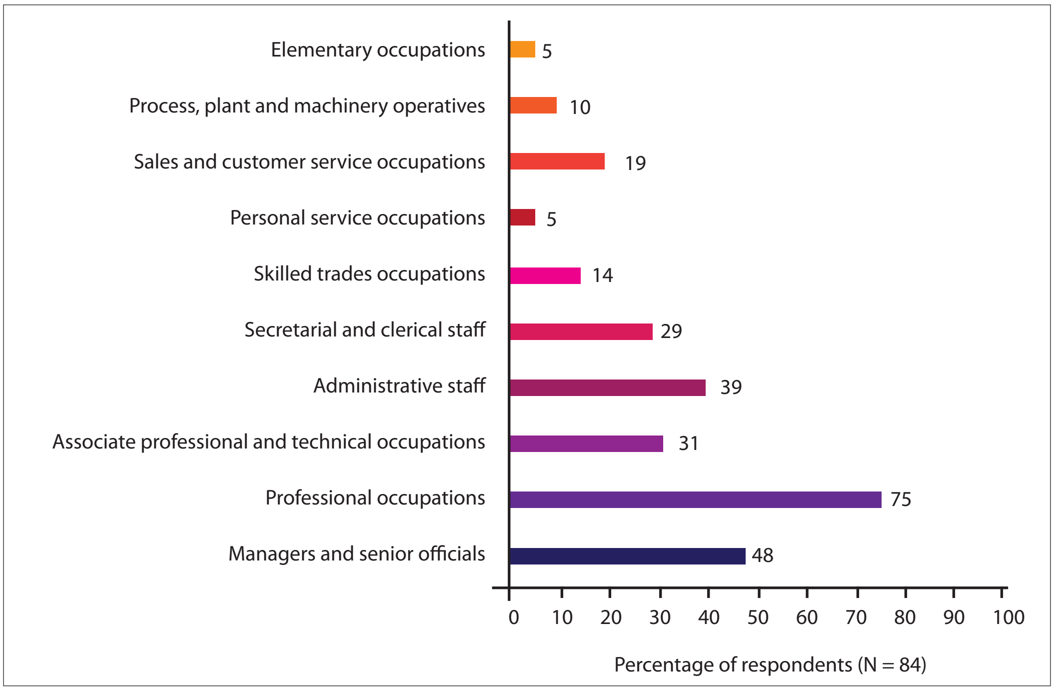


Fig. 5: Types of occupation in which numeracy tests form a component of recruitment processes

Almost two thirds (64%) of responding organisations indicated that they use commercially available numeracy tests (e.g. from SHL, PSYTECH International, ASE & Graduate and Managerial Assessment, OPP, Kenexa-PSL3), while 36% use bespoke tests. The most popular commercial supplier of numeracy tests was Saville-Holdsworth Ltd (SHL), adopted by 73% of the 40 respondents who provided an indication of the commercial source of their tests. A larger proportion of locally-based employers appeared to favour the use of bespoke numeracy tests compared with multinational and national companies, although within all three categories a higher proportion used commercial rather than bespoke numeracy tests (Fig. 6). Companies employing a relatively large graduate workforce also favoured the use of commercially available tests, while those employing fewer than 100 graduates exhibited a marginal preference for bespoke tests (Fig. 7). One possible reason for the latter statistic is that for smaller companies/organisations bespoke tests may prove more economical and cost-effective than commercially available tests, particularly if the former are developed 'in house' by the company itself.

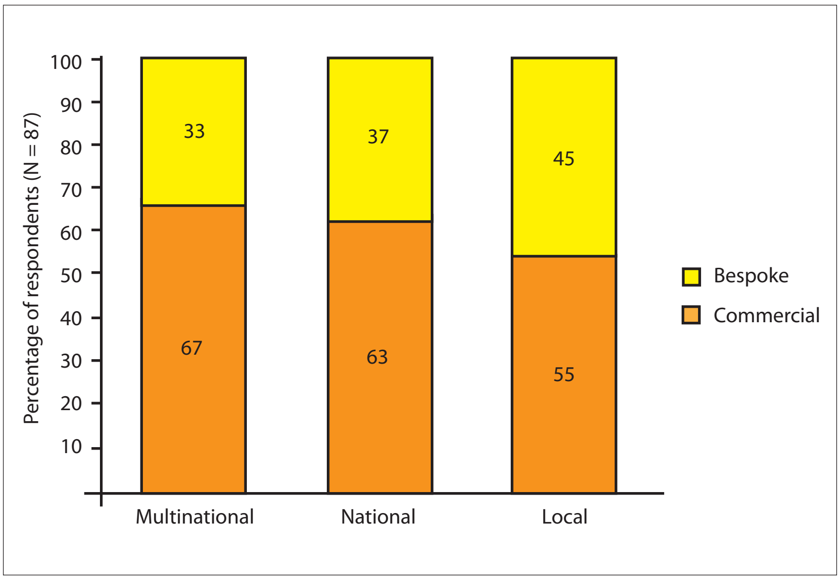


Fig. 6: Use of commercially available vs. bespoke tests on the basis of regional presence

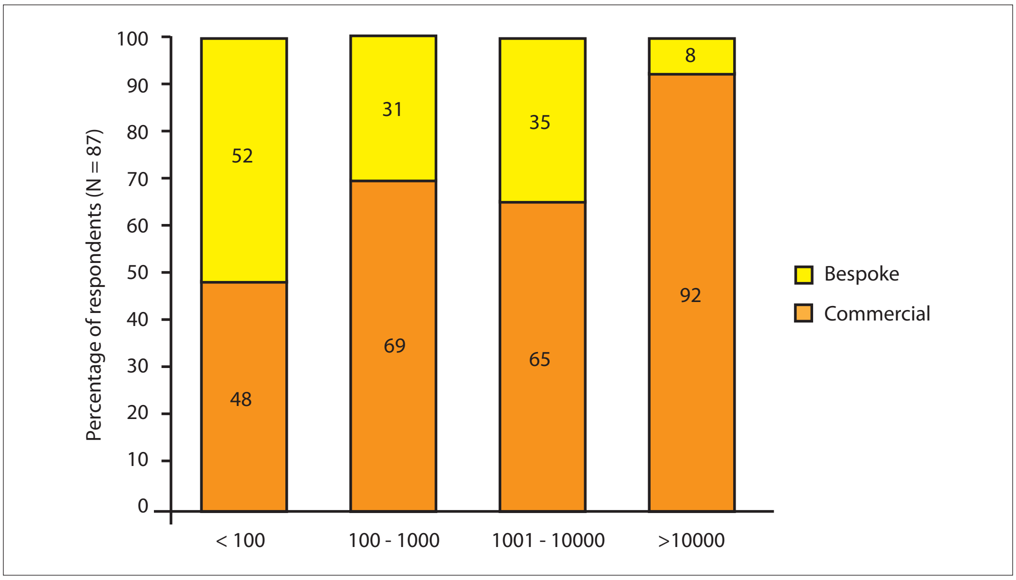


Fig.7: Use of commercially available vs. bespoke tests on the basis of size of graduate workforce

The potential for poor numeracy skills to limit the attainment of graduate employment is reinforced by the fact that 70% of employers reported that it was 'essential' for applicants to 'pass' their numeracy tests, while the remaining 30% indicated that it was 'desirable' (N = 81).

> *Many graduates are rejected without interview because of poor maths skills.* (Banking or financial services)

Examples of sectors in which ≥ 60% of respondents indicated that it was 'essential' for applicants to pass their numeracy tests included bank or financial institutions/services, accountancy or professional services firms, and engineering or industrial companies (Table 2).

Table 2: Respondents' indication of whether it was 'essential' or 'desirable' for applicants to pass their numeracy tests

Employment sector	Percentage of respondents (N*)	
	Essential	Desirable
IT or telecoms company	100 (3)	0
Recruitment and HR	100 (3)	0
Research and development	100 (3)	0
Healthcare	100 (2)	0
Police	100 (2)	0
Travel/transport	100 (2)	0
Chemical or pharmaceutical company	100 (1)	0
Leisure	100 (1)	0
Manufacturing	100 (1)	0
Oil company	100 (1)	0
Teaching	100 (1)	0
Bank or financial institution/services	90 (10)	10
Accountancy or professional services firm	80 (10)	20
National government	75 (4)	25
Armed forces/defence	67 (3)	33
Engineering or industrial companies	64 (11)	36
Consulting firm	57 (7)	43
Local government	33 (6)	67
Charity/voluntary sector or special interest organisation	33 (3)	67
Sales (wholesale and/or retail)	25 (4)	75
Facilities management	0 (1)	100
Fast-moving consumer goods company	0 (1)	100
Marketing	0 (1)	100

* N = number of respondents within a sector indicating that they use numeracy tests

The minimum score candidates were expected to achieve in order to 'pass' a numeracy test varied across employment sectors and was dependent upon the graduate scheme and type of vacancy to which candidates applied, e.g. a minimum mark of 40% could be required for 'mainstream' candidates, but over 70% for applicants on 'fast track' schemes. Almost a third (32%) of all respondents required their applicants to achieve a mark of $\geq 60\%$ (Fig. 8); employment sectors represented within this group included those listed in Table 3.

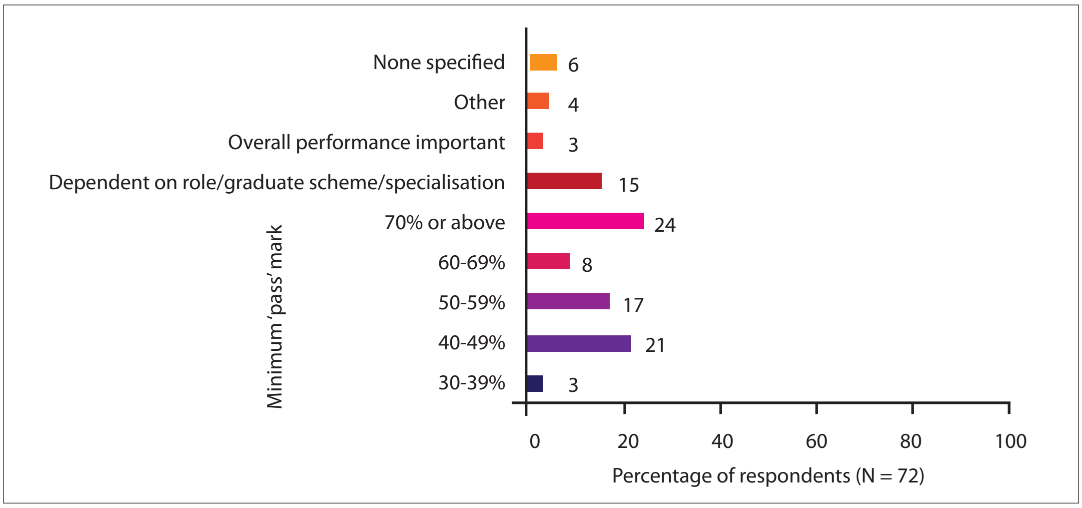


Fig. 8: Percentage frequency distribution with regard to the minimum 'pass' mark required in numeracy tests

Table 3: Employment sectors requiring applicants to achieve a mark of $\geq$ 60% in numeracy tests

Employment sector	N
Accountancy or professional services	1
Bank or financial institutions	4
Consulting firms	1
Engineering or industrial companies	1
Facilities management	1
IT or telecom companies	4
Local government	1
Oil companies	1
Recruitment and HR	2
Research and development	3
Sales	1
Travel/transport	2
Total	22

Employers' minimum requirements in terms of a mathematics (or -related) qualification

Forty-eight percent of respondents stipulated that their graduate applicants should hold a minimum of a GSCE in mathematics or a mathematics-related subject, such as statistics, physics, economics or accounting (Fig. 9); these respondents included $\geq$ 60% of healthcare organisations, law firms, recruitment and HR organisations, and accountancy or professional services firms. Although no specific GCSE grades were stipulated, grades A to C are generally considered to represent a 'pass' at GSCE level. Only 17% of respondents demanded a higher secondary level mathematics (or -related) qualification (e.g. at AS or A2 level) (Fig. 9); these included consulting firms, engineering or industrial companies and banks or financial institutions. The requirement for a first degree in mathematics or in a mathematics-related subject was limited to only 16% of respondents, and appeared to be most prevalent amongst IT or telecoms companies (69%), followed by engineering or industrial companies (32%) and banks or financial institutions (18%). Multinational organisations seldom set a minimum standard, perhaps because of the global diversity of applicants' qualifications. However, some companies clearly believed that the attainment of a first degree in any discipline represented sufficient proof of numerical proficiency:

> [Formal mathematics (or -related) qualification] *Not always applicable for graduate recruitment - often attainment of the degree is proof enough of qualification.* (National Government)

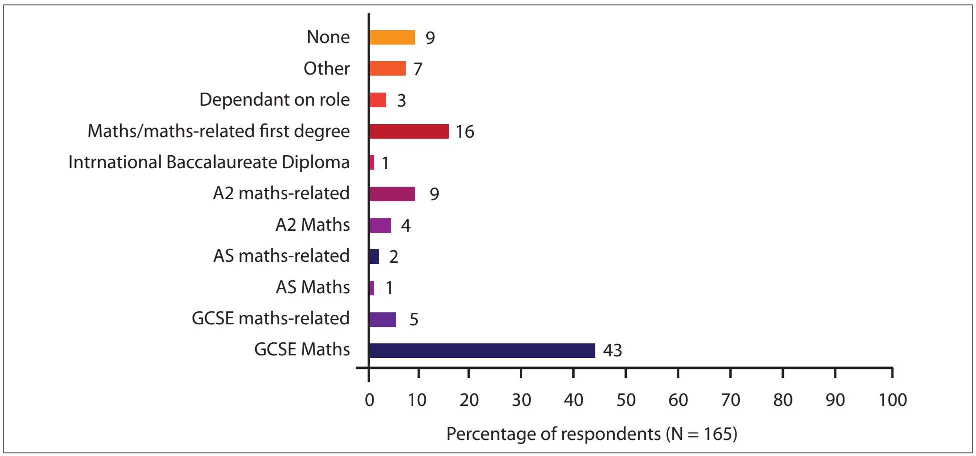


Fig. 9: Percentage frequency distribution with regard to the minimum mathematics (or -related) qualification required of graduate recruits

Importance of the subject and classification of an applicant's first degree

Table 4: Percentage frequency distribution with regard to the importance of an applicant's first degree subject and/or degree classification

Employment sector	Percentage of respondents		N
	Subject	Classification	
Consulting firM	80	80	20
Engineering or industrial companies	89	90	19
Bank or financial institution/services	47	100	17
IT or telecoms company	69	77	13
Accountancy or professional services firm	8	100	13
Local government	50	40	10
Recruitment and HR	25	50	8
Charity/voluntary sector or special interest organisation	50	63	8
Law firm	0	100	5
Healthcare	40	40	5
Teaching	25	25	4
Sales (wholesale and/or retail)	0	100	4
Research and development	75	100	4
National government	75	100	4
Marketing	50	75	4
Armed forces/defence	50	50	4
Travel/transport	67	0	3
Fast-moving consumer goods company	33	67	3
Police	0	0	2
Manufacturing	50	100	2
Chemical or pharmaceutical company	100	100	2
Property development, renting, business or research	100	0	1
Prison service	0	0	1
Oil company	100	100	1
Media company	0	0	1
Leisure	100	0	1
Investment Bank	100	100	1
Fashion design	100	100	1
Facilities management	0	0	1
Electricity, gas or water supply	100	100	1
Construction firm	100	0	1
Childcare	0	100	1

In addition to an applicant's secondary level academic qualifications, as part of their selection procedures many graduate employers also consider the subject and/or classification of the applicant's first degree (Table 4). In the present study, 74% of respondents considered the classification of an applicant's first degree to be important, compared with 53% of respondents who regarded the subject of the degree to be important. These results are in contrast to those presented in a recent CBI survey in which employers ranked their graduate applicants' degree subject higher in importance (41%) than their degree classification (28%) (CBI, 2009b). However, the CBI also found that employers specify a particular degree subject for only 30% of graduate level jobs (CBI, 2008), and that the highest demand from employers was for STEM (Science, Technology, Engineering or Mathematics) degrees, followed by business-related degrees (CBI, 2009b). In the current study, among the 53% of respondents who considered the subject of an applicant's first degree to be important, 70% required their applicants to possess a STEM or business degree. Examples of employment sectors in which ≥ 60% of respondents considered the subject of an applicant's first degree to be important included engineering or industrial companies, IT or telecoms companies, and consulting firms. Twenty-two percent of respondents indicated that whether or not the degree subject was important would depend upon the applicant's future role or specialisation within the organisation. Interestingly, Purcell and Elias (2004) found that a majority of graduates (56% male and 56% female) believed that their degree subject had a more important role to play in them obtaining their current job than the classification of their degree.

Table 5 provides examples of different employment sectors' requirements in terms of the classification of their applicants' first degree. Of the employers in the current study, 65% required at least a 2.1 degree, 24% a minimum of a 2.2 degree, 6% indicated that the minimum requirement varied and was dependent upon the applicant's role and/or the university from which they graduated, and 5% provided no indication. These findings reflect the selection criteria of AGR employers, which reveal that 57% of employers require a 2.1 degree or higher, 33% require at least a 2.2 degree, and only 29% require a specific degree subject (AGR, 2008). Findings with respect to banks or financial institutions/services and accountancy or professional services revealed that these employment sectors are three times more likely to require a minimum of a 2.1 degree compared with the human resources (HR) sector; findings which support Bennett's (2002) conclusion that job advertisements for finance positions are more likely to ask for a minimum of a 2.1 degree compared with advertisements for human resource management positions. Similarly, the CBI reported that employers from finance, banking, professional services, science, high-tech and IT sectors are more likely to demand a minimum of a 2.1 degree (CBI, 2009b).

Table 5: Examples of employment sectors stipulating a minimum requirement in terms of the classification of an applicant's first degree

	Employment sector	Percentage of respondents (N*)	
2.1 honours degree:	Law firm	100	(5)
	Accountancy or professional services firm	85	(13)
	Bank or financial institution/services	82	(17)
	IT or telecoms company	80	(10)
	Research and development	75	(4)
	Local government	66	(4)
	Charity/voluntary sector or special interest organisation	60	(5)
	Consulting firm	56	(16)
	Engineering or industrial companies	50	(17)
2.2 honours degree:	Recruitment and HR	75	(4)
	Engineering or industrial companies	50	(17)

*N = number of respondents within the sector who indicated that they considered the classification of an applicant's first degree to be important

Expectation of numerical competency amongst graduate recruits

When employers were asked to indicate those numeracy skills in which they would expect their graduate recruits to be competent, the only skills for which the percentage of respondents fell below 50% were: using statistical software, representative sampling, using database software and, understanding the language of maths (Fig. 10). For eight out of the fourteen skills listed, the percentage of respondents indicating an expectation of competency was above 70%.

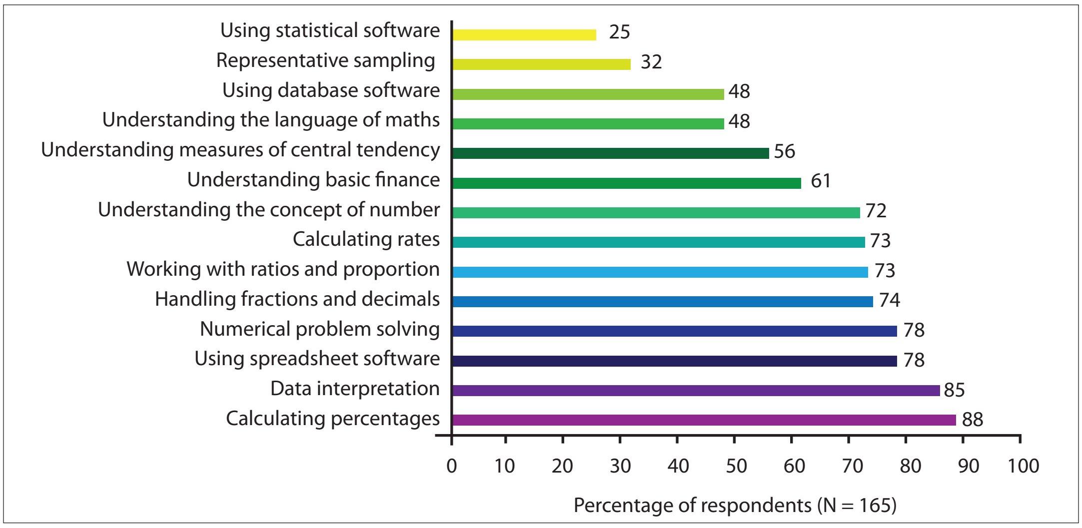


Fig. 10: Generic numeracy skills in which employers expect graduate competency

Table 6: Percentage frequency distribution with regard to respondents' dissatisfaction or satisfactionwith only technical numerical competence

Employment sector	Percentage of respondents		N
	Dissatisfaction	Satisfaction	
Consulting firm	65	20	
Engineering or industrial companies	68		19
Bank or financial institution/services	76		17
IT or telecoms company	77		13
Accountancy or professional services firm	69		13
Local government		60	10
Recruitment and HR		63	8
Charity/voluntary sector or special interest organisation	50	50	8
Law firm		100	5
Healthcare		60	5
Teaching	50	50	4
Sales (wholesale and/or retail)	75		4
Research and development	50	50	4
National government		75	4
Marketing		100	4
Armed forces/defence	75		4
Travel/transport		100	3
Fast-moving consumer goods company	67		3
Police		100	2
Manufacturing	100		2
Chemical or pharmaceutical company	50	50	2
Property development, renting, business or research	100		1
Prison service		100	1
Oil company	100		1
Media company		100	1
Leisure	100		1
Investment Bank	100		1
Fashion design		100	1
Facilities management		100	1
Electricity, gas or water supply		100	1
Construction firm		100	1
Childcare	100		1

Interestingly, although 44% of respondents reported that they would be satisfied if their recruits were technically competent in carrying out mathematical computations (e.g. using calculators or computers to do so) without actually understanding the mathematical concepts underpinning them, 56% stated that they would not be satisfied with this level of skill competency. Table 6 provides a summary of employment sectors indicating dissatisfaction or satisfaction with only technical competence.

Opportunities for training in numeracy skills for graduate recruits

Only 41% of respondents indicated that their company/organisation provides opportunities for training in numeracy skills for their graduate recruits. Examples of the types of support or training opportunities offered are summarised in Table 7.

Table 7: Types of numeracy support or training opportunities offered by employers

Type of Training	Percentage of respondents (N = 67)
On the job training	54
Courses/classes	19
Accountancy/financial skills training	16
Workshops	16
Further study	7
On-line training/support	7
Books/CD-ROMs	4
Statistics course	3
Excel training	3
Need-based training	3
Remedial mathematics/GCSE Mathematics	3
Pre-course employment training	3
One-to-one tuition	1

In summary:

The majority of responding employers

- use numeracy tests in their graduate recruitment processes, particularly when recruiting to those types of occupations often associated with graduates' aspirations;
- use commercially available numeracy tests;
- consider the classification and/or subject of an applicant's first degree to be important;
- expect their recruits to be competent in a range of basic mathematical/numeracy skills;
- would not be satisfied with only technical numerical competence.

8.1.2. Undergraduates' and tutors' perspectives

Profile of undergraduate respondents

Table 8 summarises the demographic characteristics of the 566 participating undergraduates at UCLan.

Academic discipline (i.e. faculty): Of the 566 respondents, 34% were from Health and Social Care, 28% from Science and Technology, 23% from Arts, Humanities and Social Sciences, 13% from Management, and 2% represented cross-faculty programmes (e.g. students enrolled on joint or combined honours degree programmes where selected modules were provided by more than one faculty). Due to the very small number of students enrolled on cross-faculty programmes, this group of students was excluded from the analyses that follow in subsequent sections of this chapter.

Age: Over a third of respondents represented mature, non-traditional undergraduates (i.e. $\geq$ 30 years old).

Gender: Although females constituted a higher proportion of respondents (76%) compared with males (24%), females comprise a greater proportion of the university's undergraduate population. For example, females comprised 61% of entrants in 2007-08, compared with 39% males.

Table 8: Percentage frequency distributions of demographic characteristics for participating undergraduates

		Percentage of undergraduates (N = 566)
Faculty:	Health and Social Care	34
	Science and Technology	28
	Arts, Humanities and Social Sciences	23
	Management	13
	Cross-faculty programmes	2
Age (years):	18-19	17
	20-29	48
	30-39	16
	40-49	14
	50 and over	5
Gender:	Female	76
	Male	24
Level of highest mathematics (or -related) or numeracy qualification:		
	No formal qualification	15
	CSE	5
	Adult Numeracy or Key Skills (Application of Number)	8
	GCSE (or equivalent, e.g. 'O' level)	55
	AS	4
	A2 (A level or equivalent)	13
Disability:		12
	Dyslexia	5.7
	Mental health difficulties	1.2
	Unseen disability/medical condition	1.2
	Multiple disabilities	1.1
	Physical impairment	0.9
	Wheelchair user/mobility impairment	0.7
	Deaf/hard of hearing	0.5
	Autistic spectrum disorder	0.5
	Dyscalculia	0.2
	Dyspraxia	0.2
Country of pre-university education:		
	UK	91
	Republic of Ireland	0
	Other EU	3
	Non-EU	5
Registration:	Full-time	92
	Part-time	8
Learning mode:	Face-to-face	94
	Distance	6
Qualification for which enrolled:		
	Honours degree (incl. combined or joint)	71
	Foundation degree	11
	Diploma	17
	Certificate	1
Year of study:	Foundation	6
	Year 1	26
	Year 2	35
	Year 3	33

Highest mathematics (or -related) qualification: In terms of the students' highest pre-university mathematics (or -related) qualifications, 15% of respondents possessed no formal 'mathematics' or 'numeracy' qualification, 5% possessed a CSE, 8% held an Adult Numeracy or Key Skills qualification, 55% held a GCSE or equivalent and 17% possessed a higher mathematics (or -related) qualification (4% at AS level and 13% at A2 level or equivalent). Although the value of 15%, representing respondents who claimed to possess no formal mathematics (or -related) or 'numeracy' qualification, appears rather high for those entering university, it may reflect the university's 'widening participation' agenda, particularly since 91% of all respondents were educated in the UK prior to entering the university. A greater percentage of males (24%) compared with females (15%) possessed a qualification at a level higher than GCSE. Students possessing higher mathematics-based qualifications also tended to be younger. In addition, a greater proportion of Science and Technology students possessed an AS or A2 in a mathematics (or -related) qualification (30%) compared with students from other faculties, e.g. Management (18%), Arts, Humanities and Social Sciences (12%), and Health and Social Care (9%).

Disability: Approximately 1 in 10 (i.e. 12%) respondents claimed to have a disability, and of these 46% claimed to be dyslexic; only four students claimed to be dyscalculic.

Country of pre-university education: An overwhelming majority (91%) of respondents had received their pre-university education in the UK.

Registration and learning mode: Ninety-two percent of respondents were registered as full-time students. The 8% of respondents representing part-time students emanated from all four faculties (43% from Science and Technology; 33% from Health and Social Care; 15% from Arts, Humanities and Social Sciences; 9% from Management). In addition, 94% of respondents were face-to-face learners as opposed to distance learners. Students comprising the 6% of distance learners also emanated from all four faculties (34% from Health and Social Care; 28% from Science and Technology; 22% from Arts, Humanities and Social Sciences; 16% from Management).

Qualification for which enrolled: Almost three-quarters (71%) of respondents were enrolled on honours degree programmes, with a further 28% enrolled on courses leading to a foundation degree or diploma.

Year of study: Two-thirds (68%) of respondents represented second- and third-year undergraduates, in approximately equal proportions, whilst an additional 26% of respondents represented year one undergraduates. Only a very small minority of respondents (6%) were enrolled in a foundation year.

Profile of tutor respondents

Table 9 summarises the demographic characteristics of participating tutors.

Academic discipline (i.e. faculty): Over two-thirds (70%) of respondents represented tutors from Health and Social Care (39%) and Science and Technology (31%). The top four disciplines represented amongst the 122 responding tutors were Nursing (21%), Business and Management (11%), Health Studies (7%) and Biosciences (7%).

Age: Approximately two-thirds of tutors were aged 40-59 years.

Gender: Male tutors constituted only 39% and female 61% of the 122 respondents, despite the fact that males comprise a slightly greater proportion of academic staff (51%) than females (49%) at the university.

Level of highest mathematics (or -related) qualification: Of those claiming to possess no formal mathematics/numeracy qualification, five respondents were based in Health and Social Care, two each in Arts, Humanities and Social Sciences, and Management, and one taught on cross-faculty programmes.

Teaching mode: An overwhelming majority (96%) of respondents were engaged in face-to-face teaching, while only 4% supported distance learning. The latter group emanated from three faculties (Health and Social Care, Management, and Science and Technology).

Table 9: Percentage frequency distributions of demographic characteristics for participating tutors

		Percentage of tutors (N = 122)
Faculty:	Health and Social Care	39
	Science and Technology	31
	Arts, Humanities and Social Sciences	13
	Management	16
	Cross-faculty programmes	1
Age (years):	20-29	6.5
	30-39	18
	40-49	40
	50-59	29
	60 and over	6.5
Gender:	Female	61
	Male	39
Level of highest mathematics (or -related) or numeracy qualification:		
	No formal qualification	8.5
	CSE	8.5
	Adult Numeracy or Key Skills (Application of Number)	1
	GCSE (or equivalent, e.g. 'O' level)	56
	AS	2
	A2 (A level or equivalent)	16
	First degree	3
	Masters degree	2
	Doctorate degree	4
Teaching mode:	Face-to-face	96
	Distance	4

Conceptions of mathematics

Undergraduates

A greater percentage of undergraduates (strongly) agreed with statements that expressed fragmented conceptions (83% - 86%; mean = 84%) compared with statements that expressed cohesive conceptions (58% - 66%; mean = 64%) of mathematics (Table 10). In addition, the mean item score (3.0) and mean total score (9.0) for the three fragmented items were significantly greater than the mean item score (2.8) and mean total score (8.3) for the three cohesive items. These statistics reveal that overall the students' conceptions of mathematics were more fragmented than cohesive, as revealed by the following comment:

> [Mathematics is] *Anything to do with numbers.* (Female, year 2, business studies undergraduate)

Interestingly, undergraduates who claimed they were not provided with any opportunities to practise or further develop their numeracy skills as part of their degree programmes appeared to hold more fragmented conceptions of mathematics, while students offered such opportunities held more cohesive conceptions. Female students also appeared to hold more fragmented conceptions of mathematics, whilst males held more cohesive conceptions. Undergraduates from Science and Technology appeared to hold less fragmented conceptions of mathematics than students from Arts, Humanities and Social Sciences and more cohesive conceptions of mathematics than students from Health and Social Care; no significant difference in conceptions of mathematics was apparent between students from Science and Technology and those from Management.

Table 10: Summary of students' (S) and tutors' (T) responses to items measuring conceptions of mathematics

Sub-scale / Item (statement)	Mean*		% (strongly) disagree **		% (strongly) agree **		N	
	S	T	S	T	S	T	S	T
Fragmented conceptions								
Mathematics is the study of numbers	3.0	2.9	16	24	84	76	567	122
Mathematics is a subject where you manipulate numbers to solve problems	3.0	3.0	14	20	86	80	566	122
Mathematics is a lot of rules and equations	3.0	2.6	17	40	83	60	565	122
Cohesive conceptions								
Mathematics is a theoretical framework describing reality with the aim of helping us understand the world	2.6	2.8	42	32	58	68	564	122
Mathematics is a set of logical systems which have been developed to describe the world and relationships in it	2.8	3.1	33	13	67	87	565	122
Mathematics is like a universal language which allows people to communicate and understand the universe	2.8	2.9	34	28	66	72	565	122

*Median and mode values for all items = 3 **Strongly disagree = 1; disagree = 2; agree = 3; strongly agree = 4

Tutors

In contrast to the responding undergraduates, tutors' conceptions of mathematics appeared to be more cohesive than fragmented. Tutors' mean item score (2.9) and mean total score (8.8) for the three cohesive items were slightly greater than the mean item score (2.8) and mean total score (8.4) for the three fragmented items. In addition, a greater percentage of tutors (strongly) agreed with statements expressing cohesive conceptions (68% - 87%; mean = 76%) compared with statements expressing fragmented conceptions (60% - 80%; mean = 72%) of mathematics, although this difference was statistically insignificant (Table 10). Although male and female tutors did not differ significantly in terms of their conceptions of mathematics, and no significant differences existed between the four faculties, tutors holding higher mathematics (or -related) qualifications appeared to hold more cohesive conceptions of mathematics.

RECOMMENDATION 1: In supporting the development of students' numeracy skills, HEIs (including UCLan) should advocate the adoption of teaching and learning strategies that encourage students to develop more cohesive rather than fragmented conceptions of mathematics. That is, they should help students to view anything mathematical as more than just 'working with a lot of numbers, rules and equations', but as a tool which can help them better understand and work more productively within their academic discipline, future workplace and everyday lives.

Attitudes towards mathematics and numeracy skills

Undergraduate and tutor participants were presented with a number of statements and asked to rate the extent of their agreement or disagreement (from strongly disagree = 1 to strongly agree = 4). Although the student and tutor surveys had several items in common, some items were worded differently to represent students' and tutors' different roles or experiences.

Undergraduates

Overall, students' attitudes towards mathematics and the development of numeracy skills were positive, as is evident from the scale's mean item score of 2.9 (Table 11). With regard to the sub-scales, students' mean item scores were highest for usefulness of mathematics/numeracy (3.2), followed by motivation (3.0), confidence (2.8) and enjoyment (2.7).

Table 11: Summary of students' attitudes towards mathematics and numeracy skills

		Number of items (statements)	Mean item score (SD)	No. of students
Sub-scales:	Confidence	7	2.8 (0.7)	566
	Usefulness	6	3.2 (0.5)	565
	Motivation	3	3.0 (0.6)	565
	Enjoyment	4	2.7 (0.6)	566
Scale:	Overall attitudes	20	2.9 (0.5)	562

Although the majority of respondents were confident (64%) when it came to learning mathematics and developing their numeracy skills, expressed enjoyment of anything mathematical (62%), were motivated to practise and develop their numeracy skills (78%) and recognised the usefulness of mathematics/numeracy in their everyday lives and their future employment (87%), just over a third lacked confidence (36%) or expressed a lack of enjoyment (38%) of anything mathematical, and only 46% of respondents indicated that they would like a job that involved them using their numeracy skills. Undergraduates already offered opportunities for numeracy skills development as part of their programmes of study exhibited more positive attitudes towards mathematics and numeracy skills than those not offered such opportunities, appeared more motivated, expressed more enjoyment of mathematics and recognised more readily the usefulness of such skills, although there was no significant effect on their confidence.

In general, the attitudes of males towards the development of numeracy skills appeared more positive than those of females, an effect that may be due, in part, to the fact that male respondents possessed significantly higher levels of pre-university mathematics (or -related) qualifications than female respondents. Male students also appeared more confident and motivated than female students, and expressed more enjoyment of mathematics/numeracy. However, males and females did not differ significantly in terms of their recognition of the usefulness of mathematics/numeracy. Science and Technology undergraduates' attitudes towards mathematics/numeracy appeared to be more positive than those of students from the other three faculties; they were more confident, expressed greater recognition of the usefulness of mathematics/ numeracy, greater enjoyment of the subject and were more motivated.

Focus group sessions revealed that some students perceive being good at maths or liking the subject as essentially an inherited characteristic:

> *I just think that the ones that don't struggle have a natural ability. I've seen it throughout school and you can see the penny drops right away with some people and I think that happens throughout life with all sorts of skills. Some people just are more natural mathematicians.*
> (Male, year 3, police and criminal investigation undergraduate)

Whilst others agreed with this viewpoint, they recognised the influence that the learning environment could have in enhancing student confidence:

> *I'd have to agree with that because definitely there are people that are better at maths. But I also think the learning environment and your teacher definitely helps your confidence with maths. If you've got someone who is approachable, you're more likely to ask them questions when you're stuck. Or if they explain it to you in ways that you understand, then you're going to be more confident and use it more.* (Female, year 2, psychology undergraduate)

Not surprisingly, students' attitudes towards mathematics/numeracy were influenced by their course experiences at secondary level:

> *When I took A Level, I had a Dr of maths and I always found .... she was almost expecting me to understand things that I didn't understand. ... so she probably lost my passion for Maths.*
> (Male, year 3, forensic science undergraduate)

Similarly, once at university, the tutors' approaches to teaching can influence the students' understanding of the subject and can determine students' levels of interest in and enjoyment of the subject:

> *He [the lecturer] relates it to everyday life as well, so he doesn't just chuck numbers at you and say 'this is the probability of finding this evidence'.* (Female, year 3, forensic science undergraduate)

Undergraduates studying subjects that did not offer gateways to particular careers or who wanted to keep their options open in terms of their graduate employment opportunities appeared more appreciative of the significance and value of opportunities for numeracy skills development during their university education:

A lot of students don't know what they want to do after they leave. So they may have done a specific degree, it doesn't mean that you're going to go into that area. So, they go into a different area and, if they need to do statistics in that job and they've not had any training, they're in trouble aren't they? Because where else can you learn it apart from uni.

(Male, year 2 psychology undergraduate)

Some students' inability to recognise the relevance of mathematics beyond simply having to pass an exam emerged as a possible contributory factor towards the development of negative attitudes:

It's not explained to you early on exactly why putting letters into equations and some of the things that you do at GCSE, why it's relevant. You're just being told it because you have to be taught it, to pass the exam. (Female, year 3, business studies undergraduate A)

It was just one of those subjects that you just had to do. It was a compulsory subject that you needed to get a good grade in, in order to get on to other courses, that was all. I just thought it would be too hard to carry on. (Female, year 2, business studies undergraduate)

Mathematics presented in context, as opposed to pure abstract mathematics, was believed to offer one solution towards arousing students' interest and enjoyment in the subject:

And I think if mathematics became more vocationally structured then people might actually start taking an interest, you know. ... It's like forensic science, because it's now vocationally structured.

(Male, year 3, forensic science undergraduate B)

Discussions revealed that students' attitudes towards mathematics/numeracy were not fixed but changeable. Several factors influenced the direction of any change. Some were related to the student's age or emotional maturity, while others were related to the perceived relevance of the mathematics being taught and the learning and teaching environment. The relevance of the mathematical/numerical elements being taught had a significant influence on whether or not students enjoyed the subject. Many students, who had not enjoyed mathematics at school because of their perception that it held no relevance to real life, started enjoying the subject at university once they recognised its relevance and applicability to their course and future employability:

For me, my numeracy skills are quite relevant because all the accounting we do requires maths. I have to do a lot of maths but here it's more applicable to everyday life. It's applicable to businesses and how they work. So it's a lot more interesting than it was at school.

(Female, year 2, accounting undergraduate)

In business modules, I've found that I can apply the maths better. Stuff that I had thought I'd never use again, like linear equations you can apply it to different life things. I really find it interesting and that's why I'm more interested in it now than I was in school.

(Female, year 2 business studies undergraduate)

In addition, individuals who had enrolled on mathematics courses as mature students revealed that they had enjoyed the subject more than when they had studied it at school:

When I did it at GCSE level, I absolutely hated it ... but then I went on and did a GNVQ and there was a lot of maths involved in that and I actually enjoyed that a lot better. ... I think taking it at a higher level when you are older helps as well because I had about two years break between GCSE and then going on to do this GNVQ course. (Year 3, history with archaeology undergraduate)

Tutors

Overall, tutors' attitudes towards mathematics/numeracy were positive, as evident from the scale's mean item score of 3.0 (Table 12). With regard to the sub-scales, mean item scores were highest for usefulness of mathematics (3.3), followed by enjoyment (3.1), motivation (3.0) and confidence (2.7). Just over a third (37%) of responding tutors appeared to lack confidence when it came to teaching basic mathematical concepts or developing students' numeracy skills and 9% appeared not to recognise the usefulness of mathematics/numeracy. Seventy-six percent of respondents appeared motivated to teach basic mathematics and improve their students' numeracy skills and 83% expressed enjoyment of anything mathematical. Ninety-one percent of respondents recognised the usefulness of mathematics/numeracy; 90% of respondents (strongly) agreed with the statement *'Students will need to be numerically competent if they are going to gain graduate employment'*, and 82% (strongly) agreed with the statement *'It's important that we ensure our students have excellent numeracy skills'*.

Table 12: Summary of tutors' attitudes towards mathematics and numeracy skills

		Number of items (statements)	Mean item score (SD)	No. of tutors
Sub-scales:	Confidence	9	2.7 (0.7)	122
	Usefulness	6	3.3 (0.4)	121
	Motivation	2	3.0 (0.7)	121
	Enjoyment	3	3.1 (0.5)	122
Scale:	Overall attitudes	20	3.0 (0.4)	121

Although there was no significant difference between male and female tutors in terms of their overall (composite) attitude scores, and their sub-scales scores for usefulness, motivation and enjoyment, males expressed greater confidence in their numeracy skills than female tutors. Statistically significant differences were also observed between tutors from the four faculties in terms of their overall attitude scores. Tutors from Science and Technology had significantly higher scores for overall attitude, confidence and enjoyment than tutors based in Health and Social Care. Differences between tutors from the remaining faculties were statistically insignificant, and no significant differences were observed between tutors from the four faculties in terms of the remaining two sub-scales, i.e. usefulness and motivation.

RECOMMENDATION 2: UCLan should capitalise on the positive attitudes towards numeracy skills that many of its students have demonstrated, their recognition of the usefulness of mathematics/numeracy, and their motivation to enhance their numeracy skills, to help students in all subject disciplines recognise the usefulness of mathematics/numeracy, particularly in the context of their future employability. The university should aim to build students' confidence and competency with regard to numerical elements of their curricula and/or with regard to employers' numeracy tests. The recognition that some students possess very negative attitudes towards mathematics and the further development of their numeracy skills should be accompanied by appropriate measures to try and motivate such students.

Undergraduates' mathematics anxiety

Students were presented with a number of statements representing situations that might cause them anxiety, and were asked to rate their potential level of anxiety on a scale of 1 = not at all anxious to 4 = very anxious.

Table 13: Summary of students' mathematics anxiety scores

		Number of items (statements)	Mean item score (SD)	No. of students
Sub-scales:	Course anxiety	3	1.9 (0.8)	565
	Task anxiety	5	2.4 (1.0)	564
	Test anxiety	4	2.3 (0.9)	565
Scale:	Overall anxiety	12	2.2 (0.9)	564

Overall, the students' average item score appeared highest for numerical task anxiety (2.4), followed by test anxiety (2.3), overall anxiety (2.2) and course anxiety (1.9) (Table 13). On the task anxiety sub-scale, 38-49% of respondents were 'very anxious' or 'fairly anxious' when it came to *'being given a set of numerical problems involving fractions and decimals to solve on paper'* (41%), *'...percentages...'* (38%), or *'...ratios and proportions...'* (49%). However, percentage values increased to 54% when it came to numerical problems involving rates or being asked to analyse a set of data requiring statistical analyses, suggesting that students were more anxious when presented with such tasks.

On the test anxiety sub-scale, 36-52% of respondents were 'very anxious' or 'fairly anxious' when *'studying specifically for a maths or statistics test compared to a test in another subject'* (52%), *'picking up a maths or statistics textbook to begin work on an assignment'* (36%), *'realising that I have to study some maths or statistics to fulfil course requirements'* (39%), or *'opening a maths or statistics book and seeing a page full of problems'* (42%). On the course anxiety sub-scale a minority of students appeared 'very anxious' or 'fairly anxious' when it came to *'buying a maths or statistics textbook'* (11%), *'signing up for a maths or statistics course'* (32%) or *'walking into a maths or statistics class'* (35%).

Students not offered any opportunities for numeracy skills development as part of their undergraduate studies expressed higher levels of course, task and test anxiety than students offered such opportunities. In addition, female students also expressed higher levels of course, task and test anxiety than males. Health and Social Care undergraduates were more maths anxious than students from Science and Technology, exhibiting greater course, task and test anxiety, while Arts, Humanities and Social Sciences and Management undergraduates did not differ significantly from Science and Technology undergraduates in terms of their maths anxiety scores.

Focus group discussions revealed that a lot of mathematics anxiety may be triggered by the language and symbols used in mathematics:

> *I think algebra scares a lot of people. You can understand all the adding and subtracting and then it goes to algebra and everyone's like 'Oh why am I doing this?' I never understood at school what the point of Maths is.* (Male, year 3, forensic science undergraduate A)

> *... it is quite scary when all these equations and stuff are up on the screen, you think 'Oh Gosh'…* (Female, year 2, psychology student)

> *On an application form when it says numeracy skills needed, I think that panics a lot of people even though it's just general numeracy skills... But, I think when you see that, it's quite alarming 'ooh have I got those skills?'.* (Male, year 3, policing and criminal investigation undergraduate)

Perhaps not surprisingly, students possessing higher pre-university mathematics (or -related) qualifications expressed more confidence in their ability to cope with anything mathematical:

> *I can't say that in my three years at UCLan that I've experienced any problems at all with maths because of the level - you know it's never been a problem.* (Male, year 3, forensic science undergraduate B, possessing an AS in Mathematics)

In contrast, another student possessing an alternative to GCSE Mathematics expressed a lack of confidence and a need for extra help:

> *I did ask about getting some extra help because in one of my first project workbooks that we had, there were some calculations that we had to work out. That daunted me a bit because, as you said before, we only had one lecture on it and it sort of made sense at the time but because they did it so fast, I couldn't take it all in. Then, I asked if they did any sort of extra tuition, you know...* (Female, year 1, nursing undergraduate A)

In the case of another nursing student, her maths anxiety was linked to her fear of potentially killing a patient due to incorrectly calculating a drug dosage; although one of her peers considered nervousness about drug dosage calculations to be a good thing:

> *I think the lecturers put so much pressure on you, don't they, to get it right, because ...... it could like potentially kill somebody if you get it wrong, so there's a quite big fear that you could kill somebody if it's not right.* (Female, year 2, nursing undergraduate B)

> *I think that every qualified nurse should keep that nervousness around medication because it's when you get complacent around it that will be when errors will start. But I wouldn't say that I was anxious, I am nervous, but I'm not anxious.* (Female, year 2, nursing undergraduate A)

Tutors acknowledged the prevalence of maths anxiety or a fear of numeracy among students, even in those disciplines which did not require students to possess advanced numeracy skills:

> *A couple of years ago she [a student] had a severe anxiety about it, ... she nearly did consider leaving the course because she felt she was very poor on numeracy, and on frequent occasions she had been asked to do calculations and she'd fallen to pieces in the clinical area, very upset, crying, and that's how it was brought to my attention.* (Nursing tutor 2)

> *But to me it's about removing the fear associated with those skills and not just saying it's something that you should be able to do. ... But a large proportion of them are still very fearful ... of the numbers. I mean just to enter the data in SPSS is quite a challenge for them.* (Psychology tutor 2)

> *When I was teaching at [another university], that was in an economic and social history department and they used to include the statistics course which was compulsory. I mean it literally used to reduce students to tears. I have seen people crying.* (History tutor)

Students' fears regarding anything mathematical were also raised in the qualitative data gathered through the survey:

> *Fear is the main cause for students staying clear of maths. It needs a gentle approach that provides plenty of opportunity to practice. I think the main area that needs attention is algebra. Once students manage to grasp this area, they will progress in leaps and bounds.* (Bioscience tutor)

The prevalence of maths anxiety amongst students was clearly taking up a lot of tutors' time and was, in part, responsible for making the delivery of 'numeracy' modules unpopular among some tutors:

> *Supporting students with numeracy does take a lot of time because some students need one to one [help]. I remember one student ... saw me for about an hour a week for about 7 weeks, so that's a lot of time.* (Nursing tutor 2)

> *Even from a staff perspective as well, there is quite a lot of anxiety over the whole module, you do get a lot of worried students coming to see you.* (Psychology tutor 1)

In an attempt to ease their students' maths anxiety, the School of Psychology had offered a maths anxiety seminar:

> *The second year developmental module has a maths end which all of our students do, it's a core module, we've have a maths anxiety seminar so we are not measuring their maths but we are talking about maths anxiety and reasons for it, you know maybe they would talk about the past, but all sorts of issues around why you would be anxious with maths and statistics ... As I say it's developmental, so it's talking about why people are anxious about maths, it's not related to the statistics module as such.* (Psychology tutor 1)

However, a response in the student survey revealed that this strategy might actually heighten tensions:

> *It made people dread the workshops and lectures on statistics more than usual, because we were also having seminars on maths anxiety. I think with some people it just highlighted that maths was something to worry about! (Psychology undergraduate)*

The comment above suggests that any strategy aimed at reducing levels of maths anxiety has to be carefully considered and evaluated due to the sensitivity of this issue.

Tutors discussed those factors they perceived to be linked to their students' fear of numeracy. Although many thought there was a link between students' confidence in their numerical ability and their maths anxiety, it was unclear whether it was a lack of ability that was causing the maths anxiety or whether maths anxiety was contributing towards low self-belief:

> *They [modules incorporating statistics] are not modules that they enjoy particularly; it's not so much their ability as their anxiety of their ability. ... the first thing students always say to me is 'I will do rubbish at this', 'I am no good at this', 'I won't be able to do this'. And what I say is 'that's not a good way to start'. We start by saying 'you can do this'. So as I say, a lot of students are coming in with very negative thinking, and worrying that they can't do it, and I think sometimes that stops them from doing it. So it's confidence - I think it's confidence.* (Psychology tutor 1)

> *I think a lot of it is confidence in that if somebody asks them to work something out without a calculator, they are petrified by the thought.* (Nursing tutor 2)

A lack of opportunity to practise numeracy skills was viewed as being linked to students' lack of confidence:

> *I think the biggest thing is that they tend to do it at school, and then they don't do it again. So things like the long division and multiplication they completely forget, you know, how to do it.* (Nursing tutor 2)

Opportunities to practise numeracy skills, combined with encouragement, were seen as being essential in order to help students overcome their fear and improve their numerical competence:

> *So it is really trying to give them confidence and trying to give them enough [support and practice] so that all levels are able to achieve.* (Psychology tutor 1)

> *But once we get them looking at it and practicing, their skills do come on ....If you don't practise you forget. So that's what we tend to say to them.* (Nursing tutor 2)

Some students' inability to recognise the relevance of mathematics and numeracy skills to their everyday lives or to their discipline (e.g. history) confirmed the findings gathered by the historians in the project team. A business studies tutor also mentioned students' inability to see the relevance of mathematics and numeracy skills, but blamed the modular system, often used in HEIs but also in schools, for students not appreciating the links between mathematics and their lives:

> *Quite often they don't see links, but that's partly because they haven't been taught to see links, and that's a fault of the modular system, which gives learning in bite size chunks and encourages them to learn a little bit and then forget it when they move on to something else. ... the modular system encourages disintegration of learning and the students have difficulty then putting it together. That's why they will say they can't see the relevance because they've not been taught to see the relevance between these disparate bits of learning.* (Business studies tutor)

The same business studies tutor identified algebra as particularly anxiety provoking and noted that students are often unprepared to think in the abstract:

> *As soon as you say algebra or come to anything that involves drawing lines, whether it's straight lines, especially quadratics, (or in some cases we get into cubics), they get into a realm of fear. ... They aren't prepared to think in the abstract .* (Business studies tutor)

A history tutor also blamed econometrics for the development of negative attitudes on the part of students:

> *... you know econometrics has killed economic history stone dead, there are hardly any departments now. I think there're about four that still use economic history in their title, whereas in the 60's it was the most attractive subject going, people queued up to do economic history - now you couldn't drag students into it with horses.* (History tutor)

Students' negative attitudes towards numeracy had made the teaching of quantitative skills extremely difficult for the history tutor who had to withdraw one of the numeracy sessions on his skills modules altogether and had to introduce the only numeracy session towards the very end of the module so that students' negative attitudes did not undermine their interest in the entire module. In spite of using a lot of 'real life' situations, such as, premier league tables, cooking recipes, bank statements, labour data, and demographical data, in order to develop students' basic numeracy skills, the tutor still felt that students failed to grasp the connection between quantification and historical studies:

> *I may shave off some of the worry, I may convince them a bit, but I don't get that feeling [that they can link quantitative skills to historical skills].* (History tutor)

RECOMMENDATION 3: HEIs (including UCLan) should ensure that tutors are aware of the nature and potential level of mathematics anxiety within their student population and its potential to impact upon student performance, particularly amongst mature, female students and those possessing no (or a low standard of) formal pre-university mathematics (or -related) or numeracy qualifications. In addition, students' perceptions regarding the relevance of mathematics/numeracy influence their attitudes towards the subject, with positive attitudes associated with recognition of its relevance. It is, therefore, important that any intra- and extra-curricular activities aimed at enhancing students' numeracy skills emphasise the context and relevance of these skills.

Students' approaches to learning

Crawford *et al*. (1998a) developed an 'Approaches to Learning Mathematics Questionnaire' which identified two approaches, namely 'surface' and 'deep'. Each approach comprised two sub-scales, 'intention' and 'strategy'. A surface learner's 'intention' is to fulfil assessment tasks and to avoid failure by adopting a repetitive 'strategy' and by memorising specific facts and accurately reproducing them. Conversely, deep learners show an 'intention' to understand what is being learned through critical engagement and use a 'strategy' that focuses on concepts applicable to solving the problem.

Students' mean item scores for surface intention, surface strategy and surface approaches to learning were lower than their mean item scores for deep intention, deep strategy and deep approaches respectively (Table 14), suggesting that, overall, students adopting deep approaches to learning mathematics outnumbered those favouring surface approaches. There were no significant differences between males and females with regard to any of the sub-scales or either scale.

Table 14: Students' mean item scores for the approaches to learning scales and sub-scales

		No of items (statements)	Mean item score (SD)	N
Sub-scale:	Surface intention	4	2.5 (0.5)	326
Sub-scale:	Surface strategy	5	2.6 (0.4)	317
Scale:	Surface approach scale (intention + strategy)	9	2.5 (0.4)	313
Sub-scale:	Deep intention	2	2.9 (0.6)	328
Sub-scale:	Deep strategy	7	2.8 (0.4)	310
Scale:	Deep approach (intention + strategy)	9	2.8 (0.4)	309

The mean score for items representing a deep approach to learning mathematics was greater than the mean item score for a surface approach across all four faculties (Table 15), once again suggesting that students adopting deep approaches to learning outnumbered those favouring surface approaches. Although there were no significant differences between the faculties in terms of scores for deep intention, deep strategy or deep approach (deep intention + deep strategy), there were significant variations amongst students across the four faculties in terms of their scores for surface intention, surface strategy and surface approach (surface intention + surface strategy); interestingly, scores for undergraduates based in Arts, Humanities and Social Sciences students' were significantly lower than those for undergraduates from the other three faculties. Kember *et al*. (2008) also found that science students scored higher on the use of surface approaches compared to students from the arts, humanities and social sciences. Such discipline effects warrant further investigation, since they may be related to variations in the learning environment and teaching strategies adopted.

Table 15: Faculty variations in students' scores for approaches to learning sub-scales and scales

	Mean item (statement) score (SD)			
	Arts, Humanities and Social Sciences (N = 17-20)	Health and Social Care (N = 108-117)	Management (N = 46-50)	Science and Technology (N = 128-134)
Sub-scale: Surface intention sub-scale	2.2 (0.5)	2.4 (0.5)	2.5 (0.4)	2.5 (0.5)
Sub-scale: Surface strategy sub-scale	2.3 (0.5)	2.6 (0.4)	2.6 (0.4)	2.6 (0.4)
Scale: Surface approach scale	2.2 (0.5)	2.5 (0.4)	2.6 (0.3)	2.6 (0.4)
Sub-scale: Deep intention sub-scale	2.6 (0.6)	2.9 (0.5)	2.9 (0.6)	2.9 (0.6)
Sub-scale: Deep strategy sub-scale	2.7 (0.5)	2.9 (0.4)	2.9 (0.4)	2.8 (0.5)
Scale: Deep approach scale	2.7 (0.5)	2.9 (0.4)	2.9 (0.4)	2.8 (0.4)

Focus group discussions revealed that students demonstrating deep approaches to learning did not necessarily possess higher pre-university mathematics (or -related) qualifications or higher grades. In addition, such learners sometimes had to struggle against either the classroom culture or a tutor's attitude and had to be persistent in their deep learning approach:

> *I'm normally the only one who wants to know how it [the formula] works out, but I have to know how it works to understand it. Otherwise, it's just trying to remember and it seems like remembering a load of meaningless numbers ... but I feel like I'm being a burden by keep asking when no-one else seems to care why things come about.*
>
> (Female, year 2, business studies undergraduate, possessing a grade B in GCSE Mathematics)

> *I went intentionally to her drop-in hours. ... But she just said you don't need to know that and that's it. But I needed to understand it and then I went to another tutor ... and she explained it.*
>
> (Female, year 3, psychology undergraduate, possessing a grade C in GCSE C Mathematics)

Psychology tutors teaching modules that incorporate statistical elements noted the presence of both deep and surface learners and tried to cater for the needs of both types of learner:

> *We are aware that a lot of students are pressing [SPSS] buttons and haven't got a clue about what's coming out... You get some who will virtually copy our handouts really, they just see the numbers and are putting them in, but the very able student will interpret the information in the way that we want.* (Psychology tutor 1)

> *Just coming in, being able to press buttons, providing an answer... it doesn't mean you understand it ...just because you can go in and say I have the right number. And that's something that's very, very important to us and that's why we've worked to change the programme.* (Psychology tutor 2)

> *.... [Some students] engage a lot and ask questions a lot. A lot try to understand all the maths that goes on behind. ... Now I know some that are not very able students and won't be able to understand all the maths behind ... we are not going to specifically teach all the maths behind it because we don't need to, but we would guide them as to where to look for that.*
> (Psychology tutor 1)

> *We go through the mathematical calculations of the statistics so we get the entire formula out and we just break it down step by step, give them an example, and they do respond so much to that. But with some students I find that actually it impairs their learning. So what I'll say to them is, you don't need to know this information. If you find mathematics daunting, and it's not something that interests you and if this is something that's interfering with your understanding so far, I don't mind if you switch off for a few minutes. But some students really benefit from their mathematics so they have the option of going through that to see the mathematics that are involved in SPSS.*
> (Psychology tutor 2)

RECOMMENDATION 4: In supporting the development of students' numeracy skills, HEIs (including UCLan) should advocate the adoption of teaching and learning strategies that take into account variations in students' approaches to learning, but should, wherever possible, encourage students to use deep, rather than surface approaches to learning.

Awareness of employers' use of numeracy tests

Students

When students were asked whether, before completing the survey, they had been aware that employers are increasingly using numeracy tests as part of their graduate recruitment procedures, 54% of respondents claimed to have been unaware. A greater proportion of Management students (62%) possessed an awareness of employers' use of numeracy tests, compared with undergraduates from Health and Social Care (45%), Arts, Humanities and Social Sciences (42%), or Science and Technology (42%). Although there was very little difference between females (46%) and males (44%) with regard to their awareness, only one in five students (20%) was familiar with the types of numeracy tests used by employers. Once again a greater proportion of Management students (29%) were familiar with the types of tests used, compared with Arts, Humanities and Social Sciences (21%), Health and Social Care (19%) and Science and Technology (15%) students. In addition, a greater proportion of males (24%) than females (18%) appeared to be familiar with the types of tests used. Business studies and nursing students appeared well aware of the use of numeracy tests in job selection procedures:

> *Well I'm applying for placements at the minute. And I know people who have applied for HR jobs and they've had to do maths and statistics tests online and they've failed it, and they've never been asked any question relating to HR yet - but they've been knocked back based on a numerical test. And I know from all that about the complaint that graduates don't have the skills to pass these numerical entrance tests even to get entered into the application process...*
> (Female, year 2, business studies undergraduate)

> *I don't think they will be relevant in the job, once you're in the job. But we can't even get to the interview stages if you can't get past the on-line test.*
> (Female, year 3 business studies undergraduate B)

However, none of the participants (including faculty student representatives) appeared aware that the university offers all its students a free online numeracy test:

> *We're the reps and we don't know. Where's that? [the online numeracy test]*
> (Female undergraduate)

Those who were unaware either of the use of numeracy testing by employers and/or the availability of a free online numeracy test at the university appeared disappointed:

> *I didn't even know that many employers did numeracy. Nobody tells you that one.*
> (Male, year 3, forensic science undergraduate A)

> *That's a huge problem that I've found amongst my peers as well. That 3rd years applying for jobs or anything, they just cannot get past the numerical online tests. They can't get their foot in the door at all. Nobody's interested. They can't get past them at all. But, I mean we really don't get taught the level of maths that you need for them on business studies as such. It's just, you know, you go down a different path.* (Female, year 3, business studies undergraduate A)

> *I've used the career service, but I haven't been told about a numeracy test or anything like that or any kind of screening process.* (Female, year 3, forensic science undergraduate)

Participants were of the opinion that a greater awareness of the use of numeracy tests in graduate recruitment processes and of the availability of sample numeracy tests would be an aid in getting them into the graduate job market:

> *If you're aware of it [use of numeracy tests], you can look at and refresh your maths and practise it. But if you're not aware and you really want a job, you might be a bit dumbfounded when it comes along and you're not going to do well if you've not looked over some maths notes.*
> (Male, year 3, forensic science undergraduate A)

The potential for a 'Personal Development' module (PDM) to increase the students' awareness of the significance of numeracy skills to their future employability also emerged during discussions. Although in one case a PDM appeared to be used effectively in this context, in another case it was not, resulting in frustration on the part of the undergraduate concerned:

> *What help we've had is the Personal Development Module. That's the only time when we get told about all these sorts of things because they're developing us to be better in business [unclear] by helping us with all these things. If we didn't have that, then I would have absolutely no idea about any of this at all.* (Female, year 3, business studies undergraduate A)

> *I've done personal development modules before in my degree and we do not cover maths. Maths is not emphasised in that at all, which is why now there are so many people on my degree and on similar degrees who have gone to apply for jobs like me basically unaware that they are going to be subject to a selection process via mathematics and it wasn't made aware to them [sic] and it isn't made aware at the Futures Centre or the Centre for Employability or anything like that, you know, in our discipline anyway. I know it's different in other disciplines, so it's come as a big shock to a lot of people.* (Female, year 3, forensic science undergraduate).

Tutors

One in two tutors (48%) was also unaware that employers are increasingly using numeracy tests as part of their graduate recruitment procedures. A smaller proportion of tutors from Health and Social Care (43%) claimed to be aware of this fact compared with those from Management (63%), Arts, Humanities and Social Sciences (62%) or Science and Technology (53%). However, 81% were unfamiliar with the types of tests employers use; this was most pronounced amongst tutors from Arts, Humanities and Social Sciences (87%), Health and Social Care (85%), and Science and Technology (82%). In contrast, 63% of tutors from Management claimed to be unfamiliar with such tests.

RECOMMENDATION 5: Since almost 50% of student and tutor respondents in the UCLan surveys appeared unaware of employers' increasing use of numeracy tests and approximately 80% were unfamiliar with the types of tests used, the university should do more to raise awareness amongst colleagues (academic and support staff) and students and provide and publicise greater access to sample numeracy tests.

Confidence in undergraduates' ability to pass employers' numeracy tests

When tutors were asked how confident they were that their students would be capable of passing employers' numeracy tests, only 15% of respondents were very/moderately confident, 57% were not at all confident/had limited confidence and 28% selected the 'don't know' option. Tutors from Management appeared to be the least confident, perhaps because of their greater familiarity with the types of tests used; they were followed by respondents from Arts, Humanities and Social Sciences, and Health and Social Care.

Although tutors from Science and Technology appeared the most confident, they had already admitted that they possessed little familiarity with the types of tests used.

Overall, fewer than half of the student respondents (48%) were moderately or highly confident that they would be able to pass an employer's numeracy test, with a greater proportion of males (65%) than females (43%) expressing this level of confidence. Although there was no significant difference in confidence levels between students whose degree programmes incorporated numerical elements and those whose courses did not, a higher proportion of students from Science and Technology (57%) were moderately/very confident, compared with those from Management (57%), Arts, Humanities and Social Sciences (54%), and Health and Social Care (37%). Further analyses revealed that younger students and those possessing higher mathematics (or -related) qualifications tended to express more confidence.

RECOMMENDATION 6: Although UCLan does currently provide some opportunity for students to attempt the type of numeracy test increasingly used by graduate employers in their selection procedures, few students in the current study appeared to be aware of this provision. UCLan should provide more opportunities for students to attempt such tests, advertise such opportunities across the university, and provide students with constructive feedback on their performance with a view to increasing confidence, particularly amongst more mature students and/or those with lower levels of formal mathematics (or -related) qualifications. Such opportunities should be supplemented with workshops and/or drop-in sessions to address any weaknesses identified and to cover those topics commonly encountered in such tests. For example, many employers' numeracy tests involve candidates interpreting data presented in a variety of formats and/or completing basic arithmetic calculations (with or without a calculator). Thus, any strategy, whether discipline-specific or aimed at improving candidates' performance in employers' tests, should ensure that such skills are developed.

Evaluation of undergraduates' numerical competency

When tutors were asked whether they felt that their students possessed the numeracy skills they needed to succeed in their chosen discipline, only 16% of respondents felt that their students did possess the necessary skills, 71% indicated that their students possessed the necessary skills *'only to some extent'*, 12% believed that their students lacked the necessary skills, and 1% (one tutor) responded *'don't know'*. This pattern was also reflected in the breakdown of the data by faculty (Fig. 11).

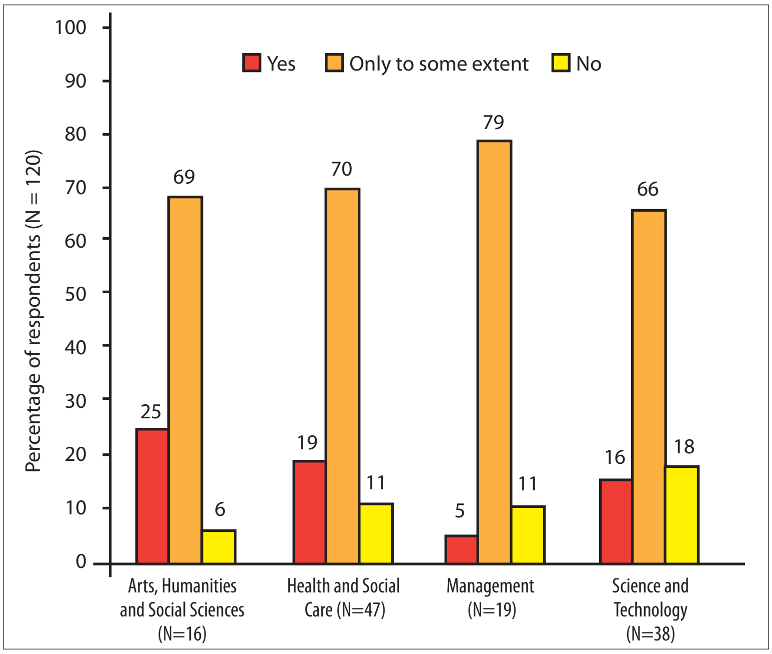


Fig. 11: Tutors' evaluation of the adequacy of their students' numerical competency with regard to their chosen discipline

When tutors were asked to indicate, from a list of 21 items, those numerical topics their students had the opportunity to develop and/or practise, perhaps not surprisingly tutors from Science and Technology selected the greatest range of topics (i.e. all 21 items). Nevertheless, the remaining three faculties appeared to cover most (17-20) of the topics listed, with the exception of working with logarithms, algebra, geometry, trigonometry and/or calculus (Table 16).

Table 16: Tutors' indications of the numeracy skills their students had the opportunity to develop and/or practise

Item	Percentage of responding tutors				
	All faculties combined (N = 122)	Arts, Humanities & Social Sciences (N = 16)	Health & Social Care (N = 47)	Management (N = 19)	Science & Technology (N = 38)
Understanding the language of mathematics	25	13	11	21	50
Understanding the concept of number	39	19	38	21	55
Handling fractions and decimals	64	56	57	42	87
Calculating rates	57	31	60	47	71
Calculating percentages	75	63	77	63	87
Working with ratios & proportions	49	38	38	32	76
Working with logarithms	16	0	0	5	50
Arithmetic	47	25	43	37	68
Algebra	22	6	0	26	55
Geometry	13	0	2	0	39
Trigonometry	11	0	0	0	37
Calculus (integration, differentiation)	12	0	0	11	34
Understanding measures of central tendency (mean, median, mode)	62	38	47	79	84
Data interpretation (e.g. tables, charts, graphs)	77	56	64	84	97
Presenting data (e.g. in tables, charts, graphs)	70	56	49	84	92
Numerical problem-solving	52	25	49	37	74
Representative sampling	34	44	19	42	45
Understanding basic finance (e.g. sales figures, gross/net profit, simple and compound interest)	20	31	2	47	24
Using spreadsheet software (e.g. Excel)	43	44	13	58	74
Using database software (e.g. Access)	10	19	2	16	13
Using statistical software (e.g. Minitab, SPSS)	30	19	11	47	47
None of the above	8	31	6	5	3

Tutors were also asked to evaluate their students' overall competencies in the 21 topics. On all 21 items, the percentage of tutors believing their students to be moderately or highly competent was below 45% (Fig. 12). However, this question did prove problematic for tutors to answer as it required them to evaluate their student cohort as a whole (i.e. to generalise), rather than consider the range of competencies displayed by individuals within the cohort. This is reflected in the following comments:

> *All students are different, and it is difficult to generalise. There are some very good students when it comes to numeracy...* (Nursing tutor)

> *My students are all individual and have a whole range of different abilities so my answers above are 'in general'.* (Business and management tutor)

To some extent this may account for the striking discrepancy between tutors' perceptions of their students' numerical competence and students' self-evaluation of their numerical competence, although students and tutors may have also been applying entirely different 'standards of competence'. In 11 out of the 21 numerical tasks listed ≥ 50% of responding undergraduates evaluated themselves as possessing only *'limited competence'* or being *'not at all competent'* (Fig. 13). Of these 11 numerical tasks, three were considered important by more than 60% of employers, namely working with ratios and proportions, understanding basic finance, and calculating rates (see Fig. 10, p. 33).

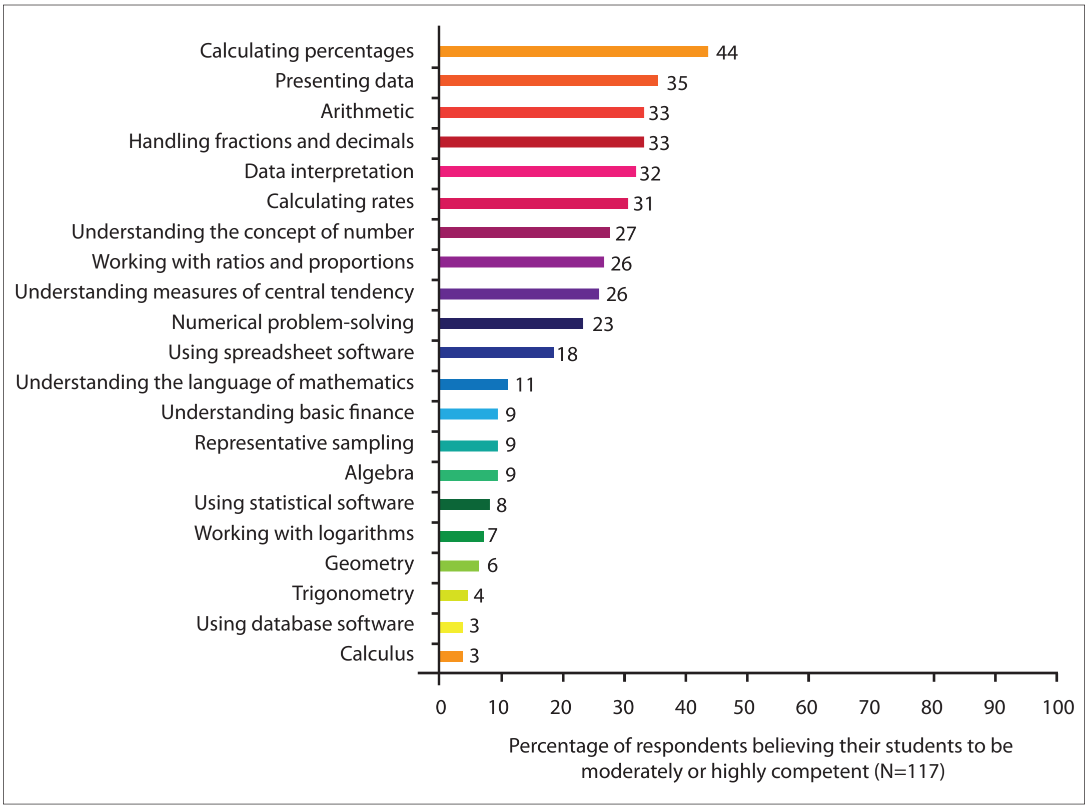


Fig. 12: Tutors' evaluation of their undergraduates' numerical competence

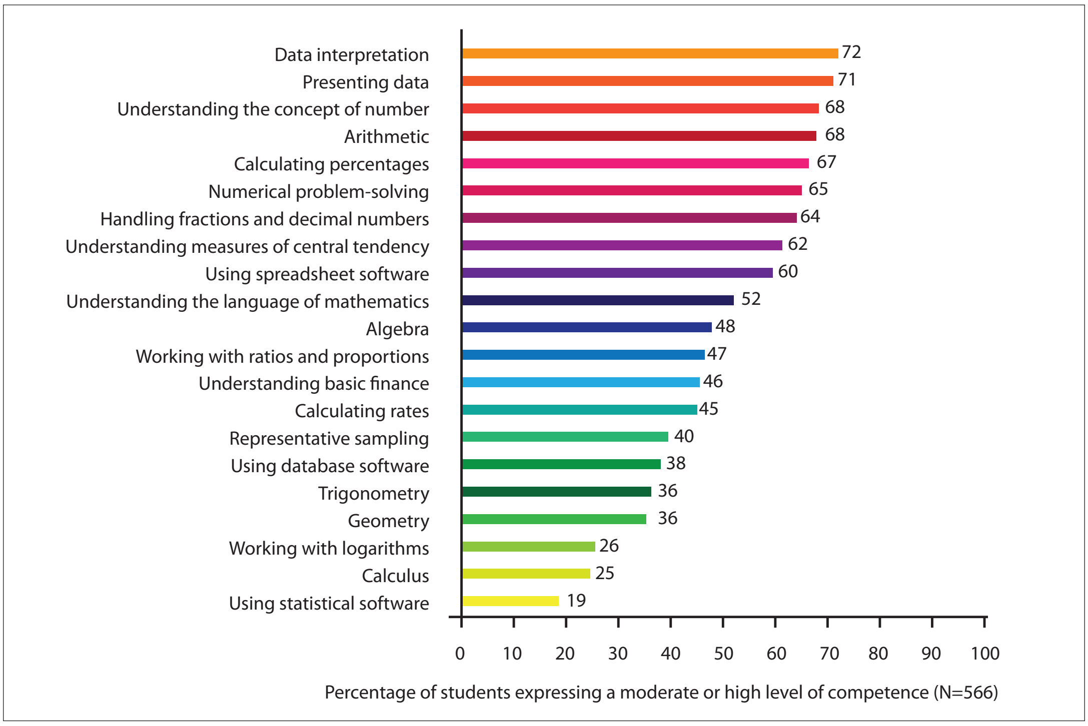


Fig. 13: Percentage of students expressing a moderate or high level of self-evaluated competence

Students' composite scores for self-evaluation of competence were analysed on the basis of gender and academic discipline (i.e. faculty) (Table 17). Male students' composite scores were significantly higher than those of females, suggesting that, overall, male students have more confidence in their numeracy skills. However, previous research has found that female students often underestimate their numerical abilities, while males have a tendency to overestimate their skills (Meelissen and Luyten, 2008). The inclusion of numerical elements within degree curricula appeared to boost students' confidence in their numeracy skills. Those students indicating that their degree programme incorporated numerical elements possessed significantly higher composite scores (mean M = 75.3; standard deviation SD = 15.2; N = 336) than those whose degree programmes did not (M = 66.3; SD = 16.3; N = 230):

> *I would require constant revision if not using the skills every day. I can learn it but also forget it very quickly.* (40-49 year-old male studying engineering)

There was no significant difference between faculties when males' mean composite scores were compared, but this may, in part, have been due to the small sample sizes. However, significant differences did exist between some of the faculties in terms of female students' composite scores. Although there was no significant difference between females from Science and Technology and those from Management, scores of the former were significantly higher than those of students from the other two faculties. No significant differences were apparent between students from Management, Arts, Humanities and Social Sciences, and Health and Social Care.

Table 17: Students' mean composite scores for self-evaluation of numerical competence

Faculty	Male students			Female students			Total students		
	Mean*	SD	N	Mean*	SD	N	Mean*	SD	N
Science and Technology	80[a]	15	57	78[a]	16	99	79[a]	16	156
Management	77[a]	15	30	71[ab]	17	46	74[ab]	16	76
Arts, Humanities and Social Sciences	78[a]	18	23	69[b]	16	107	71[b]	17	130
Health and Social Care	71[a]	14	21	65[b]	14	171	66[c]	14	192

* Values possessing different superscript letters are significantly different ($p < 0.02$)

While younger students tended to exhibit higher composite self-evaluation scores ($r = -0.27$, $p < 0.001$, N = 566, $R^2 = 0.07$), mature students appeared to have lost confidence in their numeracy skills. Discussions with students revealed that a lack of opportunity for practising numeracy skills, rather than age *per se*, may have resulted in low levels of confidence amongst more mature students:

> *My course involves a lot of statistics which is pitched at people who have recently completed A levels. As a mature student I haven't studied statistics for 14 years so am at a disadvantage.*
> (30-39 year old female forensic and investigative sciences undergraduate)

Mature students with some recent experience of studying for a mathematics qualification appeared more confident:

> *I mean I'm in a better position because I've just literally sat the GCSE before I came on the course …*
> (20-29 year old nursing student)

Only 11% of students and tutors believed it satisfactory that graduates exhibit only technical competence, although 63% and 47% respectively indicated that this would be acceptable for some numerical tasks; 26% and 42% respectively believed it important that graduates understand any underpinning mathematical concepts. A greater proportion of tutors from Science and Technology (53%) expressed dissatisfaction with mere technical competence, compared with tutors from Management (39%), Health and Social Care (38%) and Arts, Humanities and Social Sciences (38%). In contrast, but perhaps not surprisingly, percentages of students expressing dissatisfaction with mere technical competence were significantly lower in all four faculties: Science and Technology (26%), Management (16%), Health and Social Care students (30%), and Arts, Humanities and Social Sciences (27%). These statistics may be compared with the significantly higher proportion (56%) of employers who indicated that they would not be satisfied if recruits were only technically competent (p. 33).

The use of technology (e.g. SPSS software) was viewed by some tutors as potentially both a help and a hindrance to the students' understanding of statistical concepts.

> *Yes, you would get a lot of lecturers in our department who would say, you know, certainly back in the old days you had to do it by hand which does create better understanding... but it would turn a lot of students off the entire subject and they would drop out... So it may be a contentious issue.*
> (Psychology tutor 1)

RECOMMENDATION 7: HEIs (including UCLan) should ensure that all their undergraduates have the opportunity and are actively encouraged to become proficient in a range of basic numeracy skills, particularly those valued by employers and often tested in employers' recruitment tests (see recommendation 6 above). Such opportunities may be intra-curricular (e.g. in those disciplines whose subject benchmarks already require the development of students' numeracy skills), or extra-curricular to accommodate students whose disciplines are unable to easily integrate numeracy skills within their curricula (e.g. English).

Summary of correlation analyses

Correlation analyses revealed significant relationships between several of the constructs investigated by means of the student survey (Table 18).

Table 18: Summary of statistically significant positive and negative correlations between constructs investigated by means of the student survey

	1	2	3	4	5	6	7	8	9	10
1. Fragmented conceptions										
2. Cohesive conceptions										
3. Attitude towards maths/numeracy		+								
4. Surface approach to learning maths/numeracy	+		–							
5. Deep approach to learning maths/numeracy		+	+							
6. Maths anxiety		–	–	+	–					
7. Course experience score		+	+		+	–				
8. Self-evaluation of maths competency score		+	+	–	+	–	+			
9. Age	–		–			+		–		
10. Highest maths (-related) qualification		+	+	–		–		+	–	

+ and – indicate statistically significant positive or negative correlation at $p < 0.01$ level

Conceptions of mathematics

Students expressing cohesive conceptions of mathematics expressed more positive attitudes towards mathematics/numeracy, adopted deep approaches to learning, lower levels of maths anxiety, reported a more positive course experience, higher self-evaluated competence scores and possessed higher mathematics (or -related) qualifications. Younger students exhibited more fragmented conceptions of mathematics.

Attitudes

Positive attitudes towards mathematics/numeracy were associated with deep approaches to learning mathematics/numeracy, whilst negative attitudes were associated with surface approaches to learning. Students exhibiting positive attitudes were also less maths anxious, reported a more positive course experience, higher self-evaluated competence scores, possessed higher mathematics (or -related) qualifications, and were younger.

Approaches to learning mathematics/developing numeracy skills

Students adopting a surface approach to learning mathematics/numeracy were more maths anxious, reported lower self-evaluated competence scores and possessed lower mathematics (or -related) qualifications. In contrast, students adopting a deep approach to learning were less maths anxious, reported a more positive course experience, and higher self-evaluated competence scores.

Maths anxiety

Students exhibiting higher levels of maths anxiety reported a more negative course experience, lower self-evaluated competence scores, possessed lower mathematics (or -related) qualifications and were more mature students. Focus group discussions revealed an intricate relationship between students' maths anxiety and their attitudes towards mathematics and numeracy. Both maths anxiety and negative attitudes towards the subject are detrimental to any engagement with the subject and may discourage effort on the part of students.

Self-evaluated competence

Students reporting higher self-evaluated competence scores possessed higher mathematics (or -related) qualifications, reported a more positive course experience, and were younger. However, younger students tended to possess higher mathematics (or -related) qualifications.

The survey data pointed to age influencing the way in which students respond to the learning and teaching environment in general and to the development of numeracy skills in particular. However, tutors regarded mature students' attitudes and practices more favourably:

> *I think mature students are more likely to ask questions and ask for help than the younger students. I think some younger students tend to stick their head in the sand and hope it will go away. ... I think the mature students tend to do that more [peer net-working]. ..... I know in first year they set up a little study group of their own, ... which was great.* (Psychology tutor 1)

QAA or NHS/DoH benchmarks and undergraduate programmes explicitly requiring students to develop and/or practise their numeracy skills

When tutors were asked *'Does your primary discipline's QAA or NHS/DoH Subject Benchmark Statement explicitly require your students to further develop and/or practise their numeracy skills during their programme of study (e.g. through mathematical manipulations, recording, analysing statistically and/or interpreting numerical data, or performing calculations, etc)?'*, 68% of respondents reported that their primary discipline did explicitly require numeracy skills development, 13% indicated the absence of this requirement and 19% selected the 'don't know' option. Similarly, 79% of respondents indicated that their school's undergraduate programmes contained elements that required students to apply their numeracy skills, 13% indicated an absence of this requirement, and 8% selected the 'don't know' option. Table 19 provides a breakdown of these statistics by faculty and discipline.

All six tutor interviewees acknowledged the centrality of numeracy to their disciplines, although the nature and level of the numeracy skills required of students to progress and operate effectively within their programmes of study varied from discipline to discipline:

> *History is about what really happened, I am absolutely clear on that. And to understand what really happened must have a hard edge, a quantitative edge... It's not about hard level stuff, it's just about that very basic sense of what is the background. And I can't think of many things in history where that level of quantitative isn't absolutely vital.* (History tutor)

> *I think numeracy is implicit in both [the modules taught] because both of them involve numbers and algebra and drawing graphs and interpreting charts and tables. So the basics, addition, subtraction, multiplication and so on, being able to relate from equations to lines, whether straight lines or quadratic equations.* (Business studies tutor)

> *All nursing modules incorporate numerical elements, both theory and practice, i.e. placements deal with government's key skills recommendations regarding numeracy (and literacy & ITC). In that sense, all tutors within the School of Health and Clinical Studies are engaged in the teaching of numeracy. However, the level of numeracy would vary from module to module and among different branches of nursing. For example, Child Branch involves intricate and complex drug calculations compared to Adult Branch.* (Nursing tutor 1)

> *What our students have to do in psychology is really learn to use a package [SPSS] that does the statistics for them. So as such they don't sit down and do calculations as such, but what we do is in the lectures we give them the theory behind the statistics that they have to use. So they are exposed to all the equations that go behind but on a day to day basis they use a package that does the statistics for them. So whilst we would expect numerical ability, we don't test it as such, we test their ability to interpret numbers that come out of a package.* (Psychology tutor 1)

Table 19: Tutors' indications of whether QAA and/or NHS/DoH subject benchmark statements for their discipline and undergraduate programmes explicitly require students to further develop and/or practise their numeracy skills

Faculty	Discipline	No. of respondents indicating a requirement for numeracy skills development (total no. respondents) *	
		Within QAA and/or NHS/DoH subject benchmark statements	Within school's undergraduate programmes
Arts, Humanities and Social Sciences	1. Art and design	2 (2)	2 (2)
	2. Communication media film and cultural studies	1 (3)	2 (3)
	3. Criminology	0 (1)	0 (1)
	4. Education studies	1 (3)	0 (3)
	5. English	0 (1)	0 (1)
	6. History	0 (2)	2 (2)
	7. Law	0 (3)	0 (3)
	8. Linguistics	0 (1)	1 (1)
Health and Social Care	1. Health studies	4 (8)	4 (8)
	2. Midwifery	5 (5)	4 (5)
	3. Nursing	24 (26)	25 (26)
	4. Operating department practice	2 (3)	2 (3)
	5. Physiotherapy	1 (2)	2 (2)
	6. Social work	1 (2)	0 (2)
	7. Counselling	0 (1)	0 (1)
Management	1. Accounting	0 (1)	0 (1)
	2. Business and management	9 (13)	11 (13)
	3. Economics	1 (1)	0 (1)
	4. Hospitality, leisure, sport and tourism	2 (4)	3 (4)
Science and Technology	1. Agriculture	2 (2)	2 (2)
	2. Archaeology	1 (1)	1 (1)
	3. Biomedical science	1 (1)	1 (1)
	4. Biosciences	6 (9)	9 (9)
	5. Chemistry	3 (3)	3 (3)
	6. Construction, property and surveying	4 (5)	4 (5)
	7. Engineering	5 (6)	6 (6)
	8. Pharmacy	2 (3)	3 (3)
	9. Physics, astronomy and astrophysics	1 (1)	1 (1)
	10. Psychology	5 (7)	7 (7)
Total:		**83 (120)**	**95 (120)**

* excludes two respondents teaching on cross-faculty programmes

Recognition of external opportunities for students to develop and practise their numeracy skills

Whilst a very small minority (6%) of undergraduate respondents failed to recognise that opportunities exist outside university for them to develop and practise their numeracy skills, the majority appeared to recognise that such opportunities do exist via the diversity of activities in which they engage (Fig. 14). When presented with a list of options, which included the opportunity to add a free text response, approximately two-thirds of respondents recognised that they practise their numeracy skills through their shopping activities and/or managing their personal or business finances. Other activities in which ≥ 40% of respondents engaged and in which they recognised the role of numeracy skills included full/part-time job or voluntary work, helping children or siblings with their mathematics (i.e. tutoring others), and games or sports.

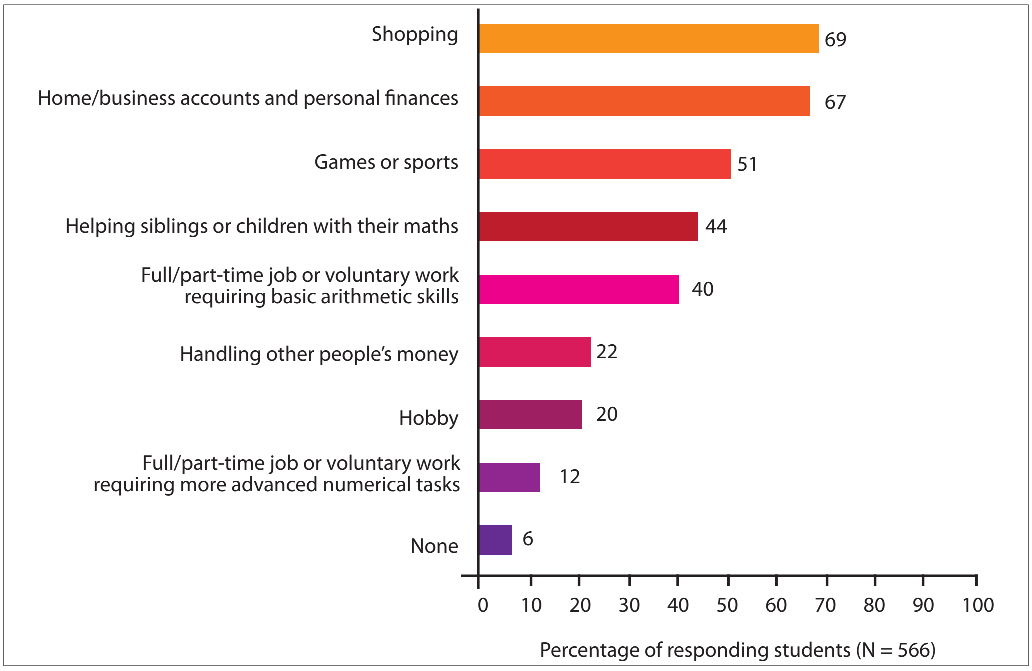


Fig. 14: Undergraduates' recognition of opportunities to develop and practise numeracy skills that exist outside the university

Existing opportunities in courses to help students develop and practise their numeracy skills

An analysis of teaching, learning and assessment practices in a range of disciplines helped identify the opportunities currently available to students to further develop and practise their numeracy skills, and the nature of any support provided.

Students

Fifty-nine percent (336) of responding undergraduates indicated that their courses contained elements that required them to further develop and/or practise their numeracy skills. Such opportunities appeared to be more widely available to undergraduates from Science and Technology, where 87% of respondents (reflecting students from 14 out of 15 disciplines) reported their provision. In comparison, only 16% of respondents from Arts, Humanities and Social Sciences (reflecting students from 8 out of 15 different disciplines) reported such opportunities. Within Health and Social Care, and Management 63% and 67% of respondents (from 4 out of 7, and all 5 disciplines) respectively were offered such opportunities. The types of opportunities within programmes available to students and identified by them varied with faculty and discipline (Table 20). However, only two types of opportunities were reported by ≥ 50% of respondents, namely lectures (57%) and data interpretation exercises (50%). Within focus group sessions, although undergraduates from a number of disciplines acknowledged that their tutors used a combination of lectures, seminars and tutorials to support their learning, almost all identified that a lecture was the teaching and learning format least conducive to enhancing students' understanding of numerical elements of the curriculum.

> *There's [sic] 170 people on my course, but that's a small course and I think that there's normally a lot more. And even if you do put your hand up, if there're a lot of people, you don't always get it answered because otherwise it goes on forever.* (Female, year 1, nursing undergraduate)
>
> *Everybody just waits for that one person who is brave enough to say 'help'.*
> (Female, year 3, history with archaeology undergraduate)

Table 20: Current opportunities (•) for the development of numeracy skills within programmes, identified by student respondents

	Discipline (total no. of respondents)	Lectures	Small group workshops or tutorials	One-to-one help as requested in or outside class	Drop-in sessions	Resources placed on WebCT	Using computer-based learning materials /exercises	Online self-assessment tests	Workbooks or worksheets for completion	Recommended textbooks	Completing calculations using mental arithmetic	Completing calculations using calculators	Completing calculations using software	Numerical problem-solving exercises	Data interpretation exercises	Presenting data	Statistical analyses of data
Arts, Humanities & Social Sciences	Art and design (10)	X	X	X	X	X	X	X	X	X	•	X	X	X	X	X	X
	Communication, media, film & cultural studies (23)	•	•	X	•	•	•	•	•	•	X	•	•	X	•	•	•
	Education studies (10)	•	X	X	X	X	X	X	•	X	X	X	X	X	X	X	•
	English (12)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	•	•
	History (14)	•	•	•	X	•	X	X	X	•	X	X	X	X	•	•	•
	Languages & related studies (7)	X	X	•	•	X	X	X	X	X	X	•	•	X	•	•	•
	Law (15)	•	•	•	•	•	•	•	X	•	•	•	•	X	•	•	•
	Social policy & administration (1)	•	X	•	•	•	•	X	X	X	X	X	X	X	•	•	•
Health & Social Care	Health studies (31)	•	•	•	•	X	•	•	•	•	•	•	•	•	•	•	•
	Midwifery (4)	X	X	X	X	X	X	X	X	X	•	•	X	•	X	X	X
	Nursing (110)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Social work (42)	•	X	X	•	X	•	•	•	•	X	X	X	X	•	•	•
Management	Accounting (9)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Business & management (35)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Economics (3)	•	•	•	X	•	•	X	•	X	•	•	•	•	•	•	•
	Finance (2)	•	•	X	•	X	X	•	•	•	•	•	X	•	•	•	•
	Hospitality, leisure, sport & tourism (27)	•	•	•	•	•	X	•	•	•	•	•	•	•	•	•	•
Science & Technology	Archaeology (4)	•	•	•	X	•	X	X	X	•	•	•	•	X	•	•	•
	Architectural technology (4)	•	X	X	X	•	X	X	X	X	X	•	X	•	•	•	X
	Biomedical science (8)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Biosciences (24)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Chemistry (1)	•	X	X	X	X	•	X	X	X	•	•	•	X	•	•	X
	Computing (11)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	X	X
	Construction, property & surveying (18)	•	•	•	X	•	•	X	•	•	•	•	•	•	•	•	•
	Earth sciences, environmental sciences/studies (1)	•	X	•	X	•	•	X	X	•	X	X	•	X	•	•	•
	Engineering (4)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Geography (3)	•	X	X	X	X	X	X	•	X	X	•	X	X	•	•	•
	MSOR (9)	•	•	•	•	•	•	X	•	•	•	•	•	•	•	•	•
	Pharmacy (1)	X	X	X	X	X	X	X	X	X	X	X	•	X	X	X	X
	Physics, astronomy & astrophysics (3)	•	X	•	X	•	•	•	•	•	•	•	•	•	•	•	•
	Psychology (42)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Disciplines where students provided no indication of any opportunities included: criminology (9); dance, drama and performance (7); early childhood studies (2); linguistics (4); music (1); philosophy (1); sociology (7); ODP (1); paramedic science/practice (1);physiotherapy (1); materials (1).

Tutors

Tutors' selections regarding the opportunities currently available within programmes to support the development of students' numeracy skills varied with faculty and discipline (Table 21). Opportunities reported by > 50% of respondents included: lectures (70%); one-to-one help (66%); calculations using calculators (62%); small-group workshops/tutorials (60%); presenting data (57%); data interpretation exercises (56%); recommended textbooks (53%); numerical problem-solving exercises (52%). Opportunities reported by < 50% included: calculations using mental arithmetic (47%); resources on *eLearn (WebCT)* (46%); statistical analyses of data (44%); use of workbooks/worksheets (43%); calculations using software (41%); computer-based learning materials (35%); drop-in sessions (29%); online self-assessment tests (14%).

Table 21: Current opportunities (•) for the development of numeracy skills within programmes, identified by tutor respondents

		Lectures	Small group workshops or tutorials	One-to-one help as requested in or outside class	Drop-in sessions	Resources placed on WebCT	Using computer-based learning materials /exercises	Online self-assessment tests	Workbooks or worksheets for completion	Recommended textbooks	Completing calculations using mental arithmetic	Completing calculations using calculators	Completing calculations using software	Numerical problem-solving exercises	Data interpretation exercises	Presenting data	Statistical analyses of data
Arts, Humanities &Social Sciences	Art and design (2)	•	•	•	•	X	X	X	•	•	•	•	•	•	•	•	•
	Communication, media, film & cultural studies (3)	•	•	•	X	•	X	X	X	•	X	•	X	X	•	•	X
	History (2)	•	X	•	X	X	•	X	X	X	•	•	•	•	•	•	X
	Linguistics (1)	•	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Health & Social Care	Health studies (8)	•	•	•	X	X	X	X	X	•	•	•	X	X	X	•	•
	Midwifery (5)	•	•	•	X	•	•	•	•	•	•	•	X	•	•	•	•
	Nursing (26)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	ODP (3)	•	•	•	X	X	X	X	•	•	•	•	X	•	X	X	X
	Physiotherapy (2)	•	•	•	•	•	•	X	X	•	X	X	X	X	•	•	•
Manage-ment	Business & management (13)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Hospitality, leisure, sport & tourism (4)	•	•	•	•	•	•	X	X	X	•	•	•	•	•	•	•
Science & Technollogy	Agriculture (2)	•	•	•	•	X	•	•	•	•	•	•	•	•	•	•	•
	Archaeology (1)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Biomedical science (1)	•	•	•	•	X	X	X	•	•	•	•	•	•	•	•	•
	Biosciences (9)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Chemistry (3)	•	•	•	•	•	•	X	•	•	•	•	•	•	•	•	•
	Construction, property & surveying (5)	•	•	•	•	•	X	X	X	•	•	•	•	•	•	•	X
	Engineering (6)	•	•	•	•	X	•	X	•	•	•	•	•	•	•	•	•
	Pharmacy (3)	•	•	•	X	•	•	•	•	•	•	•	•	•	•	•	•
	Physics, astronomy & astrophysics (1)	X	X	•	X	•	X	X	•	•	•	•	•	•	•	•	•
	Psychology (7)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	X

Disciplines where tutors provided no indication of any opportunities included: criminology (1); education studies (3); english (1); law (3); counselling (1); social work (2); accounting (1); economics(1)

It became apparent through tutor interviews that several means of numeracy support are currently available to psychology students:

> *We do provide method support sessions as well … it's three hours a week actually but in one hour slots, where students can come as individuals and ask for extra one to one help.* (Psychology tutor 1)

> *They meet the seminar tutors on a regular basis …… and the idea is that you encourage students to come along with their lab work and you can identify problems and assist them with problems across disciplines, across the modules and find out any errors. You also get a chance to talk about the skills that they've developed … Students see one tutor throughout the entire three years. So they can get to develop a personal relationship with you and you get to know where their weaknesses are so you can talk about them.* (Psychology tutor 2)

Some discrepancies are apparent between students' (Table 19) and tutors' (Table 20) perceptions of the current opportunities available. These may reflect the fact that students in the first or second year of their programmes may have only limited experience on which to base their evaluation, in contrast to tutors, who may be better placed to present an overview of their undergraduate programmes. Based primarily on tutor responses (Table 20), it appears that there is currently little use of ICT in the support of students' numeracy skills, either through the use of computer-based learning (CBL) materials in teaching and learning, or the use of online self-assessment tests.

RECOMMENDATION 8: Given the responses of undergraduates and tutors in the UCLan surveys, UCLan should encourage and support the greater adoption and use of ICT to support the further development of students' numeracy skills and to provide students with more opportunities to practise their numeracy skills. For example, through the use of eLearn (WebCT) and/or QuestionMark Perception to develop and deliver online self-assessment and summative tests (where appropriate); use of Minitab, SPSS, Excel; development of new or use of existing CBL materials such as *mathtutor* and/or direction to appropriate web sites providing support materials.

Who is primarily responsible for supporting the development of undergraduates' numeracy skills?

It appears that tutors from a variety of sources are responsible for supporting the development of students' numeracy skills. Although a majority of tutors (79%) reported that subject tutors responsible for delivering undergraduate programmes primarily assumed this role, in health studies, midwifery, nursing, ODP, and engineering mentors in practice or work placements also supported the students. However, it appeared that students in business and management, biosciences, engineering and pharmacy were also supported by tutors from mathematics or other mathematics-related disciplines. In some cases, such additional support may be due to discipline-specific tutors either possessing insufficient mathematical knowledge and experience, or lacking the confidence to deliver more advanced numerical components of the curriculum.

RECOMMENDATION 9: UCLan should ensure that all tutors (including postgraduate demonstrators) delivering numerical elements of the curriculum and/or responsible for providing additional numeracy support to students, possess appropriate levels of knowledge, experience and confidence. To this end the university should consider establishing a programme of workshops and/or a forum at which tutors could exchange examples of good practice, discuss advantages/disadvantages of specific practices, and support one another in addressing particular issues or problems associated with supporting the development of students' numeracy skills.

How are classes which focus on numerical elements of the curriculum organised?

Figures 15 and 16 summarise students' and tutors' perceptions regarding the organisation of classes which focus on numerical elements of the curriculum. Within three of the four faculties (i.e. Arts, Humanities and Social Sciences, Health and Social Care, and Management) the trends appear similar for both groups of respondents, with whole class teaching (e.g. lectures, practical/laboratory/clinical classes) and small group work (e.g. tutorials, workshops) being adopted in almost equal measure and more frequently than individual work (e.g. in tutorial or practical/laboratory/clinical sessions). In Science and Technology, students' perceptions varied slightly from those of their tutors, with the former believing that small group and individual work occurred less frequently than was suggested by their tutors. However, the greatest discrepancy between students' and tutors' perceptions was apparent amongst respondents from Arts, Humanities and Social Sciences, with students believing that all three forms of class organisation occurred only occasionally. Once again, such discrepancies may reflect some students' (e.g. first- and second-years') limited experience.

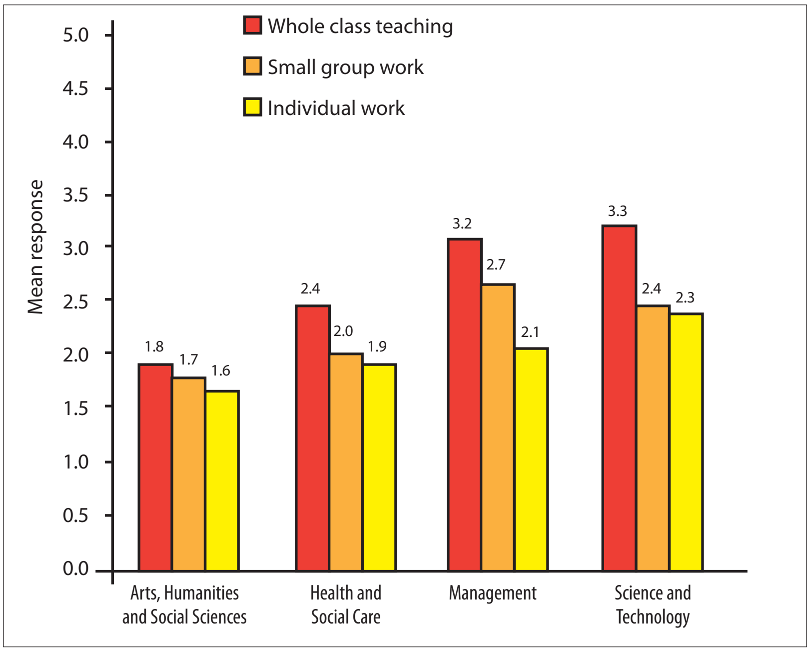


Fig. 15: Students' perceptions regarding the organisation of classes which focus on numerical elements of the curriculum (1= never; 2 = occasionally; 3 = regularly; 4 = mostly; 5 = always)

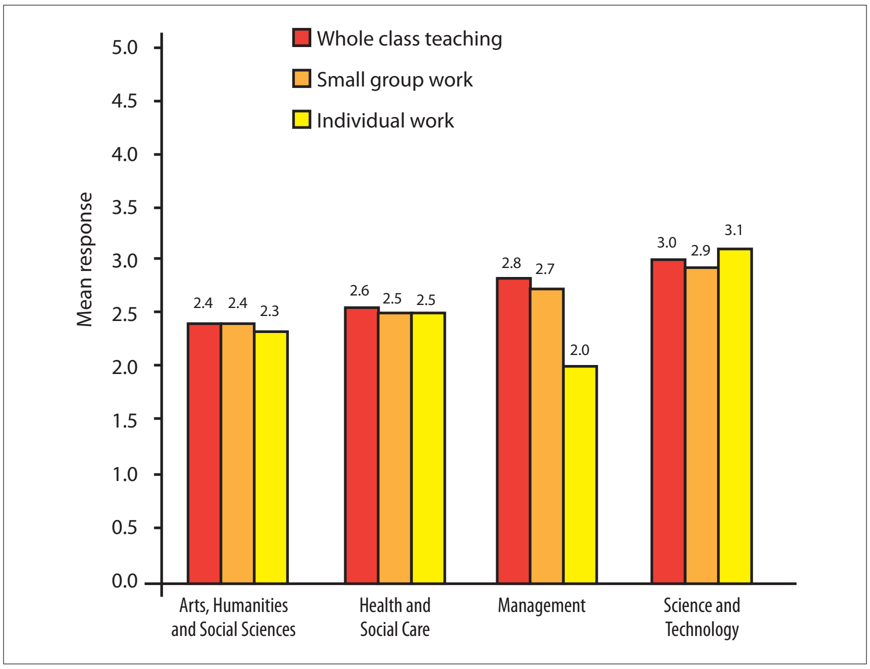


Fig. 16: Tutors' perceptions regarding the organisation of classes which focus on numerical elements of the curriculum (1= never; 2 = occasionally; 3 = regularly; 4 = mostly; 5 = always)

Do programmes contain specific modules dedicated (partially or entirely) to supporting the development of undergraduates' numeracy skills?

When tutors were asked whether their programmes contained specific modules dedicated (partially or entirely) to supporting the development of undergraduates' numeracy skills, tutors from eight out of the eighteen disciplines supporting intra-curricular development of numeracy skills indicated that their programmes completely embedded numeracy skills development within subject-specific modules (e.g. archaeology, art and design, biomedical science, health studies, history, midwifery, ODP, and physiotherapy). In the remaining ten disciplines, programmes also provided compulsory and/or optional stand-alone 'numeracy' modules. In addition, of those 18 disciplines supporting intra-curricular development of numeracy skills (Table 22), 17 provided such opportunities in two or more years of their undergraduate programmes (including a foundation year [Year 0] in some cases); in ODP such opportunities appeared to be focused in Year 1.

Table 22: Examples of disciplines containing entire and/or parts of modules dedicated to supporting the development of undergraduates' numeracy skills

QAA or NHS/DoH Subject Benchmark in which discipline is included	Part(s) of module(s) dedicated to supporting numeracy skills development	Both entire module(s) AND part(s) of module(s) dedicated to supporting numeracy skills development
Archaeology	+	
Art and design	+	
Biomedical science	+	
Biosciences	+	
Business and management		+
Chemistry	+	
Communication, media, film and cultural studies		+
Construction, property and surveying		+
Engineering		+
Health studies	+	
History	+	
Hospitality, leisure, sport and tourism		+
Midwifery	+	
Nursing	+	
Operating department practice (ODP)	+	
Pharmacy	+	
Physiotherapy	+	
Psychology		+

Opinion is often divided regarding the embedding of numeracy skills within curricula or the use of free-standing modules devoted to delivering numerical elements of the curriculum. However, what is often more important in terms of engaging the students is contextualising the numerical components, emphasising their relevance to the students' academic studies and/or future employability.

Use of diagnostic tests with new undergraduates

Table 23: Use of diagnostic tests

Faculty	Discipline	Use of diagnostic test(s)	Form of diagnostic test(s)
Health and Social care	Nursing	Some programmes	Pre-course on-line assessment; intra-venous infusion rate calculation
	Midwifery	All programmes	
Management	Business and management	Some programmes	Foundation year entry students may take a test in order to be exempt from attending classes (if they have sufficient knowledge and skills)
Science and Technology	Biomedical science	Some programmes	
	Biosciences	Some programmes	MCQ's /calculations involving concentration
	Construction, property and surveying	Some programmes	Induction week numeracy tests; problem-based numeracy test
	Engineering	All/some programmes	An optional test at induction to assess mathematical ability, specific individual needs
	Pharmacy	Only as part of recruitment process	
	Physics, astronomy and astrophysics	All programmes	Self-test Maths Pack prior to application

When tutors were asked whether their undergraduate programmes incorporated a diagnostic test to assess the numeracy skills of new students, respondents from only eight disciplines indicated that their programmes did so (Table 23). In pharmacy diagnostic testing was used only as part of their recruitment process.

RECOMMENDATION 10: HEIs (including UCLan) should take care when considering the introduction or expanding the use of diagnostic numeracy tests, since their indiscriminate use can emphasise a 'deficit model' with regard to students' numeracy skills, promoting a lack of confidence (and in some cases encouraging maths anxiety) amongst students.

Assessment of undergraduates' numeracy skills

Table 24: Undergraduates' perceptions of the types of tasks (•) in which their numeracy skills are explicitly assessed

Faculty	Discipline (total no. of respondents)	Class tests	Assignments	Practical, laboratory or clinical work (e.g. practical write-ups)	Work placements	Workbook(s) or worksheet(s)	Numerical problem-solving exercises	Data interpretation exercises	Statistical analyses	Exams	OSCEs (Objective Structured Clinical skills Examinations)	Not explicitly assessed
Arts, Humanities & Social Sciences	Art and design (10)	X	X	X	X	X	X	X	X	X	X	•
	Communication, media, film & cultural studies (23)	•	X	X	X	•	X	X	X	•	X	•
	Education studies (10)	X	X	X	X	X	X	X	X	X	X	•
	English (12)	X	X	X	X	X	X	X	X	X	X	•
	History (14)	•	•	X	•	X	X	X	•	X	X	•
	Language & related studies (7)	X	•	X	X	X	X	•	•	X	X	•
	Law (15)	X	•	•	X	X	X	X	X	X	X	•
	Social policy & administration (1)	X	X	X	X	X	X	•	X	X	X	•
Health & Social Care	Health studies (31)	X	•	X	•	•	•	•	•	X	X	•
	Midwifery (4)	X	•	•	•	X	X	X	•	X	•	•
	Nursing (110)	•	•	•	•	•	•	•	•	•	•	•
	Social work (42)	X	X	X	X	X	X	X	X	X	X	•
Management	Accounting (9)	•	•	•	X	•	•	•	•	•	X	X
	Business & management (35)	•	•	•	•	•	•	•	•	•	X	•
	Economics (3)	•	•	•	X	X	•	•	•	•	X	X
	Finance (2)	•	•	•	X	X	•	•	•	•	X	X
	Hospitality, leisure, sport & tourism (27)	•	•	•	X	•	•	•	•	•	X	•
Science & Technology	Archaeology (4)	X	•	•	X	X	X	•	•	X	X	X
	Architectural technology (4)	X	•	•	X	X	X	X	X	•	X	X
	Biomedical science (8)	•	•	•	•	•	•	•	•	•	•	•
	Biosciences (24)	•	•	•	•	•	•	•	•	•	X	X
	Chemistry (1)	X	•	•	X	X	X	X	X	•	X	X
	Computing (11)	•	•	•	X	X	•	X	•	•	X	X
	Construction, property & surveying (18)	•	•	•	•	•	•	•	•	•	X	•
	Earth sciences, environmental sciences/studies (1)	•	•	X	X	•	X	•	•	X	X	X
	Engineering (4)	•	•	•	X	•	•	•	X	•	X	X
	Geography (3)	•	•	•	X	X	X	•	•	X	X	X
	MSOR (9)	•	•	•	X	•	•	•	•	•	X	X
	Pharmacy (1)	X	•	•	X	X	X	X	X	•	X	X
	Physics, astronomy & astrophysics (3)	•	•	•	X	•	•	•	•	•	X	X
	Psychology (42)	•	•	•	X	•	•	•	•	•	X	X

Table 25: Tutors' indications of types of tasks (•) in which undergraduates' numeracy skills are explicitly assessed

Faculty	Discipline (total no. of respondents)	Class tests	Assignments	Practical, laboratory or clinical work (e.g. practical write-ups)	Work placements	Workbook(s) or worksheet(s)	Numerical problem-solving exercises	Data interpretation exercises	Statistical analyses	Exams	OSCEs (Objective Structured Clinical skills Examinations)	Not explicitly assessed
Arts, Humanities & Social Sciences	Art and design (2)	X	•	•	•	•	•	X	X	X	X	X
	Communication, media, film & cultural studies (3)	X	•	•	X	X	X	•	•	X	X	•
	History (2)	X	•	X	X	X	X	X	X	X	X	•
	Linguistics (1)	X	X	X	X	X	X	X	X	X	X	•
Health & Social Care	Health studies (8)	X	X	•	•	X	X	X	X	•	X	•
	Midwifery (5)	X	X	•	•	X	•	X	X	X	•	•
	Nursing (26)	•	•	•	•	•	•	•	•	•	•	•
	ODP (3)	•	X	X	•	•	•	X	X	X	X	X
	Physiotherapy (2)	X	X	X	X	X	X	•	•	X	X	•
Manage-ment	Business & management (13)	•	•	•	•	•	•	•	•	•	X	•
	Hospitality, leisure, sport & tourism (4)	X	•	•	X	X	X	•	•	X	X	X
Science & Technology	Agriculture (2)	•	•	•	X	•	•	•	•	•	X	X
	Archaeology (1)	X	•	•	X	•	•	•	•	X	X	X
	Biomedical science (1)	X	•	•	X	•	X	X	•	•	X	X
	Biosciences (9)	•	•	•	X	•	•	•	•	•	X	X
	Chemistry (3)	•	•	•	X	X	•	X	X	•	X	X
	Construction, property & surveying (5)	•	•	•	X	X	•	•	X	•	X	•
	Engineering (6)	•	•	•	X	X	•	•	•	•	X	X
	Pharmacy (3)	•	•	•	X	•	•	•	•	•	X	X
	Physics, astronomy & astrophysics (1)	•	•	•	•	•	•	•	•	•	X	X
	Psychology (7)	•	•	•	•	•	•	•	•	•	X	X

Undergraduates and tutors were asked in which teaching and learning tasks students' numeracy skills were assessed. The three most popular tasks selected by responding undergraduates included assignments (54%), exams (47%) and practical, laboratory or clinical work (44%). Nursing, business and management, and several disciplines within Science and Technology provided the greatest diversity of tasks in which students' numeracy skills are explicitly assessed. Students' perceptions that the disciplines of art and design, education studies, English and social work did not explicitly assess their students' numeracy skills (Table 24) may be due to the small sample sizes or may be a reflection of the students' experiences to date. Tutors' responses indicated that the two most widely adopted methods for assessing students' numeracy skills were assignments (16 disciplines) and practical, laboratory or clinical work (17 disciplines) (Table 25). The explicit assessment of numeracy skills in class tests and exams was a strategy adopted by only 11 and 12 disciplines respectively.

Appropriate assessment strategies were viewed as essential in promoting students' conceptual understanding:

Well the assessment is just about to change entirely. I've changed it all... Coming September there won't be any written course work on the statistics. They're going to be doing a computer test. ...They want to have the time to understand the calculations behind the statistics. So we've doubled the amount of time they can have hands on with the steps in a workshop. So four weeks of practical and then they have a practical assessment. Seventy five percent of the module will now be assessed by the practical core statistical skills. (Psychology tutor 2)

We are changing it again this year to make less course work assignments and more open book - not tests as such but open book assessments. But again we do have problems with plagiarism in coursework, students just copy off each other ...... so that becomes an issue when they do their third year dissertation - they don't understand. So it is making sure that students are in their own merit understanding what they are doing, which hopefully with these additional podcasts and things it will help. (Psychology tutor 1)

RECOMMENDATION 11: Some disciplines within UCLan may wish to consider using a greater diversity of tasks in the assessment of their students' numeracy skills, in order to cater for students' different learning approaches. The introduction or increased use of class tests and examinations for both formative and summative assessment of numeracy skills may be appropriate for some disciplines, since these can provide less opportunity for collusion or plagiarism between students. In addition, some disciplines may wish to explore the use of *eLearn (WebCT)* and/or *QuestionMark Perception* to develop and deliver online self-assessment and summative tests, where and when appropriate.

Students' overall view of their course experience (with regard to numerical components)

Students were provided with twenty Likert items (strongly disagree = 1, to strongly agree = 4), modified from those used previously by Crawford *et al*. (1998a) and which form the basis of the Course Experience Questionnaire (CEQ) used by Ramsden (1991). The mean item score for the entire scale of 20 items was 2.6, while that for each of the five sub-scales ranged from 2.6 to 2.9 (Table 26). Similar statistics were obtained when students' course experience scores were broken down by faculty (Table 27). These data, in conjunction with the median and mode values for individual items, indicated that students' perceptions of their course experience and learning environment with regard to numerical components of their course were largely positive.

Table 26: Summary of students' course experience scores

		Number of items	Mean item score (SD)	No. of students
Sub-scales:	Clear goals	1	2.9 (0.8)	333
	Good teaching	12	2.6 (0.5)	306
	Appropriate workload	2	2.9 (0.7)	322
	Assessment	3	2.8 (0.5)	320
	Independence	2	2.6 (0.6)	323
Scale:	Overall course experience	20	2.6 (0.4)	299

Table 27: Summary of students' course experience scores by faculty

		Mean item score (SD)			
		Arts, Humanities and Social Sciences (N = 16-19)	Health and Social Care (N = 102-120)	Management (N = 47-51)	Science and Technology (N = 126-135)
Sub-scales:	Clear goals	2.8 (0.6)	2.9 (0.9)	2.8 (0.8)	3.0 (0.7)
	Good teaching	2.6 (0.5)	2.5 (0.5)	2.6 (0.4)	2.6 (0.5)
	Appropriate workload	3.6 (0.5)	2.9 (0.6)	2.6 (0.7)	2.9 (0.7)
	Assessment	2.6 (0.6)	2.8 (0.5)	2.7 (0.6)	2.8 (0.5)
	Independence	2.7 (0.5)	2.6 (0.6)	2.6 (0.5)	2.5 (0.5)
Scale:	Overall course experience	2.7 (0.3)	2.6 (0.3)	2.6 (0.3)	2.7 (0.4)

Within the focus group sessions, students compared the teaching methods of different tutors and indicated that they preferred methods that enabled them to obtain more 'hands on' practice, as opposed to those which simply involved them being told what to do:

> *He'll [the lecturer] put one calculation on the board for you and you have to work through it and then at the end he'll go through each of the questions with you and the answers and if you don't understand you can go back to him in class. ... the lecturers at university are really helpful.*
>
> (Biomedical science, year 3, female student)

To whom or to what do students turn for help?

Students were asked to indicate to whom or to what they would turn for help if experiencing difficulties with numerical elements of their curriculum. The top three sources of help selected by > 30% of undergraduates were the lecturer (48%), friends on the same course (i.e. peers) (44%) and books (39%) (Fig. 17). Amongst the least popular chosen from the list provided were postgraduate demonstrators, WISER, university workshops and CBL materials. However, some of the least popular selections may reflect the lack of availability of help from such sources or a lack of awareness that they exist.

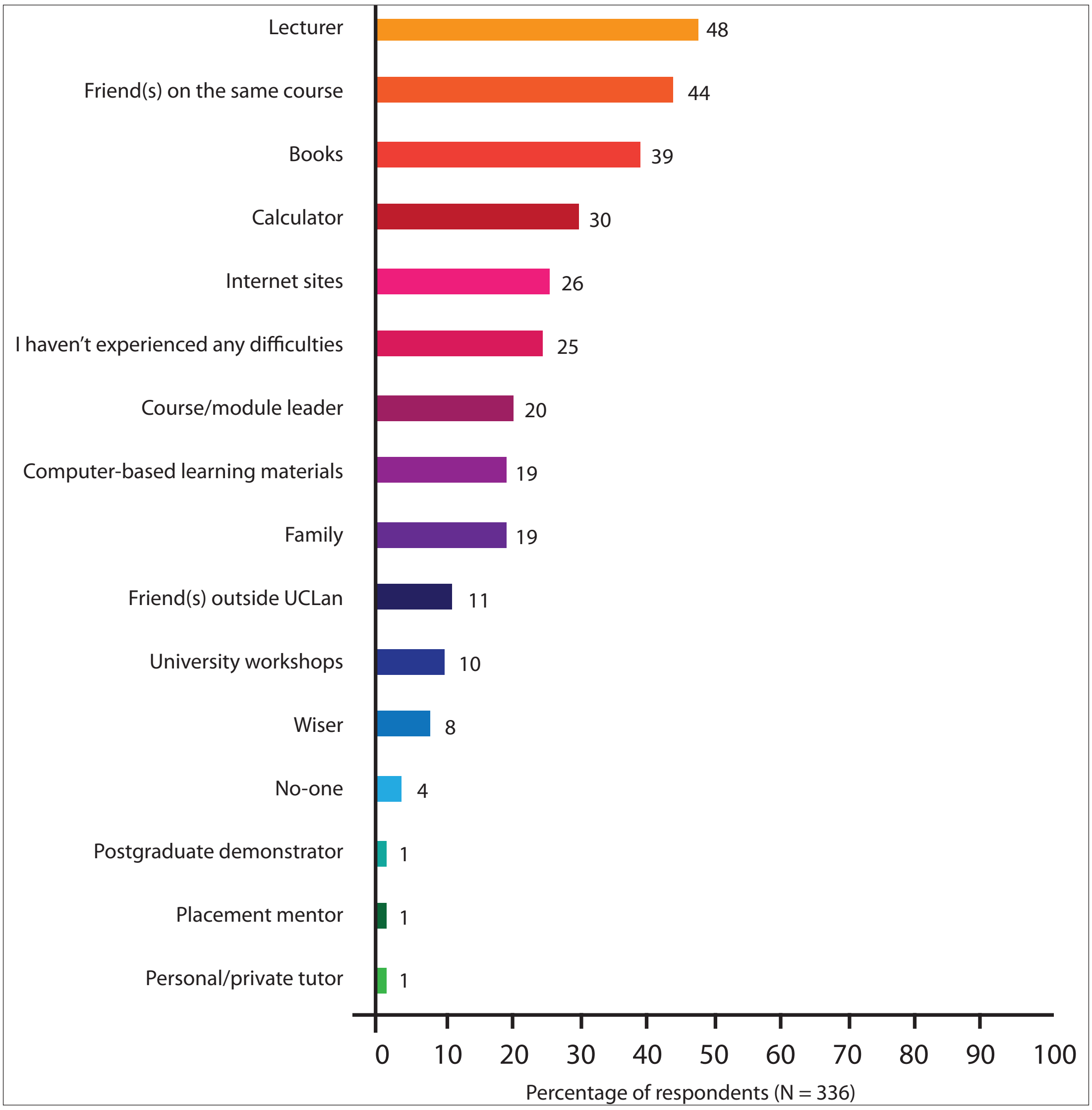


Fig. 17: Sources of help to which undergraduates turn when experiencing difficulties with numerical elements of the curriculum

RECOMMENDATION 12: Since responding students expressed a preference for peer support (i.e. help from friends on the course), in disciplines where tutors have insufficient time to devote to extensive one-to-one tutoring, departments within HEIs (including UCLan) should explore the design and introduction of peer-tutoring schemes or sessions, as well as greater use of ICT (e.g. direction to appropriate websites, access to CBL materials and/or online self-assessment tests).

Do tutors believe their programmes could or should do more to support students' numeracy skills?

When tutors were asked whether their programmes could or should do more to support the development of undergraduates' numeracy skills, 84% of respondents believed that they should. Amongst the explanations provided by the 19 respondents who did not believe that their programmes could or should do more were the following comments:

> *Not applicable* (English tutor)
>
> *It is not our responsibility to teach maths - we are HE and our students should have these skills as a prerequisite to joining our programmes* (Psychology tutor)
>
> *The programmes are already full and demanding and students need to take some responsibility. They come in with a certain level and should they need further support, there should be somewhere at university level available. Although I can do maths, I cannot teach it or explain how I arrived at the answer. It needs to be taught by people competent at teaching maths.* (Nursing tutor)
>
> *Students are required to have GCSE Maths or equivalent at entry level to the programme (General Social Care Council requirement), and I feel that this is adequate for the numeracy skills required within the profession.* (Social work tutor)
>
> *Students admitted to our programme with a prerequisite level of maths - if this is not enough to meet our needs then we need to look at changing this not plugging the gap ourselves. The curriculum is already crowded I do not believe we could meet the required professional standards if we were to have to include this in the programme as well.* (Physiotherapy tutor)

These comments reflect the fact that in some cases the development of numeracy skills was perceived to have no direct relevance to the discipline (e.g. English, counselling), while in other cases respondents believed that adequate support was already provided (e.g. biosciences) or that their students' numeracy skills were already adequate (e.g. social work, physiotherapy). In many cases, respondents' believed that there was either insufficient time available in an already demanding curriculum (e.g. chemistry) or that as higher education providers it was not their task to strengthen the numerical competence of their undergraduates (e.g. psychology) and that if skills gaps existed they should be dealt with at university level (e.g. nursing) or through tightening admissions procedures so that only those students possessing the requisite levels of competence were admitted on to degree programmes.

Types of support within programmes

Students and tutors were asked what types of support might help students further develop and practise their numeracy skills within their programmes of study. Items selected by >30% of students included greater access to online CBL materials, drop-in sessions, more small group teaching, a brief revision guide containing useful equations and calculations, more one-to–one help, and more use of workbooks and worksheets (Table 28). The first three items were also selected by ≥ 50% of tutors, along with the use of diagnostic tests to determine the initial numerical competencies of students.

Arts, Humanities and Social Sciences: Items favoured by students included an optional subject-specific introductory maths module, and direction to good maths support websites, while items favoured by tutors included one-to-one help, greater access to online computer-based learning (CBL) resources, emphasis on explaining the how, why and processes involved in numerical methods and small group teaching.

Health and Social Care: The item students favoured the most was drop-in sessions, selected by respondents from all four disciplines that incorporate some numerical elements. Although nursing students would like to see all the listed items implemented, their top five selections included more use of workbooks or worksheets, a brief revision guide, drop-in sessions, more one-to-one help and access to online CBL resources. Items tutors favoured included one-to-one help, drop-in sessions, using diagnostic tests, and greater access to online CBL resources.

Management: Students from Management also favoured drop-in sessions the most, although other popular suggestions included a brief revision guide, access to online CBL resources, more one-to-one help, more use of workbooks or worksheets, more small-group teaching, an optional subject-specific introductory maths module and more recommended text(s). Items tutors favoured included providing recommended text(s), drop-in sessions, use of workbooks or worksheets, a brief revision guide containing useful equations and calculations, using diagnostic tests, greater access to online CBL resources and maths support websites, small group teaching and greater integration of numeracy within subject-specific modules.

Table 28: Selections for improving students' numeracy skills within programmes of study

Item	Percentage of respondents	
	Students (N = 336)	Tutors (N = 121)
Greater access to online computer-based learning resources	40	58
Use of diagnostic tests	15	53
Small group teaching	32	51
Drop-in sessions	34	50
One-to-one help	35	48
Use of workbooks or worksheets	34	47
A brief revision guide containing useful equations/calculations	46	45
Emphasis on explaining the how, why and processes involved in numerical methods	27	44
Direction to good maths support websites	29	40
Revision sessions on basic numeracy skills at the beginning of the module or programme	26	35
Greater integration of numeracy within subject-specific modules	13	33
Regular testing	21	30
Lectures dedicated to numeracy skills	17	30
Focus on mental arithmetic	23	28
Providing recommended text(s) to assist with numeracy skills	15	28
An optional subject-specific introductory maths module	22	21
Pre-university summer course offered by the discipline	9	20
A compulsory subject-specific introductory maths module	11	12
None	9	9
Guest tutor/facilitator who is expert in teaching quantitative skills*	NA	2
Streaming by competency*	NA	1

*Suggestions offered by tutors under 'other'

Science and Technology: The item students favoured was a brief revision guide, selected by respondents from 12 out of the 14 disciplines represented. Other popular suggestions included access to online CBL resources, more small-group teaching, more one-to-one help, drop-in sessions and emphasis on explaining the how, why and processes involved in numerical methods. Items tutors favoured included a brief revision guide containing useful equations and calculations, using diagnostic tests, focus on mental arithmetic, emphasis on explaining the how, why and processes involved in numerical methods, revision sessions on basic numeracy skills, and small group teaching:

> *I think the workshops - because we have workshops - are really helpful and really they do help a lot. Because you can put it into particular contexts and you see 'right, I need to do this bit here, I don't understand that bit'. You can isolate it all, whereas in a lecture they've got to deliver a certain amount of material in a certain period of time, so they can't keep stopping for each individual person. The workshop's the place for that. Ideally, I would have more workshops. I think there is a call for that and that would be very helpful.* (Male, year 2, psychology, year 2 undergraduate)

In interviews, nursing tutors acknowledged the difficulties involved in helping students develop their numeracy skills:

> *I think, from my colleagues' point of view - the majority of them - the discussion was we're not maths teachers, and we shouldn't be teaching maths, and we haven't got time to teach maths. ...... but we still think that it's a skill that they need to develop and we should support them with that, because at the end of the day mistakes are made, and if you look at the research, medication errors is one of the biggest errors that nurses make, regardless of whichever, child, adult, mental health. So we think the emphasis of it should be raised higher so that everybody is made aware of the importance - and with the new curriculum, hopefully it will be.* (Nursing tutor 2)

In spite of the hurdles, numeracy skills were emphasised in the revised nursing curriculum and more regular testing and the involvement of more staff in the teaching of numeracy skills had been adopted in nursing programmes:

> *An entirely new curriculum would be offered from September 2009 in which every single module taught within the School of Nursing and Clinical Studies will have either been revised or some may have been replaced... I assume that many of them would incorporate numeracy to take account of the government's recommendation on key skills. Again, the level of complexity of numeracy skills would vary depending on the branch and module.* (Nursing Tutor 1)

There's going to be more tests, we're looking at tests within some of the modules, and again a numerical element to most of the teaching so that when students are in class and they're looking at drugs and things like that, they'll be focusing on their ability to be able to perform calculations effectively. (Nursing tutor 2)

As with psychology, nursing students (particularly those in the Child Branch) were being offered several forms of support with their numeracy skills:

... within the module that I teach ... they have regular drop in sessions for numeracy, and they have regular numeracy supervision - there's lots of numeracy resources on the eLearn site that's related to that module. ... We do try to keep some records of any tests we give them maths wise and [a colleague] tends to keep records so that we can see whether they are actually improving. I think the biggest record I can see for improvement is when I took over this module and introduced this maths exam - our pass rate was very, very low, it was less than 40% and since we've introduced more numeracy supervision and more help and practice, it has actually come up - I think out of last year, out of our group of 45, we actually only had five who failed in the numeracy element so we are seeing improvements. (Nursing tutor 2)

So, very soon after starting they do a drug administration session, and that's when we first introduce the numeracy to them, and then following that they do a numeracy drop in, and that's when they do their first test. And we use that as a diagnostic test .... And then throughout other sessions through the year depending on what we're teaching, we might just throw in a test. (Nursing tutor 2)

I also put practice questions on numeracy for students on the WebCT [eLearn]. In addition, I direct students to skills learning resources and useful websites on numeracy resources and drug calculations through WebCT. Students also use an online discussion forum to get support for any numeracy problems. We also have drop-in sessions for numeracy skills. Furthermore, mentors in practice may deal more with numeracy. (Nursing tutor 2)

Perceived barriers to adopting a more proactive approach towards supporting the development of undergraduates' numeracy skills within programmes of study

Table 29 summarises the selections tutors made when asked what they perceived to be the main barrier(s), if any, to adopting a more proactive approach towards supporting the development of students' numeracy skills within their programme(s). Potential barriers selected by the greatest numbers of tutors, and reflected in responses from across all four faculties, included: fear of loss of subject time (60%), lack of trained staff (45%), staff expectations that students embarking upon programmes already possess the necessary skill competencies (39%), lack of necessary numeracy skills/mathematical expertise amongst staff (27%), and perceived lack of the value of numeracy to the subject/discipline (24%).

Table 29: Perceived barriers to adopting a more proactive approach towards supporting the development of students' numeracy skills within programmes of study

Item	Percentage of tutors (N = 121)
Fear of loss of subject time to accommodate numeracy skills	60
Lack of staff trained specifically to support numeracy/mathematics	45
Staff expectations that students embarking upon programme already possess necessary numeracy skills	39
Lack of necessary numeracy skills/mathematical expertise amongst staff	27
Perceived lack of the value of numeracy to your subject/discipline	24
No barriers	9
Student recruitment and retention targets	5
High staff workload	2
Lack of dedicated time	2
Student attitude	1
Lack of financial support	1
Entrants' poor maths skills	1

A shortage of time was perceived as a hindrance to tutors being able to pursue strategies aimed at fostering students' deep learning:

> *Because teaching time is limited, and because staff time is very pressurised, I don't feel that we have enough time to really explain the background to statistics (i.e. how everything is derived) in a way that students find meaningful. They get the theory in their lectures, but I don't think they find it easy to tie that in with the practical elements (e.g. use of SPSS), and by the time they're getting to grips with the practical stuff, the theory is just a distant memory.* (Psychology tutor in the survey)

In an attempt to provide students with additional help, while at the same time reducing the time-pressure on staff, in 2009/10 the School of Psychology introduced podcasts:

> *We are this year putting on podcasts as well as additional help ..... I mean we have time pressures over staffing as well ... we would love endless time. The podcasts will help because that is a different class if you like for the students to go to.* (Psychology tutor 1)

Central support provided by the university

A majority of tutors (55%) believed that the university could or should do more to support the development of students' numeracy skills, while a further 42% selected 'perhaps'. Amongst the explanations provided by the four respondents who did not believe that the university could or should do more were the following comments:

> *University already does everything reasonable.* (Business & management tutor)

> *Students will only overcome their resistance to maths when they can see immediate applications and benefits within the subject area.* (Communication, media, film and cultural studies tutor)

> *Students should have these skills when they arrive.* (Psychology tutor)

When asked what types of central support facilities and/or strategies, if any, the university should provide or adopt to better support students in the development and practice of their numeracy skills, those favoured by more than 45% of responding students included drop-in sessions, greater access to online CBL resources, one-to-one help and self-assessment tests (Table 29). More than 50% of tutors also favoured drop-in sessions, greater access to online CBL resources and one-to-one help, along with the establishment of a central maths support unit (Table 30).

Arts, Humanities and Social Sciences: Central support strategies favoured by > 40% of responding students included drop-in sessions (61%), greater access to online CBL resources (54%), an optional general maths/statistics/numeracy course (53%), self-assessment tests (43%), and direction to good maths support websites (42%). Central support strategies favoured by tutors included self-assessment tests, diagnostic tests, greater access to online CBL resources, and direction to good maths support websites.

Health and Social Care: The preferences selected by > 40% of students included drop-in sessions (71%), more use of workbooks or worksheets (54%), self-assessment tests (48%) and direction to good maths support websites (41%). Central support strategies favoured by tutors included one-to-one help, drop-in sessions, greater access to online CBL resources, and sessions which place emphasis on explaining the processes involved in numerical methods.

Management: Central support strategies favoured by > 40% respondents included drop-in sessions (47%), greater access to online CBL resources (43%) and one-to-one help (42%). Central support strategies favoured by tutors included use of workbooks or worksheets, diagnostic tests, and greater access to online CBL resources.

Science and Technology: The preferences of > 40% of students included a brief revision guide containing useful equations and calculations (56%), drop-in sessions (54%), one-to-one help (50%), direction to good maths support websites (48%), self-assessment tests (47%), greater access to online CBL resources (46%), sessions placing an emphasis on how, why and processes of numerical methods (43%), an optional general maths/statistics/numeracy course (42%) and use of workbooks or worksheets (41%). Central support strategies favoured by tutors included drop-in sessions, greater access to online CBL resources and establishment of a central maths support unit.

Strategies favoured by tutors from two or more faculties included: greater access to online CBL resources, drop-in sessions, and diagnostic tests to help determine the initial numerical competencies of students.

Table 30: Selections for central university support for numeracy skills

Item	Percentage of respondents	
	Students (N = 567)	Tutors (N = 122)
Drop-in sessions	61	65
Greater access to online computer-based learning resources	47	56
Establishment of a central university maths support unit	32	55
One-to-one help	47	52
Diagnostic tests to help determine initial numerical competencies of students	34	44
Self-assessment tests for students	46	43
Direction to good maths support websites	43	43
A brief revision guide containing useful equations and calculations	44	43
An optional general maths/statistics/numeracy course	40	37
Sessions which place emphasis on explaining the how, why and processes involved in numerical methods	32	36
Use of workbooks or worksheets	42	34
Providing more recommended text(s)	21	29
Sessions focusing on mental arithmetic	35	25
None (any support should be subject specific/integrated in subject)	1	3
Specialist staff*	-	2
Increase entrance qualification*	-	1

**Suggestions offered by tutors under 'other'*

Both the psychology tutors interviewed were of the opinion that psychology students could benefit from some training in basic numeracy skills offered centrally at university level; anything more specific could be dealt with in the discipline. The nursing tutors also favoured the use of such a facility:

> *I do think they need something like WISER for maths to help students. ... Just sessions for them to go to get practice at maths with somebody specifically that teaches numeracy, so that they can look at the different ways of doing it, and understand different methods* (Nursing tutor 2)

How would students prefer to further develop and practise their numeracy skills?

When students were asked how they would prefer to further develop and practise their numeracy skills, the top three preferences selected by ≥ 40% of respondents included the use of CBL materials (58%), small group tutorials or workshops with a lecturer (53%) and working their way through a textbook (40%) (Fig. 18).

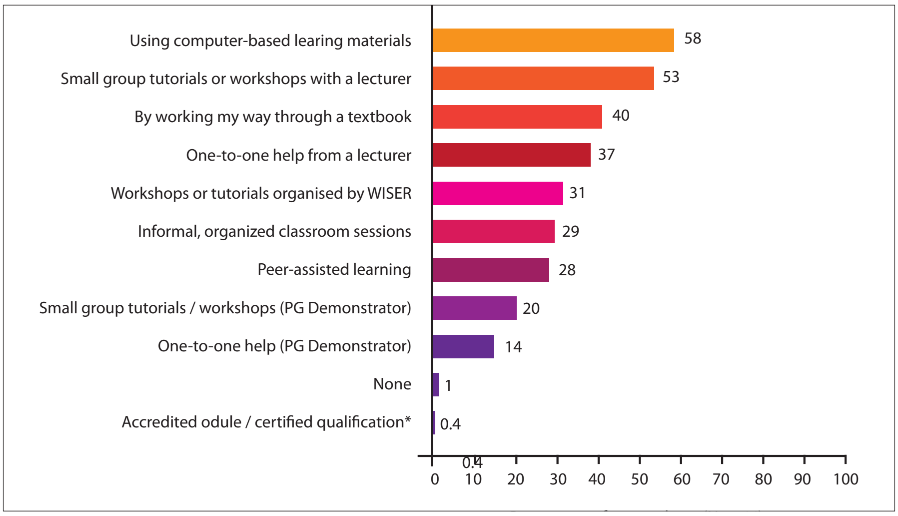


Fig. 18: Undergraduates' preferences for further developing and practising their numeracy skills (an additional proposal from respondents)*

Arts, Humanities and Social Sciences: Options selected by > 40% respondents included the use of CBL materials (63%) and small group tutorials or workshops with a lecturer (44%).

Health and Social Care: Options selected by > 40% of respondents included small group tutorials or workshops with a lecturer (56%), the use of CBL (43%) and by working their way through a textbook (42%).

Management: Options selected by > 40% of respondents included the use of CBL materials (55%) and small group tutorials or workshops with a lecturer (42%).

Science and Technology: Options selected by > 40% of respondents included small group tutorials or workshops with a lecturer (64%), the use of CBL (56%), one-to-one help from a lecturer (46%) and by working their way through a textbook (43%).

Focus group sessions enabled further discussion on the following:

Peer support

Many students acknowledged either helping or seeking help from their peers and recognised the benefits of peer assisted learning both to those who sought such support and to those who provided it:

> *When we are doing our assignments, because I like the maths bit of it, like ...... and doing the logs, and rather than going to the lecturer or whatever, they'll ask me to help them with it or like we'll all discuss it between us rather than going to one of the lecturers or something.*
>
> (Female, year 2, psychology undergraduate)

> *Well, normally people ask me because all my friends usually give up and willingly admit that 'Oh I can't be bothered with it and I give up', so I usually try and explain things to them.*
>
> (Female, year 2, business studies undergraduate)

> *It kind of helps me because sometimes I'm working it out while I'm trying to explain it to them.*
>
> (Female, year 2, business studies undergraduate)

> *In the initial stages you'd get together and perhaps help each other out and do your work, sort of like round a table like this together, as opposed to going to the lecturer and asking for help or asking for help during the seminar. It became more comfortable for us all to do that.*
>
> (Female, year 3, business studies undergraduate A)

Students offered several reasons for preferring peer support over seeking help from lecturers, including friends being more approachable, the absence of any formal and cognitive hierarchy helping improve the learning process, and students finding admission of their lack of understanding to tutors embarrassing:

> *It's so much easier to explain it to your peers. Whereas if it's a lecturer it's their daily routine, so they kind of skip hurdles that would make it so easy to connect in our head. They skip them and just expect us to understand the terminology and stuff that they're using.*
>
> (Male, year 3, forensic science undergraduate A)

> *It is easier to ask your friends than the teachers. Teachers are more distant.*
>
> (Female, year 3, accounting undergraduate)

> *They're [peers] very friendly. Sometimes students get scared to go to the lecturers thinking that they're going to reject them and say that 'you should have listened in the lecture'. So you find it much easier to go to your friends because they probably understand it as much as the lecturers do, but they put it in an easier context for you to understand.*
>
> (Female, year 2, psychology undergraduate)

> *As approachable as your lecturer may be, it's a lot easier to communicate with your peers than it is to communicate with a lecturer, especially because that's the person that you're trying to impress. You don't want them to think badly of you, so it's a lot easier to and if you don't understand anything, you can just sort of say 'come on sort it out, mate'.* (Male, year 3, forensic science undergraduate B)

Peer support appeared to be particularly attractive and useful to mathematically weak students who, often out of a sense of embarrassment, felt they could not seek help from their tutors:

> *Because I have no idea what's happening in Stats at all, I don't want them [tutors] to know this. Because if they asked what I wanted them to explain, it would be just like the whole class [lecture]. They would obviously think she either had not attended the lecture or she just hadn't paid any attention. I'd rather ask my friends because they can sit and just relax 'right you have to do this' and really fill the gap. Whereas if I was asking the teacher I'd feel obliged to kind of say I understand this. If the teacher kind of explains it a bit, I have to kind of say 'Oh, yeah now I get it' because they have made the effort to teach you.* (Female, year 1, psychology undergraduate)

When asked about the use of peer support, tutors acknowledged its usefulness, even if it was not adopted formally:

> *...although there's a big emphasis on mentoring in the university as a whole, there isn't really much support for it or resource or encouragement and I would be given no resource or timetable for organising anything like that.* (Management tutor)

> *Yeah, we do encourage them. Whilst they're in these numeracy sessions they work with others there. And they do discuss and I know sometimes if a student is struggling she will say to her friends,' how have you got the answer, what do I do?', and then they will compare and they'll talk through it. (Nursing tutor 2)*

Postgraduate tutors

Some students were in favour of having more support from postgraduate tutors (demonstrators), often for the reasons also cited for peer support:

> *We have the stats sessions with the postgrad. students, so you feel a lot less intimidated when you don't understand, because they are lecturers, but they're students as well and they've not long since finished their degree as well. It's a lot easier to talk to them.*
> (Female, year 3, forensic science undergraduate)

Personal tutors

> *It emerged that every nursing undergraduate is assigned a 'personal tutor' who 'is normally a good point of call for a generalized subject, like saying 'I am struggling with maths'. They can either help or direct you to somebody who will help.'* (female, year 2, nursing undergraduate A)

Drop-in sessions / a different lecturer

Forensic science undergraduates highlighted the use of drop-in sessions, which offered help with specific problems. However, they indicated that they would like to see drop-in sessions where they could seek more general help, i.e. not necessarily linked to the specifics of the course:

> *We have drop-in sessions for statistics, but we're told they're for if you've got a specific problem. Like say for example, you did something on statistics and you think 'Oh I didn't really understand that, I'll go to the drop-in session' - you're advised not to do that. You're advised to go to the drop-in session if you've got a really specific problem. So, if you're actually thinking 'Well I haven't got a specific problem, I just need a bit of extra help' and you think well that's not what they're there for, so maybe there should be something different.* (Male, year 3, forensic science undergraduate A)

> *I think that's another example of why it's really important .... that there's someone else there that you can approach because sometimes you just can't understand what somebody is saying and if somebody else puts it another way it becomes more understandable. And it's not a reflection on their teaching skills it's just sometimes the way they're putting it helps to make it a bit more interesting sometimes.* (Female, year3, business studies undergraduate A)

Drop-in sessions were also favoured by mature students who often have other responsibilities (e.g. children, family commitments).

WISER

Year 3 students, who had sought help from WISER (UCLan's Study Skills Support Unit) with regard to numeracy in their first year of study, bemoaned the fact that this source of help was no longer available to them:

> *They took them off, the maths [help], and I've had a lot of problems with that because I'm a course rep ... and I've had the Foundation people complaining that the WISER skills have been dropped for maths. I don't think they were there last year either. They were there when we were new first years, but last year they were dropped. I know a lot of people that have complained about those and I've mentioned it at several meetings, but they've not been put up yet.*
> (Female, year 3, forensic science undergraduate)

Workshops

Students, whose courses comprised a lot of lectures, particularly favoured the use of workshops for any future numeracy support:

> *Like with mine, it's all lecture-based and then you either have to make an effort to go and see your lecturer or you'd have to put in a lot of effort, but I think with a simple workshop… not even necessarily for everyone.* (Male, year 3, forensic science undergraduate B)

Irrespective of the type of support offered, tutors believed that those students in most need of support were the ones least likely to avail themselves of it:

> *No, it's very curious and unless you've been in this business it's difficult to believe this. You would think that students have their own best self interests at heart but in fact they do some curiously illogical things, and if they're very weak they're more likely to miss classes than to go to more classes. ...Now, it maybe something to do with their anxiety, fear, or it maybe something to do with lack of commitment, it may be motivation in general, who knows? But for whatever reason, it's the weaker students that tend not to attend. It's counter-productive.* (Management tutor)

> *...sometimes students are not engaging with what we are putting on...So we do put on sessions but whether students choose to attend or not is an issue. The problem is you will know it is usually ones that don't need to attend who are attending. Again maybe because they don't like it or you know they hope it goes away* (Psychology tutor 1)

> *You know, it's down to the individual student ultimately to take advantage of the resource that is available. And they don't all take advantage of it...* (Psychology tutor 2)

RECOMMENDATION 13: Since, with regard to students' learning, 'one size will not fit all', institutions (including UCLan) should ensure that the diversity of students' preferences, needs and circumstances are taken into account when devising strategies aimed at better supporting students' numeracy skills development, either within curricula at departmental level and/or centrally at university level.

RECOMMENDATION 14: HEIs (including UCLan) should ensure that the development of their undergraduates' and postgraduates' numeracy/quantitative skills is included in any appropriate existing or future institutional strategies, and establish coherent and consistent information throughout the university, enabling students to be readily directed to the numeracy skills resources (online and physical) which can support them in their academic studies and/or in enhancing their employability.

8.1.3. Current 'numeracy' support at UCLan and elsewhere

Maths/numeracy support at UCLan

From discussions with UCLan's student support units it emerged that the general enquiry unit, the 'i', had received enquiries for maths support and that these were being referred to WISER (the students' study skills support unit). At that time WISER happened to have someone who could deal with some enquiries of this nature even though this was beyond the remit of the unit. Some students (mainly on nursing courses) went directly to WISER seeking help with their numerical work. As the number of students seeking help increased WISER had to ask the 'i' to refrain from referring these students as there was a danger that the unit's core work would suffer.

'Futures' (UCLan's careers and employability support unit) did offer support with psychometric testing but this support did not extend to the numerical sections of such tests or cover the Qualified Teacher Status (QTS) test for qualifying teachers. Since October 2009 a small course entitled 'Maths confidence for the world of work' has been offered as part of the optional 'Futures Award'. On the university's website there are various links to support materials for general study skills, e.g. general modules within eLearn (virtual learning environment) and others accessible from WISER or TAG (The Alternative Guide provided by the Students' Union). However, no additional support was provided via any of these web addresses. This provision is now being rationalised as communication between WISER, Futures and TAG has been established through this project.

Discussions with tutors revealed agreement with findings in the surveys, in that certain subjects had particularly problematic aspects within their curricula, e.g. biomechanics for sports science, dosage calculations for nursing and SPSS for psychology students. There was evidence of good practice in supporting students' quantitative studies but it was piecemeal and depended on particular members of staff. For instance, the current Student Liaison Officer in Health and Social Care is able to offer maths support but this is beyond his job description and he is in post for only one year.

A Faculty of Management workshop entitled *'Numbers, numbers, numbers'* was held in March 2009, in conjunction with UCLan's Centre for Research-informed Teaching (CRiT). Sixteen lecturers attended, with representatives from most of the nine divisions in the faculty's two schools (Lancashire Business School, and School of Sport, Tourism and the Outdoors). The aim of the workshop was to establish how the faculty should focus on numeracy development, with an emphasis on courses and employability. This workshop reinforced the findings of the tutor and student surveys with the following comments being recorded.

Fear:

> *Students' and staff's fear of numbers gets in the way.*
>
> *Staff may tend to collude with the students to avoid the issue….we all keep in our comfort zone.*

Curriculum:

> *Numbers are stripped out of the curriculum because they are 'difficult'.*
>
> *Students often avoid courses or modules with 'numbers'.*
>
> *Integrating numbers within the modules would be beneficial but not easy.*
>
> *Numeracy should be a theme throughout a degree course and not just a Year 1 module…could be an element of PDP.*
>
> *We may need to avoid badging modules as 'maths', or even 'numeracy'….ensure students see the development of their skills in this area as a 'means to an end'….*
>
> *The timetabled time allocated to doing 'numbers' needs to be reviewed and the group size… .ensure this is reflected in validated module descriptors.*

Testing/assessment:

> *Tests are avoided as failure is anticipated and this brings problems for staff as well as students….modules with 'high' failure rates attract 'management attention'...*

Employability and relevance:

> *We need to raise students' awareness of how important 'numeracy' is for employers…and that they will test candidates on entry.*

Support for staff:

> *Knowing where to go for help and sharing practice would be useful.*
>
> *Try to team-teach modules so that a 'numerate' colleague can be involved.*

This lack of clarity over where students could go for support was also found by the student intern as he performed his 'secret shopper' exercise, visiting UCLan's support units as a prospective student enquirer.

Maths/numeracy support elsewhere

In July 2009 a visit was made to the Mathematics Learning Support Centre (MLSC) at Loughborough University to see a dedicated support facility. Their attractive premises provided a permanent base for mathematics support. Handouts, books, computers and meeting space were all available. Timetables were displayed for workshops, drop-in sessions and software support. Support for QTS tests was offered to 2nd and 3rd year students and there was separate provision for those who had maths on their course and those who had not. Students were self-referred to the centre, but proactive advertising of facilities was carried out by targeted emails and the use of student ambassadors (one per faculty) during all induction programmes. There was also a separate centre (Eureka Centre) for SWANS (Students With Additional Needs) which catered for students with maths phobias in addition to those with disabilities.

This provision had taken several years to build up, but in their role as a CETL they provided advice to universities on how to establish and operate smaller scale support schemes. Their advice included considering using the library as the central meeting place if appropriate, offering a drop-in session even if only for one hour per week, and ensuring that leaflets and workbooks are readily available. The importance of choosing the 'right' staff was emphasised, i.e. people who can offer support as well as maths help were needed. However, a reliance on too few people was hazardous as a scheme could lose momentum when a key person left. In their experience maths support is a good selling point for a university and its representation at open days should be ensured.

Support Materials

There is a multitude of good online support materials for quantitative subjects. This was highlighted by the SUMS workshop at Anglia Ruskin University in December 2008, where representatives from BBC Skillswise, the Open University, and the National Centre for Excellence in Teaching Mathematics (NCETM) were among those present and a database of resources was established. This database has been extended and is now available as a searchable database (at http://www.step-up-to-science.com/sumsv3/index.php).

It became apparent very quickly that the challenge in directing students to support materials was not one of finding materials on any given subject, but of determining a route to materials of an appropriate style for any particular learner. It was also important that any route not be too long, or beset with sites that are hard to navigate so that the student gets disheartened and gives up. This aspect of directing or signposting students to appropriate support was an aspect of the work of the CRiT intern's project.

Research-informed Teaching intern project

An undergraduate intern (funded by UCLan's Centre for Research-informed Teaching) worked with us for 10 weeks during the summer of 2009. He investigated what 'numeracy' support was currently available at UCLan from a student's perspective by acting as a 'secret shopper', interviewed other undergraduate interns to record what maths support would be useful for their courses, visited the MLSC at Loughborough and attended the MSOR conference at the Open University (September 2009). The ultimate aim was to provide reliable signposts to sources of support for a wide range of numerical work tailored for particular subject specialisms. Discussions with other interns confirmed the information that psychology students particularly need help with statistics and SPSS, forensic science students with statistics, nurses with drug calculations and sports science students with biomechanics.

As a 'secret shopper' the intern visited the i, Futures, WISER and the Students' Union to discover first-hand what advice students received when enquiring about support for general numeracy problems and for advice on tests used by employers. While all the support units were helpful, none could provide detailed advice beyond directing students to general study skills websites such as Skills4study (www.palgrave.com/skills4study/index.asp), keyskills4U (http://www.keyskills4u.com/) and another (password-protected) site within UCLan's eLearn provision. The Students' Union was working on The Alternative Guide to UCLan (TAG) (www.taguclan.org.uk/) and, following discussions with them, they included links to *mathcentre* and *mathtutor* sites and a variety of others; no information is currently available regarding how well these have been received or whether students ask for further support. Little help was available specifically for supporting students attempting employers' numeracy tests. Documentation collected from Futures was later found to contain details on how to access a site (www.profilingforsuccess.com/main) that allows students to practise psychometric tests, including numeracy tests. Although there is a lot of good will with regard to supporting students' numeracy skills development, as yet it is uncoordinated and it is very hard to obtain any comprehensive, consistent or complete information on the support that students may be directed to. This situation was summarised in a poster that the undergraduate intern produced, *'ABC for 123'* (Brightman, 2009), advising that when recommending a strategy for maths support the current provision should be **A**ssessed, then **B**olstered (build on what already exists) and then **C**onsolidated to establish a sustainable provision.

How students search for support

A focus group session was held with 15 second year students on a Business Information Technology course in October 2009. These students are IT literate and were asked how they would search for help on numerical/ quantitative issues. If the query was of a general nature the consensus was that firstly they would ask friends, then they would use Google. If the query related to mathematics for their course, their strategy was firstly to ask friends on same course, then their tutor, Google, followed by books from library. They had found that some of the websites listed in the results of a search were confusing and said they would welcome direction from their tutor as to which were relevant to their course. Websites they had used in their pre-university studies included: *About.com:mathematics* (http://math.about.com/); *maths for morons like us* (http://library.thinkquest.org/20991/home.html); and *algebrahelp.com* (http://www.algebrahelp.com/). When asked to comment on the *mathtutor* materials they responded positively, with the videos presentations being particularly welcomed by a student from Poland.

MathsAid

As part of the *Every Student Counts* project it was decided to trial a central drop-in session. The advice received from Loughborough MSLC was followed as far as possible, with a one-hour lunchtime drop-in session made available through WISER during term-time (mid October 2009 to March 2010). WISER provided a room, organised the advertising (via the plasma screens located throughout the campus) and flyers were displayed in the WISER corridor.

One of the reasons for this trial was to further develop the signposting to materials for specific courses and enquirers. By looking at the maths support details on the websites of other universities a list had been compiled of the websites recommended by other universities for maths support. Some institutions had developed their own materials (e.g. Portsmouth), but the majority referred their students to the MathCentre/*mathtutor* materials in the first instance; we decided to do the latter. Therefore, our initial guidance, when appropriate, was to the *mathtutor* materials (online or paper-based). If this did not satisfy the enquirer's needs further websites would be suggested (e.g. BBC's Skillswise and Learn Direct were our next suggestions for general numeracy enquiries). When a student had a module workbook it was deemed more sensible to help them learn how to use it rather than introduce further materials. There were, inevitably, teething problems. For example, not all features of the online *mathtutor* (www.*mathtutor*.ac.uk) that we wanted to use would work on UCLan's computer network, due to *mathtutor*'s use of Active X. However a very recently 2010 updated version of the *mathtutor* web site seems to have addressed this problem.

Despite very limited advertising, over 20 students were seen in the drop-in sessions, with a further eight being supported by email. Almost all were full-time students with an even distribution of male and female students. Although most were 1st-year students, several 2nd-year and two 3rd-year students attended. Students represented all of the university's four faculties: 40% were from Science and Technology and their questions included rearranging equations, use of a module workbook, laws of motion, differentiation, sine rule, vectors and Laplace transform; 20% were from Management, these were primarily foundation degree students who sought clarification on questions set and the presentation of coursework (Greek students), while algebra was raised by other students; 20% of enquirers were from Health and Social Care and their main concern was converting units of measurement. The main concern of the 10% of enquirers from Arts, Humanities and Social Sciences was the level of numeracy required to pass the QTS test for prospective teachers. These percentages do not total 100% as students who emailed their queries did not always provide their faculty. Interestingly, all those students who were shown the *mathtutor* website and helped to navigate to the section covering their query were very happy with it and left prepared (and keen) to work through the section(s).

8.2 National and international audit of History: undergraduate, graduate and tutor perspectives

8.2.1. Current student survey

Responses to the survey were obtained from 162 students at the three partner institutions. Of these, 92 were at MMU, 50 at SHU and 20 at UCLan. The vast majority (85%) fell into the 18-22 year age range and most (59%) were male.

The students' mathematical qualifications

Nearly all the group (92%) had obtained a GCE O-level or GCSE award as their highest pre-university mathematics qualification. Nearly 80% of them had achieved grade C or above, but only nine per cent had secured an A grade. A small minority had studied mathematics beyond the compulsory education years, with three per cent attaining an AS level award and a further three per cent an A-level award. It was apparent that all the students sampled had attained qualifications requiring them to demonstrate their understanding of a range of basic numerical techniques.

Ability to undertake basic numerical tasks

In self-assessing their basic numerical tasks, the students were asked to use a five-point scale, with five equating to 'highly competent' and one to 'not at all competent'. The results are shown in Fig. 19.

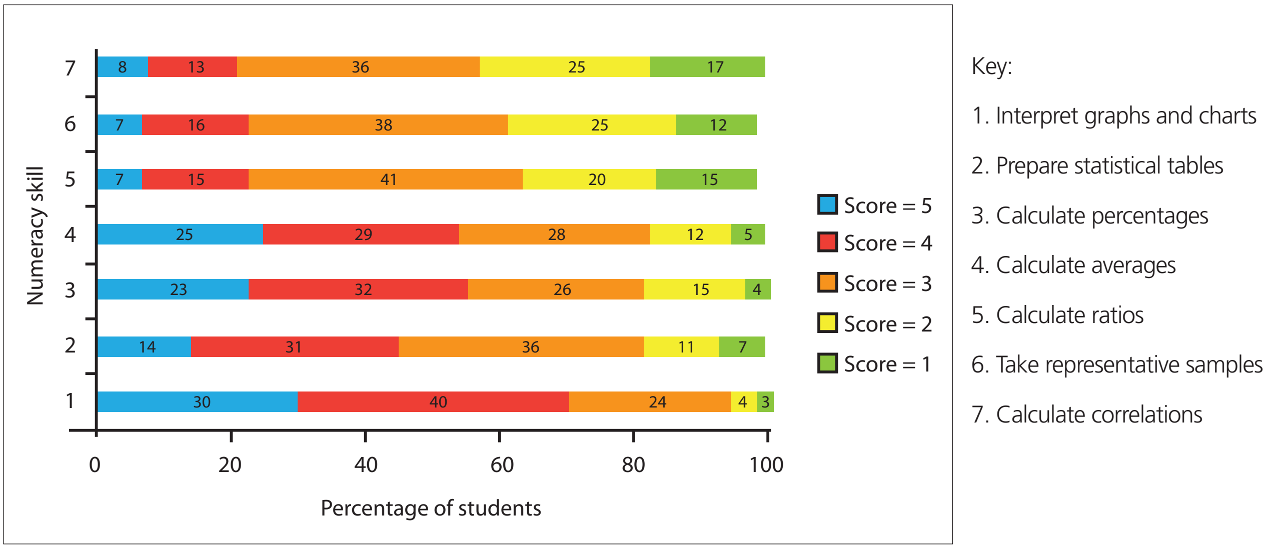


Fig. 19: Perceived ability with particular numerical techniques

The following points should be noted:

- Amongst the tasks listed, students expressed greatest confidence in their ability to interpret graphs and charts and least confidence in their ability to calculate correlations. Only seven per cent gave scores as low as one and two with regard to the former, compared with 42% for the latter.
- The pattern of responses in relation to calculating ratios and taking representative samples is very similar to that for calculating correlations. In all three cases, little more than 20% of students recorded scores of four or five.
- The response patterns for calculating percentages, calculating averages and preparing statistical tables are also fairly similar to one another, though with rather lower confidence being registered with regard to preparing statistical tables.
- Even with regard to the skills in which they generally profess relatively high levels of competence, with the exception of interpreting graphs and charts, approaching 20% of students still scored themselves at only one or two.

On the basis of these findings, incorporating opportunity for undergraduate historians to engage with numerical activities would cause little anxiety as far as interpreting graphs and charts are concerned. Nor might it be thought that the majority would have too much difficulty coping with preparing statistical tables and calculating percentages and averages. However, since student self-evaluation may be misleading, it was necessary to test their claims (see section 8.2.3).

Other numeracy skills students consider important

Only 35 students (22%) noted other numeracy skills as being important. Two stated that none were. The most frequent response, occurring in seven instances, was counting. The other skills eliciting more than a single response were long division (six), mental arithmetic (five), pie charts (four), multiplication (three) and addition (two).

Reflecting on the responses to this and the preceding question raises the key issue of the advantage that can be derived from giving history students opportunity to apply their existing numeracy skills, which are generally of a basic nature, rather than from trying to enhance these skills. Undertaking aggregative analysis in historical demography and compiling occupational distributions using census schedule or parish register evidence are cases in point. The active learning approaches that are being increasingly applied in undergraduate history teaching, coupled with the wide range of primary evidence that has become readily available to undergraduates, certainly offer the means for improving the teaching of numeracy skills. Consistent with the definition of numeracy given in section 6.3.1, it is necessary to caution against trying to teach *all* history undergraduates additional numeracy skills for, as the findings presented in other sections of this report suggest, such an endeavour may well be counter-productive, meeting with strong resistance from both tutor and student. Developing new numeracy skills might best be reserved for those areas of the history programme such as economic history modules where they are specifically required.

Perceived ability to use numeracy skills in historical study

As Fig. 20 shows, only a little over one in three of the 155 respondents gave themselves a four or five score (using the same five-point scale) when asked to rate their ability to apply numeracy skills in historical study.

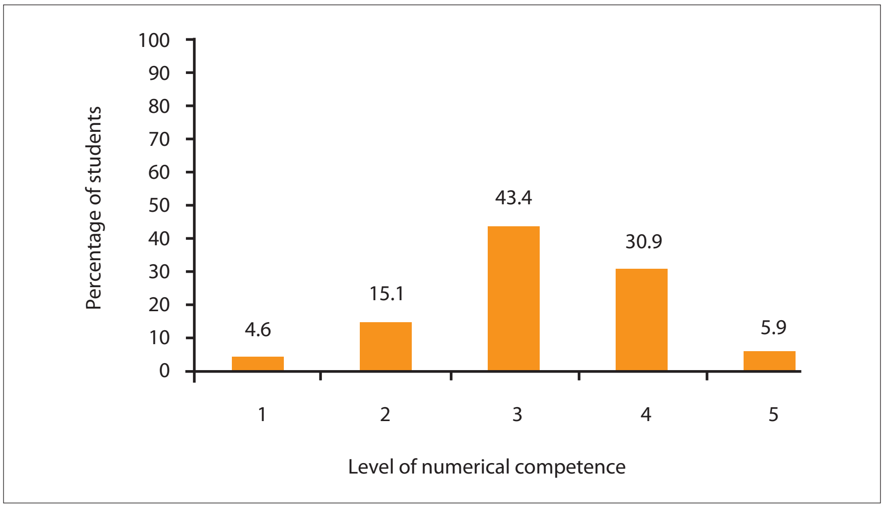


Fig. 20: Perceived ability to apply numeracy skills in historical study (N = 155)

The distribution of grades is somewhat biased towards the upper end of the grading range; a smaller minority of respondents (20%) declared a rating of just one or two. This finding may be seen as giving some grounds for optimism in terms of introducing numerical components into history courses, at least as far as the application of students' existing numeracy skills is concerned. However, it should be borne in mind that not only do the responses relate to student perceptions, which may be misconceived, but also they only relate to an overall assessment of general ability and not to specific mathematical skills regarding which, as Fig. 19 reveals, the responses were more diverse.

Value in developing historical skills

A very high proportion (85%) of students felt that developing numeracy skills would enhance their employment prospects. However, as Fig. 21 reveals, a much lower proportion (44%) thought that developing numeracy skills would enhance their learning in historical studies.

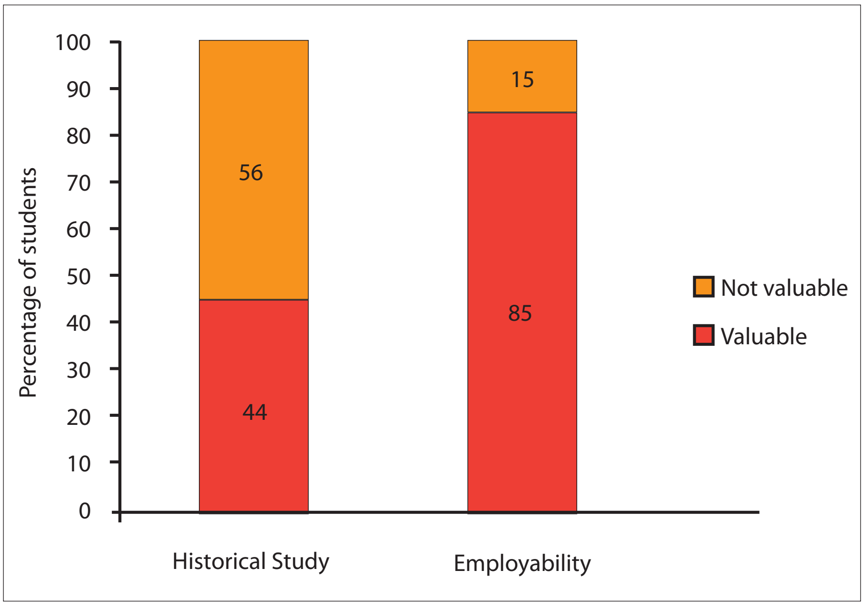


Fig. 21: Value in developing historical skills (N = 160)

Given these findings stressing the importance of numeracy skills in employability terms may be a useful way of encouraging history students to overcome their reluctance to engage with them. However, as the focus group discussions demonstrate, such reasoning would not necessarily weigh heavily with all of them (see section 8.2.2.).

Use of computer applications with numerical data

A total of 156 students responded to this question, some noting they had used more than one type of application. Of these, a very high proportion (at least 88%) had used a spreadsheet (almost exclusively Excel) with numerical data. In contrast, only around one-third had used a database programme, and a mere four per cent had used statistical packages. Four students (approximately 3%), noted they had created numerical tables using word-processing software (Microsoft Word).

That the great majority of history students have used a spreadsheet points to a further opportunity to use their existing skills in incorporating numeracy elements into history teaching. An obvious possibility would be to encourage them to prepare original charts and graphs from the data they have derived through investigating primary evidence, as a prelude to interpreting their findings.

8.2.2 Focus group discussions

The respondents

The following four focus group sessions were undertaken within the partner institutions:

Group 1 (UClan): Four first-level students, one of whom was from the USA. The three UK students had achieved grade B in mathematics at GCSE and the US student Algebra 3 at high school.

Group 2 (UClan): Two first-level students, both with GCSE Mathematics.

Group 3 (MMU): Three first-level students, one with a GCSE Grade B in mathematics, one a grade C and the third with Level 2 numeracy through *Learning Direct.*

Group 4 (SHU): Five third-level students, two with grade A, one with grade B, and two with grade C passes in GCSE Mathematics.

Attitudes towards mathematics

Questions dealing with whether or not the students liked mathematics and what considerations influenced their views brought the following responses:

- Most of the first-level students disliked mathematics – one positively hated it – and they were generally relieved to have finished studying it after the compulsory school years. However, one felt that the statistics component of the GCSE course was useful, whilst another stated that he would opt for a module containing numerical elements if the module content appealed to him. Additionally, two third-level students reported a positive experience in studying the subject. Indeed, one had deliberately chosen economic history modules in order to practise her numeracy skills.
- One first-level student had lost interest as the content of his mathematics course became progressively more abstract and less relevant; another remarked that there would have been more incentive to study mathematics if context had been given. Deficiency in teaching quality was also seen as an issue in the students' dislike of mathematics, the charge being made that some teachers concentrated merely on 'giving the facts' rather than explaining the underlying concepts. However, one third-level student remarked that he had struggled with the subject, but a good teacher had enabled him to recognise its practical use and relevance.

Views on the value of numeracy teaching

Discussion here focused on the value of numeracy in studying history and in relation to employability and as a life skill.

- There was some appreciation of the value that numeracy can have in historical study. For example, one group remarked that they would look at tables of historical data if they felt their understanding would be enhanced by so doing. Otherwise, they would skip over them. The general feeling, however, was that numeracy had limited value in the study of history. The applications mentioned in which it would have value were compiling and interpreting historical statistics, including those given in tabular form, perhaps, say, to show the effects of war. One student remarked: *'Basic sets of numbers related to historical situations are OK and useful.'*
- There was a general recognition among the group that numeracy was important in gaining a job. One third-level student had found quantification to be more important than she had anticipated while working part-time in an archive, whilst another commented that it would be difficult to *'imagine a job where you would not be expected to have a grasp of numeracy'*. However, one-first-level student thought that teaching numeracy should be the responsibility of the employer not the university, whilst another thought that the option of studying numeracy should be available at university for those wishing to apply for jobs in which numeracy mattered.

Some respondents stated that they would be put off entering a career which required engagement with numerical work, though four out of the five third-level students stated that this would not be the case. Three out of five third-level students were aware that prospective employers might use a numeracy test as part of the job selection process. Four of them asserted that they were not unduly concerned about taking such a test.

- There was an appreciation of the value of numeracy as a general life skill, linked with the notion of making numeracy relevant.
- The third-level students were asked how their perceptions of the value of numeracy had changed over the course of their studies. The responses were divided. One student thought its importance remained about the same; two others believed that it had 'faded-away' somewhat; and two others considered its value had increased.

Inclusion of numeracy in undergraduate history provision

The focus groups were asked about the extent to which numeracy provision should be incorporated into undergraduate history provision and the means of so doing.

- Opinion was divided regarding the extent of numeracy provision. One first-level student observed that it might not be a 'big deal' if only part of a module was involved and one of the first-level groups agreed that the most they would want is for numeracy to figure as an occasional element. This view suggests that students would not be against a 'ticking over' approach.

Another first-level group took a somewhat stricter line, suggesting that it should not be possible in a history degree programme to avoid quantification altogether provided it was introduced in ways with which students would feel comfortable and its relevance to historical study made clear, a view with which the third-year group concurred. Yet a member of the same first-level group expressed a contradictory view, suggesting that the big attraction of studying history was that mathematics was not needed.

- On the question of how quantification might be incorporated into undergraduate history provision, one first-level group felt that either a hidden or an overt approach was acceptable. One of the group observed that 'smuggling in' numeracy – that is, incorporating limited numerical elements into modules that are essentially non-quantitative in nature - might help those who do not like mathematics.

There was no support for including a dedicated 'bolt on' numeracy module in undergraduate history programmes; students preferred the 'smuggling in' (or integrated) approach. There was support for optional economic history modules and for more advanced numeracy provision for those history undergraduates who wished to engage with quantification.

Understanding of mathematics

The students were asked whether they were happy to rely on using calculators rather than have a conceptual understanding of numeracy.

- The first-level students felt that, where necessary, calculators were fine and there was no need for conceptual understanding. One observed that this would be the case with regard to statistical calculations. They were uncertain, however, as to at what point they would turn from understanding to machine, apart from one who stated she would attempt the calculation first.
- The first-level students said they were comfortable with calculating percentages and averages but expressed some uncertainty about the different measures of central tendency and about correlations, although one had done scatter graphs and knew what they meant because context was given to them. As in the case of the current student survey (section 8.2.1), students' self-assessment of their capabilities did not correspond with their performance in the numeracy test (*cf*. below, section 8.2.3).
- The third-level group showed awareness of the value of practising numeracy in order to retain understanding. Two of the group also noted they needed to write down mathematical calculations rather than do them mentally.

Use of calculators and ICT applications

The groups were asked about the ways in which they used ICT, particularly in relation to numerical applications.

- They reported that they use ICT mainly for word processing (including, for some of them, creating tables) and internet research. They had also used spreadsheets, in some cases to prepare bar and pie charts.
- They also reported that they use calculators for basic arithmetical calculations frequently but did not feel they could use them, or computers, for more complex calculations. The members of one group noted that they would have a rough idea in their heads of the answers they should obtain when using a calculator.

Opportunity to practise numeracy skills

Asked if the courses they were taking should keep their numeracy skills 'ticking over', do more than this or not address the matter at all, the general view was in favour of a 'ticking over' approach. Asked about how much 'ticking over' should take place, and whether it should be compulsory or optional, the responses from the first-level students were:

- one specific module would be acceptable
- the provision should not be optional
- although compulsory, it should maybe not be made a big part of the grade because the overall grade could be affected.

Rating the value of studying numeracy

The students were asked to rate the value of numeracy in historical study and to employability on a scale of 1-5 (with 5 being the highest value). The mean ratings given for the level 1 and level 3 groups are given in Table 31.

Table 31: The value of numeracy to historical study and employability: student ratings

Year group	Historical study	Employability
Level 1	2.9	4.0
Level 3	2.6	3.2

These results accord with those obtained from the current survey (see section 8.2.1), both samples demonstrating a limited, but by no means insignificant, appreciation of the value numeracy can have in historical study and a stronger awareness of the advantages it can bring in terms of employability. What might not have been anticipated is that students approaching the end of their undergraduate courses would give a rather lower rating to the value of numeracy in future employment than those at the start of their courses.

8.2.3 History students' numeracy test

The students and their mathematics qualifications

Usable test results were obtained from seven HE institutions in England. The number of students taking the test was 365. Sixty-one per cent were male and 82% were aged 18-22. In order to assess the quantitative skills of students at the beginning of their university study, the great majority (86%) of those asked to undertake the test were at level one. However, for comparative purposes and as a measure of progress through their undergraduate programmes, a small proportion of the sample (14%) was at levels two and three. The extremely unequal sample sizes in terms of age and level of study mean that comparisons between groups have to be treated cautiously.

In terms of their highest pre-university mathematics qualifications, 80% had achieved a GCSE pass, eight per cent had gained an A2 award and one per cent an AS-level award. Other types of mathematics awards, including CSE, NVQ, and City and Guilds, were held by three per cent of the students. The remaining eight per cent possessed no formal mathematics or numeracy qualification.

Distribution of test scores

The normality of the data was tested using the Kolmogorov-Smirnov test; scores for individual items and the composite score were all found to be normally distributed (Fig. 22).

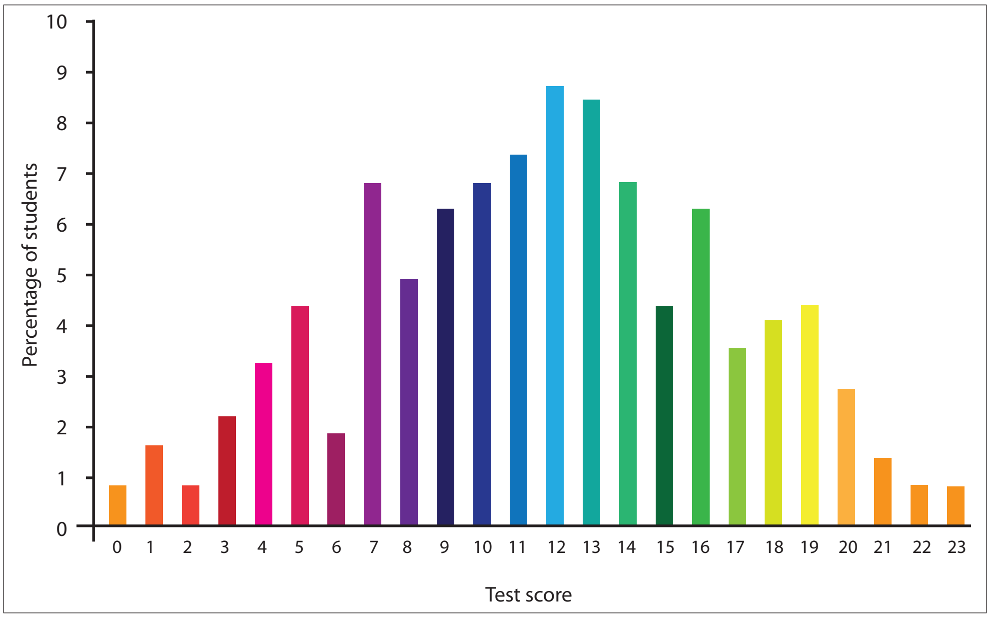


Fig. 22: Frequency distribution for test scores (N= 365)

The mean score for the 14-item test was 11.7 (47%) out of a possible 25 and the standard deviation was 5.0. The lowest score was zero. Forty per cent of the students scored 40% or less; 14% scored between 70 and 90%; and no student scored higher than 23 (92%).

Given that the participating students were asked to apply fairly basic mathematical skills of the type they would have encountered prior to their undergraduate years, the overall results demonstrate quite low levels of ability. Moreover, given that nine per cent of the participants obtained an A2 or an AS award in mathematics, rather more results at the higher end of the range might have been anticipated.

Performance on individual test items

If the 14 quantitative skills are grouped into similar types of numerical task, the following distribution emerges:

- four questions measured the ability to interpret data (1a,1b,1c and 1d);
- four determined the ability to calculate percentages (2b, 2c, 3b and 3c);
- four (3a, 3d, 4ai and 4aii) assessed the ability to calculate measures of central tendency;
- one tested the ability to calculate ratios (2a) and one to prepare a frequency distribution (4b).

The marks attained by the students for each question are given in Fig. 23.

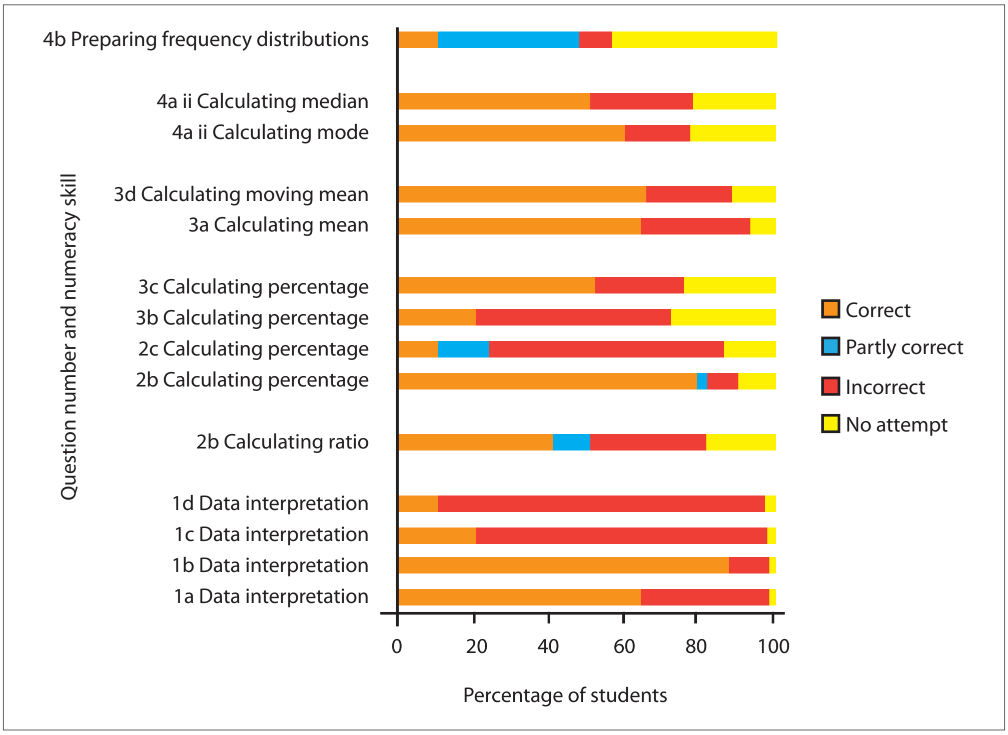


Fig. 23: Scores on individual test questions

Students achieved the second highest average score (44%) on questions pertaining to data interpretation, though with the mean masking a wide variation in performance Questions 1a and 1b were multiple choice and the scores achieved were higher than those for questions 1c and 1d which were open-ended. In fact, question 1b produced the most correct answers in the entire test and 1d the least. Students had considerable difficulty identifying longer time periods (three and four years) on the charts they were given. The overall performance on the data interpretation questions runs contrary to expectations from the current student survey in which the respondents had expressed high levels of confidence about their ability to interpret graphs and charts. These findings demonstrate that history undergraduates can easily be overconfident by failing to recognise their limitations with tasks they see as being relatively straightforward.

The same type of observations can be made with regard to calculating percentages, the success rates again varying markedly. Question 2c introduced a degree of difficulty by requiring students to combine a simple percentage calculation with a subtraction. A small proportion of them gained credit by correctly dealing with the percentage element. As for question 3b, the reason for the difficulty experienced by many students is less easy to discern; having to convert one eighth into a percentage figure without the aid of a calculator may be the explanation.

Students performed best on those parts of the test that gauged the ability to calculate measures of central tendency. On these questions, the average score was 60%. Calculating a median proved the most difficult with 45% of students providing a correct answer. There was comparatively little variation between the students' answers to the central tendency questions.

The number of students who correctly calculated the ratio was 41%. In several cases, a mark was secured by identifying the component numbers of the ratio, without cancelling them down completely. A repeated error was to express the ratio numbers the wrong way around.

Performance was weakest in preparing the frequency distribution with only 10% of students attempting the task correctly. Many demonstrated conceptual understanding but made the mistake of providing overlapping values in the age groups they distinguished. The fact that 40% of the students did not attempt this question – the highest non-response rate - may reflect their unfamiliarity with frequency distributions, though, since the question was the last on the paper, shortage of time may also have been an issue.

Relationship considerations

Male students (M = 12.6, SD = 4.8, N = 208) scored rather more highly than female students (M = 10.8, SD = 5.0, N = 134), though not to any marked extent. Additionally, younger students, especially males, tended to obtain better scores than those in the older age groups. As would be expected, students possessing higher previous mathematics qualifications and grades performed better than those with lower ones.

Conclusion

Whilst only guarded conclusions can be drawn from the limited amount of testing undertaken, the results obtained support the notion that history students tend to over-estimate their ability in applying basic numeracy skills within historical contexts. They performed inconsistently in the test, even with regard to the numeracy skills in which they professed to be the most confident. Additionally, whilst the test results were normally distributed (Fig. 22), those from the students' self-assessment of their numerical ability are somewhat skewed towards the higher end of the distribution range, reflecting their over-estimation of their mathematical competencies (Fig. 20). Finally, the superior performance of younger students in the test compared with their elder peers may mean they are retaining some of the numeracy skills acquired at school and suggests that there is a better chance of keeping these skills 'warm' if they engage with quantitative study early in their programme.

8.2.4 Graduate survey

Respondents' backgrounds

History graduates were surveyed to ascertain their views on numeracy skills in regard to their education and their subsequent employment. They were contacted via the alumni offices of their former universities and were asked to complete a short online questionnaire. Eleven universities in all were surveyed - nine pre-1992 and two post-1992 – from across the UK; six were English, three Scottish, one Northern Irish and one Welsh. The focus was on graduates of the previous six years (2003-2008) who formed 89% of the sample. The remainder comprised UCLan graduates from earlier years (1994-2002). The universities surveyed were: Bristol, Dundee, Edinburgh, Glasgow, Lampeter Wales, Leeds, Manchester, Queen's Belfast, Sheffield Hallam, UCLan and Warwick.

Responses were received from 96 graduates. All had a first degree in history, though 19 had studied another subject either jointly or 'with' history. After university 68 had pursued, or were pursuing, a further qualification. In terms of their personal backgrounds, 82% were aged 30 or under. Relatively few had been mature students, with 78% of them entering university by the age of 19. There were more female (62%) than male respondents.

Nearly two-thirds of the total (65%) had entered university with a GCSE (or equivalent) as their highest mathematics qualification. No fewer than 19% had gained a full A-level pass in mathematics and another four per cent had achieved AS standard. These figures are higher than the eight per cent of A2 level passes and one per cent of AS level passes achieved by students participating in the numeracy test, and the three per cent A2 level and three per cent AS level passes of the current students surveyed.

Graduates' assessment of their numerical competencies

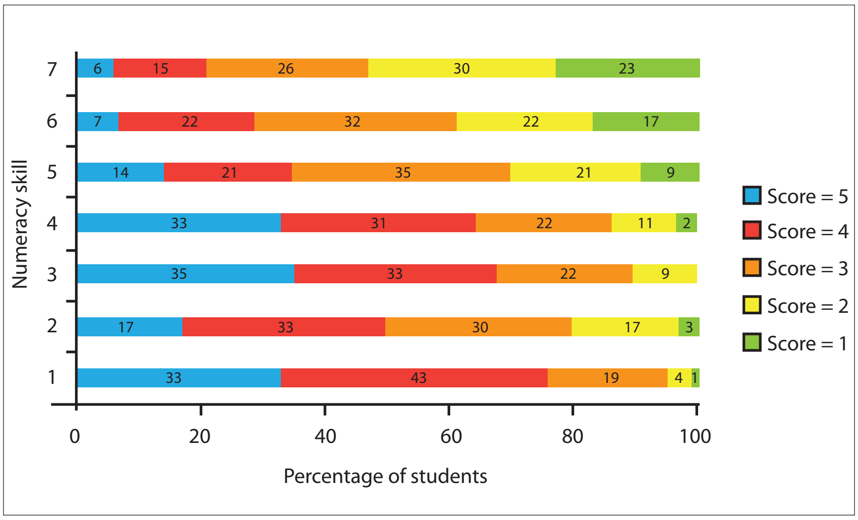
The graduates were asked to use a five-point scale in assessing their numerical competency, with five equating to 'highly competent' and one to 'not at all competent'. In Table 32, the mean scores and standard deviation are shown for each of the numeracy skills.

The respondents' self-assessment of their competencies is quite positive, with no mean score falling below 2.5. Even so, considerable variation is evident, with notably higher degrees of competency being expressed in some cases than in others, a point which is demonstrated in greater detail in Figure 24 which shows the percentage ratings for each of the numeracy skills. The main points to note are:

- Respondents assessed themselves the most competent in interpreting graphs and charts – 76% giving themselves a rating of four or five - and least competent in calculating correlations – only 21% giving a four or five rating.
- High levels of competence were also claimed with regard to calculating percentages and averages, with 68% of respondents giving a four or five rating for the former and 64% for the latter.
- In contrast, much lower levels of competency were recorded in calculating ratios and taking representative samples. Only 35% of respondents gave a rating of four or five with regard to the former and 29% with regard to the latter.

Table 32: Graduates' assessment of their numerical competencies (N = 96)

Numeracy skill	Mean	Standard deviation
calculating correlations	2.5	1.2
taking representative sampling	2.8	1.2
calculating ratios	3.1	1.2
preparing tables of statistics	3.4	1.1
calculating averages	3.8	1.1
calculating percentages	3.9	1.0
interpreting graphs and charts	4.0	0.9
Total	**3.4**	**1.1**



Key:

1. Interpret graphs and charts
2. Prepare statistical tables
3. Calculate percentages
4. Calculate averages
5. Calculate ratios
6. Take representative samples
7. Calculate correlations

Fig. 24: Graduates' assessment of their numerical competencies

In general, these findings are in accord with the self-evaluation ratings given in the current student survey. Both groups expressed varying levels of competence concerning the range of numeracy skills about which they were asked and showed a broadly similar pattern of response in so doing.

Numeracy skills developed in undergraduate courses

The graduates were asked to assess, using a five-point scale with one meaning 'very little' and five 'a great deal', the extent to which their undergraduate history courses had helped them develop particular numeracy skills. The results are set out in Fig. 25 which shows the average rating for each of the numeracy skills.

The numeracy skills graduates thought their undergraduate degree courses had helped them develop the most were interpreting graphs and charts (M = 2.6), and preparing tables of statistics (M = 2.2). At the other end of the scale were calculating correlations (M = 1.8) and calculating ratios (M = 1.6). Despite this variation in the results, the mean ratings given by the respondents were in general relatively low, indicating that the opportunities to develop their numeracy skills as undergraduates were limited.

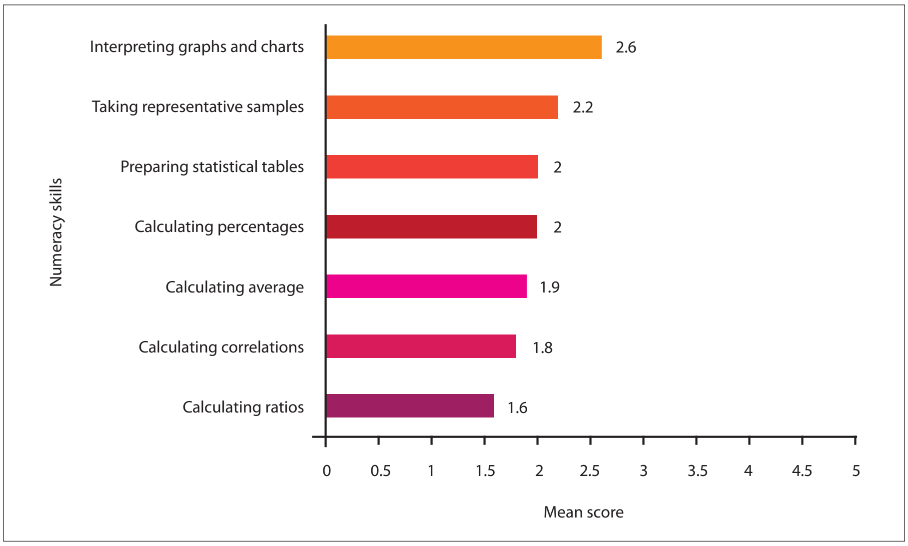


Fig. 25: Numeracy skills developed on undergraduate history programmes (N = 96)

The survey also asked which, if any, numeracy skills the graduates would have liked to have had the opportunity to develop as part of their undergraduate history courses. The results are presented in Fig. 26.

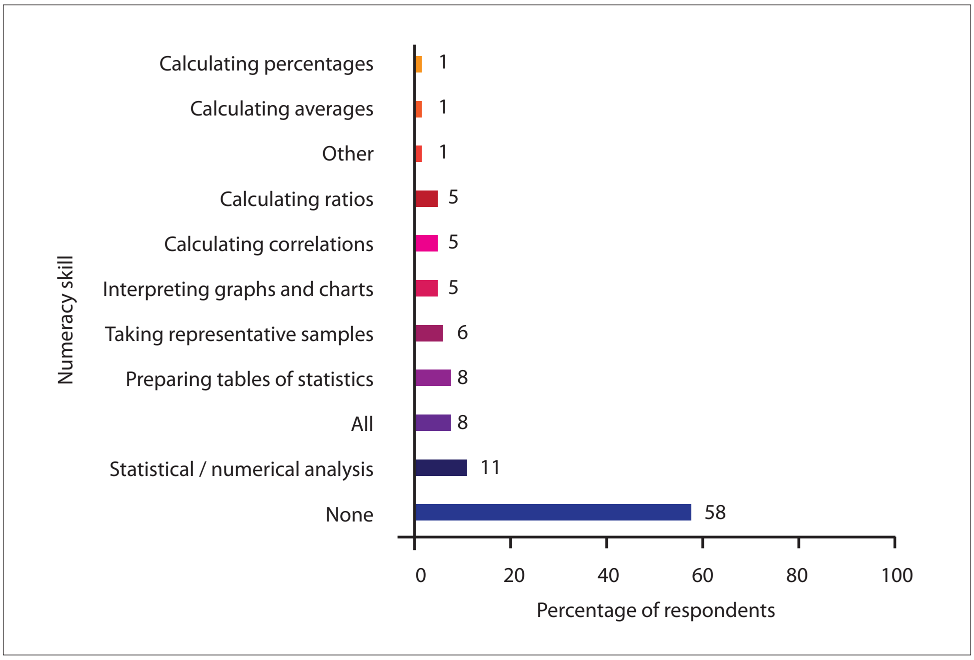


Fig. 26: Numeracy skills graduates would have welcomed as part of their undergraduate programme (N = 79)

The majority of the respondents (58%) did not see any need for further provision of opportunities for numeracy skills development. In fact, only one skill, namely statistical/numerical analysis, was mentioned by more than one in ten respondents. This may be because these skills are not perceived as being of much relevance to historical studies or because they had not been useful in their employment or both.

Underlying these perceptions is a general antipathy towards numeracy, evidenced in some of the comments made by the graduates:

> *I don't really think numeracy would have been relevant to history.*
>
> *I don't think an undergraduate history course is necessarily the place to be developing numeracy skills.*
>
> *I don't think that an historian needs numerical ability above GCSE level.*
>
> *I went to study history, not maths/numeracy.*
>
> *None were needed for the degree.*
>
> *None - I hate sums.*

Given such attitudes, it is no surprise to find that, when asked a further question about what degree of emphasis their undergraduate history studies should have placed on developing their numeracy skills, 65% (N = 96) believed the emphasis had been about right. A small proportion (eight per cent) took the view that the emphasis should actually have been less. However, 27% did believe that their degree programme should have placed more emphasis on numeracy.

It might be thought that these differences in opinion could be explained, at least in part, by the different programmes that the graduates had experienced, but this does not appear to be the case. When the data were analysed by university, 60% or more of the graduates from each of them (except for one) thought there had been the right balance of emphasis on numeracy skills in their undergraduate programmes. In the case of the one exception, as many as 62% (8 out of 13) of its graduates were of the view that their undergraduate history degree should have provided them with more opportunities to develop their numeracy skills. That the average figure masks appreciable variation serves as a reminder of the survey's limits and suggests that further research is needed here.

The analysis of the data by gender revealed that 66% of female and 61% of male graduates thought the provision of numeracy skills development in their degree programmes adequate; three per cent of female and 17% of male graduates considered this provision should have received less emphasis; and 31% of female and 22% of male graduates wanted more opportunities for the development of numeracy skills.

The final question about the respondents' experience of numeracy skills development sought to compare the influence that their undergraduate history courses had in this respect compared with school, undergraduate employment and subsequent employment. Again a five-point scale was used, with one equating to 'very little' and five to 'a great deal'. The findings are graphed in Fig. 27, with the respondents' average rating given for each of the variables.

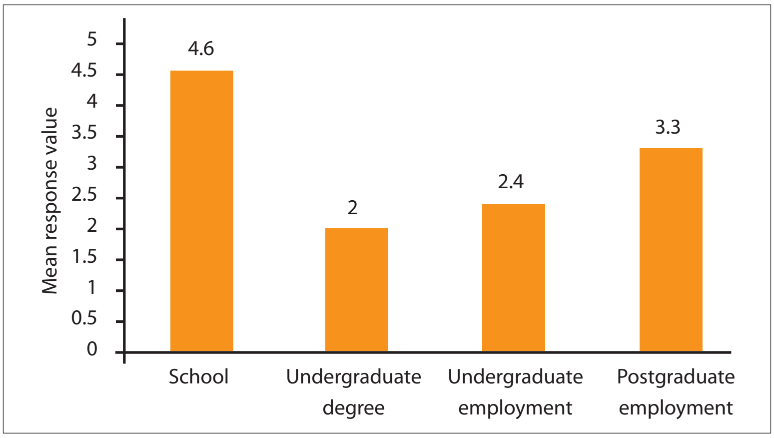


Fig. 27: Educational and employment experiences in graduates' numeracy skills development (N = 96)

Two points stand out from this feedback:

- The perception of the graduates is that school, which was given the very high rating of 4.6, was by far the the most important influence on the development of their numeracy skills. In contrast undergraduate provision scored the lowest mean rating (2.0). The implication is that, during their undergraduate years, respondents were at best 'marking time' and at worst slipping back with regard to their numerical capabilities.
- Quite a high rating (3.3) was given to numerical skill development in the workplace reflecting no doubt the need for specific job-related skills and suggesting that more could be done at undergraduate-level to anticipate this need.

For the great majority of history graduates sampled, it is evident that basic numeracy skills were developed during the compulsory years of education but that these were largely neglected or under-utilised until they entered the world of work.

Graduate employment

The respondents were asked to state their current employment with a view to ascertaining how far they had entered sectors in which numeracy was likely to be important. The breakdown of their occupations is shown in Table 33 using the employment categories found in the survey of first destinations of history graduates compiled by the Higher Education Statistics Agency (HESA). This survey is published as What do Graduates do? on the Prospects website at www.prospects.ac.uk. For purposes of comparison, the 2005 HESA data are included alongside the graduate sample data. Because the HESA statistics are based on destinations six months after graduation, they provide only an interim picture of graduate employment. Many graduates are engaged in further study (21.3% in 2005), temporary unskilled jobs or are still unemployed. Accordingly, the HESA percentages in the table below are based on the 52.1% of their sample who were in full employment. For the sake of comparison, the graduates in the current survey who are unemployed (2), retired (3), in part-time employment (3) or studying for a further qualification (6) have been excluded from the analysis.

Table 33: Breakdown of occupations of history graduates

Occupational group	Percentage of history graduates	
	Prospects survey	Current survey (N = 82)
Marketing, Sales & Advertising Professionals	6.1	12.1
Commercial, Industrial & Public Sector Managers	11.6	15.9
Scientific, Research, Analysis & Development Professionals	0.1	1.2
Engineering Professionals	0.3	1.2
Health Professionals & Associate Professionals	0.5	1.2
Education Professionals	4	14.6
Business & Financial Professionals & Associate Professionals	8.8	8.5
IT Professionals	0.7	0
Arts, Design, Culture, Media & Sports Professionals	4.2	6.1
Legal Professionals	0.5	3.7
Social & Welfare Professionals	2.3	3.7
Other Professionals, Associate & Technical Occupations	4.4	8.5
Numerical Clerks & Cashiers	3.8	1.2
Other Clerical & Secretarial Occupations	22.9	8.5
Retail, Catering, Waiting & Bar Staff	14.2	2.9
Other Occupations	15.4	4.9
Unknown Occupations	0.2	3.7

That more of the survey graduates than the ‘Prospects’ graduates are in professional jobs (77.2% against 43.5%) and fewer in unskilled jobs is a reflection of the longer time in the employment market of many of the former and their completion of further qualifications. It confirms the pattern established in other research that the six-month destination statistics are an incomplete and misleading guide to longer term employment. The distribution of occupations three years after graduation provides a more reliable indication of graduate career prospects.

That said, both sets of figures show that history graduates are not, for the most part, taking up positions in the occupational categories that clearly demand numerical and ‘strong’ IT skills, notably numerical clerks and cashiers and IT professionals. However, a few do go on to take accountancy courses and some are extremely successful in the realms of business, finance, industry, sales and marketing. Whether the low uptake of such jobs reflects an innate aversion among those students who elect to take history degrees or is a product of the general absence of numeracy teaching from history programmes are questions once again posed by the data. It is also not possible to determine from the raw employment data what degree of numeracy is required by the many ‘professional’ occupations. This question was explored further in the graduate survey.

Numeracy skills in the workplace

Respondents were requested to state which numeracy skills, if any, they had found particularly useful in the workplace. They reported that some numeracy skills were proving more useful than others, with interpreting graphs and charts (mentioned by 39%) and calculating percentages (mentioned by 38%) leading the field. In third place, some way behind at just 29%, was preparing tables of statistics. Of the rest, only calculating averages received a response in double figures (18%), though 14% thought that all numeracy skills were useful. However, almost as many (13%) had found none of any use. The only others mentioned were calculating ratios (5%) and taking representative samples (4%).

The two numeracy skills that figured highest in the workplace were also those in which the graduates had professed the highest levels of competency. Incorporating these skills within the history curriculum may therefore have particular advantage in career terms and might well meet with little resistance. Overall, though, relatively few respondents identified numeracy skills as being particularly useful to them in the workplace; not one was singled out by a majority of the respondents in this respect. It is possible that they had not been attracted to jobs in which numeracy skills had to be applied to any appreciable extent. If so, their career choices might have been somewhat circumscribed.

Asked if a numeracy test had been required as part of their recruitment and selection process, just under a third (30 per cent) said this was the case. The sectors in which this was required were teacher training, the civil service, financial institutions and retail companies. Whilst, for the most part, history graduates may not be experiencing numeracy tests in the workplace, a significant minority do have to take them. Moreover, numeracy tests are being set in some of the careers that are popular with history graduates.

Only 19 of the graduates (20%) had received any numeracy training from their employers. It appears that the graduates were able, on the whole, to cope with the numerical tasks required in their current jobs. However, 31% believed that more numeracy training in their history programme would have increased their career opportunities, though the mean figure once again masks appreciable variation. In the case of one institution, a 70% response in favour of more numeracy training was in inverse proportion to the overall response figure. If this result is discounted, the overall proportion in favour of more training falls to just 22%.

Graduates' use of ICT applications

The vast majority (93%) of the respondents stated that they were using ICT applications in their current jobs. A breakdown of these applications showing the proportion of respondents using each of them is given in Fig. 28.

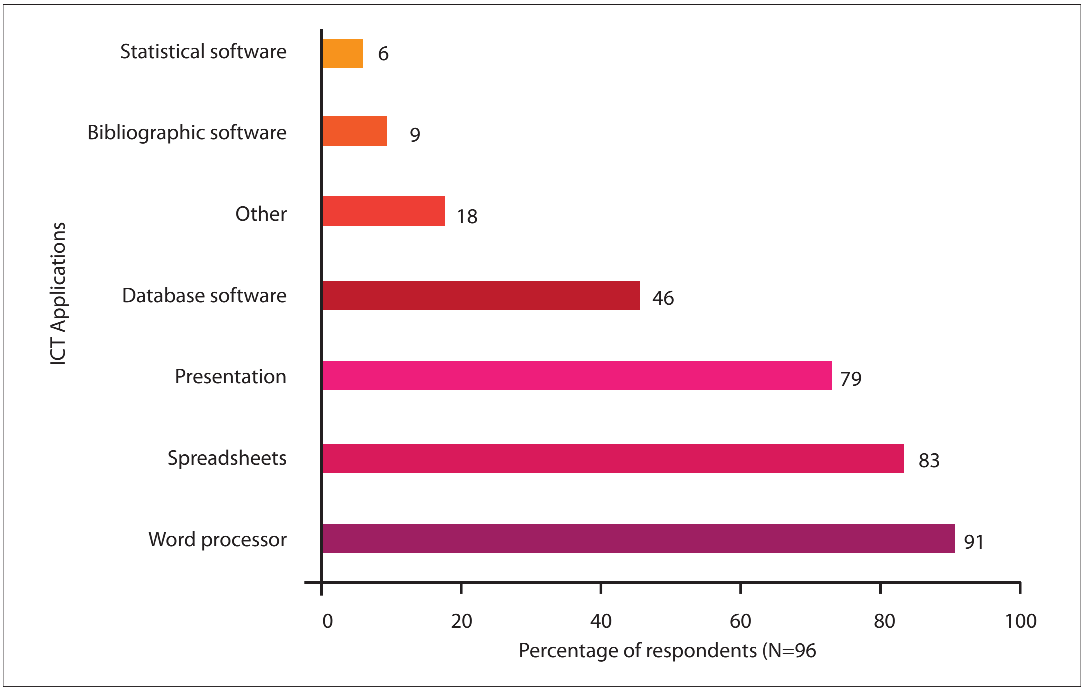


Fig. 28: Types of ICT applications used by graduates in their work

Nine out of ten were using word processing software and almost three out of four were using presentational software, neither of which would give much scope for dealing with numerical data. However, more than four out of five were working with spreadsheets, and almost half were using databases, suggesting that numeracy featured in their work to some extent. This use of spreadsheets, and to a lesser extent of databases, in the workplace, reinforces the point about the value that teaching these two applications might have in improving the numeracy skills and the employability of history undergraduates.

This notion is given further support once the graduates' response to being asked about the extent to which their history degree courses had helped to develop their ICT skills is examined. Although 65% said their programme had helped, analysis of the responses reveals that the ICT applications most frequently used were word processing, PowerPoint presentations, the internet as a research resource and referencing software, none of which required numerical competence. A few, however, did use databases and Excel for collating and processing information and a small minority were provided with training in these applications outside the history programme.

8.2.5 Survey of UK university history departments

General provision of numeracy teaching

The survey of 91 UK higher education institutions offering single-honours history programmes produced replies from 64, an extremely robust response rate of 70%. Coverage was nationwide and both pre- and post-1992 institutions were well-represented.

In line with the benchmarking recommendation that, where appropriate, provision might be made to incorporate numeracy and quantitative methods into single honours history programmes, 42 (66%) of the respondents stated that their departments did so and a further four (6%) that they did so partially. The remaining 18 (28%) said that they did not incorporate numeracy into their programmes. A sizeable majority of history departments sampled were therefore reporting at least some provision. However, as the data from the questionnaire goes on to show, these raw statistics give an overly optimistic impression of the amount of numeracy teaching that is actually taking place.

Of the 64 respondents, the 42 who said they were teaching numeracy skills together with three of the four who were partly addressing the issue went on to complete the main body of the questionnaire. The following data are based on these 45 responses.

Methods of incorporating numeracy into history programmes

Several of the departments reported that they used more than one method to develop students' numeracy skills (Fig. 29).

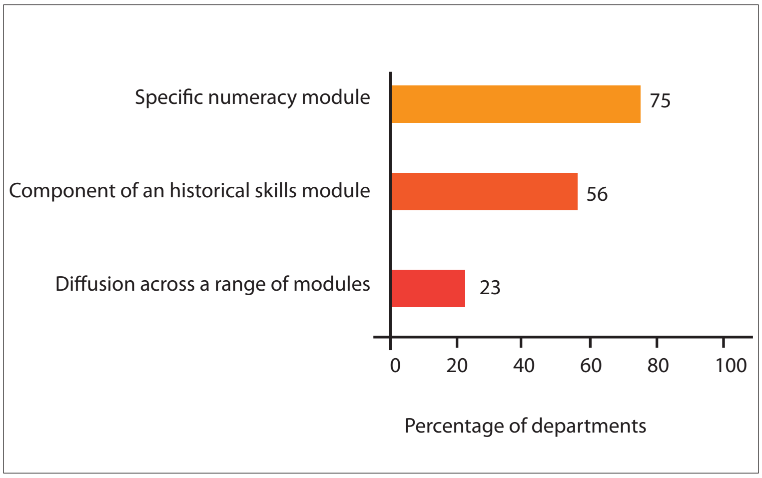


Fig. 29: Methods of incorporating numeracy skills

The most frequently cited method, used in 34 cases (75%) was 'diffusion across a range of modules' – in other words the skills are taught in small doses within any type of module across the whole programme. However, 27 departments (56%) incorporate numeracy skills in modules dealing specifically with historical skills. However, the time allocated to this numerical component using either of these approaches may be quite limited. Nor is it certain whether assessment was used. Both were issues explored in follow-up interviews and via the website survey (see sections 8.2.6 & 8.2.8). Very few departments (23%) reported having specific *modules* dedicated to numeracy learning, preferring to disperse rather than concentrate it.

Managing the development of numeracy skills

Responsibility for managing the teaching of numeracy skills was most frequently left to committed individuals, occurring in 21 of the 45 departments (47%). The qualitative data, together with evidence collected at the follow-up visits, suggests that these were usually the economic historians in the department. For example, one respondent observed:

> *Individual members of staff, in the area of economic and business history, use statistical evidence in their module deliveries, and engage students in interpreting historical trends. This does not, however, add up to a programme strategy for developing numeracy.*

In nine departments (20%), small teams took on the responsibility. Seven departments (16%) expected all tutors to participate (for example, by teaching compulsory 'introductory skills' or 'methods' courses), while in the remaining eight (18%), responsibility was not assigned to anyone, usually because some numeracy skills were taught but not in any managed or collectively planned way. The implication of these findings (and of the website survey, section 8.2.7) is that departments in general do not pay as much attention to developing numeracy as they do to other key skills.

Numeracy skills and progression

The absence of collective planning in numeracy teaching is further demonstrated by the small number of survey returns from departments that incorporated numeracy skills into their programmes in a progressive way. Only 11 of the 45 (24%) stated that they did so, and none systematically through all three or, in the case of the Scottish universities, four years of the degree programme. The following comments illustrate this:

> *There is no pathway through the options of our degree programme which will ensure that all students receive training in numeracy and quantitative methods (with consequent and appropriate forms of assessment).*
>
> *Very few of the dept admit to using spreadsheets any way, even fewer use Access, and probably not more than 1 (myself) or 2 use SPSS. So if taught in the first year it would not in practice be reinforced in years 2 and 3.*

The survey evidence suggests that the majority of UK history undergraduates can pick their way through their programmes of study so as to have little or no need to engage with numerical or quantitative techniques.

Compulsory teaching of numeracy skills

As the data presented in Fig. 30 reveal, numeracy skills are infrequently taught as a part of compulsory modules.

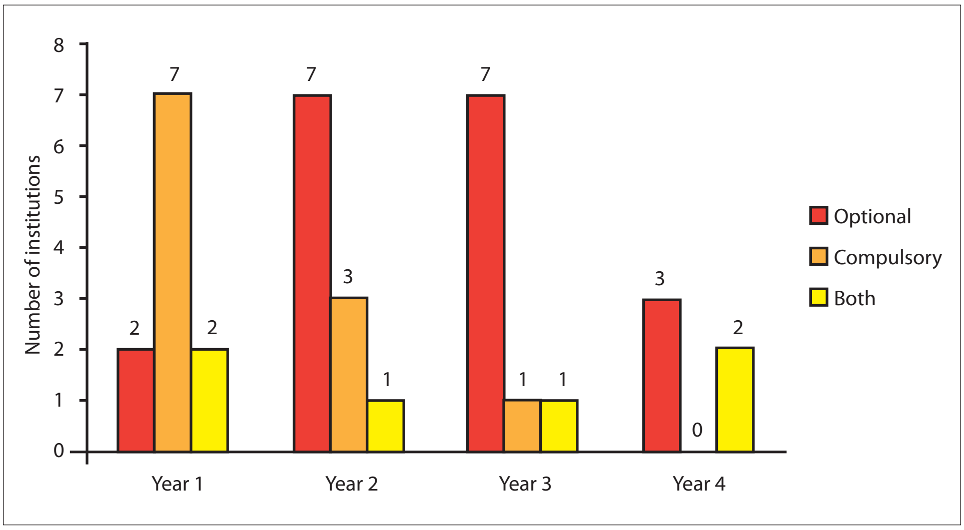


Fig. 30: Location by year of numeracy skills modules

In only eight departments (13%) was such compulsion reported in year one, a figure that fell to four in year two, two in year three and one in year four. After year one, most numeracy teaching was optional and occurred in no more than eight of the responding departments in either years two or three. Not a single UK history department in the sample was found to have a compulsory numeracy skills element in every year. These findings add weight to the point made above that most history students can avoid engaging with numeracy by their choice of modules.

Assessing numeracy skills

Only 17 (38%) of the 45 departments in the sample reported that they used assessment strategies to measure the attainment of numeracy skills. The apparent lack of attention to assessing numeracy skills, a finding supported as well by the paucity of examples uncovered in the website survey (8.2.8), is especially significant because of the weight that students place on assessment. The issue of assessment of numeracy skills is therefore one that merits further investigation.

Numeracy teaching through ICT

Most of the 45 departments stated that they provide students with the opportunity to use one or more ICT applications to engage with numeracy. How these are delivered is illustrated in Fig. 31.

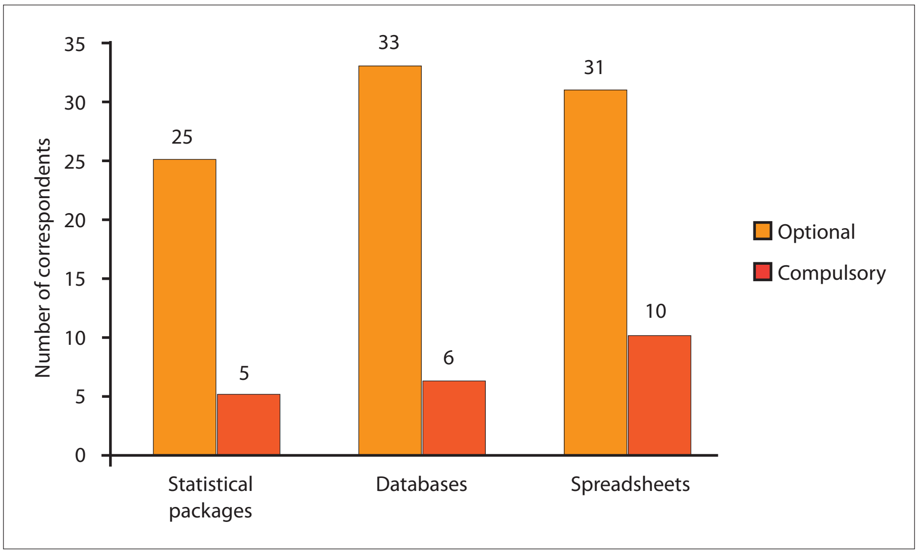


Fig. 31: ICT applications used to teach numeracy

Databases were reported to be the most frequently used of these applications, occurring in no fewer than 33 departments (73%), but only on a compulsory basis in six of them (13%). Spreadsheets were being used in almost as many departments (31 or 71%), though with compulsion being required in just under a third of them. Statistical packages were used less frequently than either spreadsheets or databases, though still in a majority of cases (57%). However, compulsion was infrequent, being reported in only 5 cases (11%).

In the surveyed departments, therefore, the great majority of students can avoid using key ICT applications for numeracy work. This evidence, together with that from the tutor survey (8.2.7), suggests that tutors appear to be more confident about requiring their students to engage with spreadsheets than with databases and statistical packages.

Departmental perspectives on numeracy teaching

The survey of UK history departments reveals just how little they are doing in the way of systematic numeracy skills teaching. Of the 64 respondents, over 90% admit that they should be doing more to improve their students' numeracy skills.

The questionnaire sent to them ended by inviting further comments and 48 of the 64 (75%) responded, including all 19 departments that did not complete the main body of the questionnaire. Their responses indicate that many of them are doing much the same (that is, not very much) as others who had said they were addressing the benchmark recommendation positively. While agreeing that more needed to be done, there is a defensiveness about many of the comments. Combative explanations are given to rationalise why more is not being done though some as well confess their own (or their colleagues) inability to teach numeracy skills.

The following represent a small selection of typical comments on various recurring themes:

1. Student resistance

There were many comments centring on the belief that history students are hostile to numeracy teaching. Familiar points were that numeracy skills are 'hard' for students to learn and that, because they don't enjoy quantitative approaches, they resist the 'imposition' of compulsory numeracy training. The language of 'retreat' was used by several of the respondents:

> *We used to have a compulsory core module at Level 1 that was universally hated by students.*
>
> *There would be massive resistance to compulsory quantitative training from the students.*
>
> *As entrants to a Humanities programme, our students are generally quite hostile to, or frightened of, or inexperienced in, quantitative analysis.*
>
> *We used to do this for all students, but have retreated … because of student hostility to it.*

2. Tutor resistance

The frequent comments about student resistance to numeracy provision were paralleled by those concerning the unwillingness of those who teach them to engage with numeracy. The general thrust of the comments was related to the lack of staff interest and expertise in quantitative approaches but time and resource constraints were also considered obstacles:

> *There are too few staff who are numerate to increase compulsory numeracy training.*
>
> *Inertia and direct opposition from … staff is also a real problem in creating a culture that emphasises the importance of numeracy skills.*
>
> *Nearly all of my colleagues are qualitative rather than quantitative historians.*
>
> *… and [staff] associate quantification with 'white coat history'. They see themselves as cultural historians rather than 'number crunchers'.*
>
> *Neither, it seems, do they [staff] need it for their own research. Those in other Universities, who seem to rate our research quite highly, do not use stats either, beyond percentages and perhaps the odd graph.*
>
> *This is one of the many things that many of us would like to do, but it is - as ever - a matter of resource.*
>
> *It is also incredibly time consuming to teach.*

3. Other priorities than numeracy

Numeracy skills are recognised as one of a range of capabilities of the history undergraduate, but for most staff an increase in its provision would be seen as an unacceptable trade-off, reducing engagement with what they perceive as more important skills:

> *The need to improve students' written and spoken English skills is more pressing than the need to improve their numeracy skills.*
>
> *… staff are not sufficiently motivated in this area. Compulsory training in numeracy skills and ICT would likely be seen as occurring at the expense of training skills regarded as more important to the historian such as palaeography, historical theory, bibliographical skills, source location and interpretation, qualitative methods.*
>
> *Probably staff give a lower priority to numeracy than to literary or communication skills.*

4. The lack of any need to teach numeracy

Some respondents were of the view that the progress of their students did not appear to be hampered by the absence of numeracy teaching; others that, through previous study, their students had acquired a sufficient level of numerical capability to obviate the need for teaching it further:

> *…it does not seem to hinder their degrees or - as far as I can make out - their subsequent employment.*
>
> *We are entitled to expect students, who must after all come with GCSE maths or equivalent, to have basic numeracy. This year's initial skills test, introduced for the first time, showed (to our slight surprise) that all of our intake had a sound enough level of numeracy to be able to work with the sort of tables and figures found in mainstream histories, albeit with one or two borderline cases.*

5. Absence of any external drivers

The point was also made by several respondents that the teaching of numeracy skills was not being advocated or required by any agencies outside their departments. This suggests that more might be done if external drivers did exist:

> *Obviously, this is an issue which needs to be addressed by History schools, but it has never been seriously raised as an issue by Externals or by last year's QA.*

The Benchmarking Statement does not require the teaching of numeracy and quantitative methods, except as one among many desirable skills to be developed.

I am not aware of specific policy statements on numeracy at University level. While the University has pushed the importance of employability there has been as yet no central directive to make it a required element in all programmes.

6. Absence of systematic planning and dependence on committed individuals

Several commentators noted that there was also no internal drive to incorporate numeracy into the history programme beyond the enthusiasm of a few staff:

There is now no specific numeracy skills training in the programme; even the core courses in the first year do not address numeracy or quantification in any systematic way. Some staff may use some quantitative material in individual modules in the second/third years but I think these are actually few and far between and students are so unfamiliar with such data they are very reluctant to engage with it at all.

We used to offer a compulsory History and computing module, but after the retirement of a member of staff we now find ourselves with little numeracy training formally embedded in the degree.

[T]he Department as a whole pays only lip service to numeracy.

There seems to be very little interest in the group for developing a programme for numeracy skills

7. The consequences of optionality

It was noted by some that student choice was a desideratum in terms of curriculum design:

If we put them [students] off too much, in the Scottish system of internal marketplace, they just drop History and do English instead.

[W]e adopt the principle of maximising student choice on modules, which tends at the moment towards text-based modules.

The teaching of numeracy has seen a significant retreat over the last two decades again mirroring trends across the history subject community and reflecting student module choice in programme structures that are far more open than previously was the case.

8. The case for more numeracy

Despite the overwhelmingly negative and defensive nature of these comments, there was nevertheless a recognition that more should be done to teach numeracy skills. Some respondents emphasised the need to anticipate postgraduate study while others made helpful suggestions as to how the current deficit might be addressed:

The decline in the level of numerical provision for undergraduate history students may have a serious impact at the postgraduate level as students enter their studies with little understanding or even acquaintance with quantitative analysis.

Any suggestions should not add to the burden but should make use of existing modules e.g. methods modules and/or the dissertation. It should also be stressed that numeracy skills are part of the historian's craft and are not just being added for the sake of developing transferable skills.

I think this would have to be on an optional basis, but it would be good to have courses available to students, like those currently available for learning/improving foreign languages.

… if quantification was seen as improving employability things might well change.

Only one respondent suggested that numeracy should be made a core component of history programmes:

The main point to this is that I feel that to be taken seriously and not simply shunted into the 'desirable but difficult' sidings of client-led satisfaction surveys, skills/methods modules that focus on numeracy have to be made core/compulsory.

8.2.6 Follow-up interviews with history departments

Key findings

Six key findings emerged from the 14 follow-up visits that project team members undertook:

- A perception frequently expressed by the hosts was that there has been a significant retreat in the extent and level of numeracy taught in undergraduate history programmes over the last two decades.
- The interviews reinforced the findings arising from the general survey of UK history departments that where numeracy skills are taught, this tends to be fragmentary and with little evidence of progression from level one onwards.
- What remains of the teaching of quantitative methods within undergraduate history programmes appears to be largely a legacy of economic and business history provision within undergraduate history programmes.
- There are 'pockets' of good practice which could be used as exemplars to demonstrate the value of numerical analysis to a wider constituency of tutors and students.
- Although this project is concerned with undergraduate programmes, a number of tutors drew attention to the knock-on effect that limited provision of numeracy skills here was having at the postgraduate level where the ability to demonstrate more than a passing acquaintance with quantitative techniques is required by funding bodies.
- The picture that emerges from the visits is one of uneven, but essentially minimum provision, confirming the evidence of the departmental and website surveys. It is possible for an undergraduate history student to complete their studies without any engagement with quantitative methods.

Reasons given for limited provision

Several reasons were advanced for the general lack of attention to the teaching of numeracy skills:

- Departments give priority to perceived deficits in undergraduate literacy, communications and search skills over quantification.
- Over the last two decades, undergraduate history programmes have been re-designed to allow for a far greater degree of student choice. Modules incorporating quantification as part of the content (usually but not exclusively, economic and business history modules) have tended to under-recruit; conversely, modules giving a low priority to numeracy skills (generally cultural history modules) have increased in popularity. The skew in the distribution of student choice in flexible structures has led to an inbuilt bias against the acquisition of quantitative skills.
- There is little institutional or external pressure to consider numeracy provision. Departments reported that undergraduate programme reviews had paid little attention to teaching numeracy skills and there was an absence of any 'steer' from faculty or university or from external agencies such as external examiners.
- It was consistently argued that any attempt to raise the extent or level of numeracy skills for undergraduates would run into a number of constraints: for example, the opportunity costs would be too high in terms of time and resources; students would resist any increase in provision and attempts to do so would reflect unfavourably on recruitment and retention targets.
- Within departments, there is a tendency not to regard quantification as a necessary skill which both contributes to historical understanding and enhances employment/career opportunities. There is an understated assumption that quantitative skills can be acquired on a 'need to know' basis, for example, to support a specific dissertation or project.

Conclusion

In short the evidence from the visits is one of resistance from both staff and students to any significant change in the extent and level of numerical provision. Any change would have to demonstrate the relevance of quantitative approaches to historical study. Bolt-on quantitative modules simply would not work, and numerical understanding must sit alongside a range of other skills as part of the capabilities of the undergraduate history student.

8.2.7 History tutor survey

The online and paper-based responses to the questionnaire seeking information on the attitudes and competency of history tutors in relation to numeracy yielded 100 returns.

History tutors' self-evaluation of numeracy skills

History tutors were asked to rate their ability to apply numeracy skills in their teaching and research on a five-point scale, with five equating to 'highly competent' and one to 'not at all competent'. The responses (N=99) suggest a profession fairly confident in its numerical capabilities (Fig. 32). Four out of five respondents (81%) considered themselves to be average or above average/highly competent in these respects with just over a third placing themselves in the two highest ratings compared with just under two-fifths in the two lower ratings.

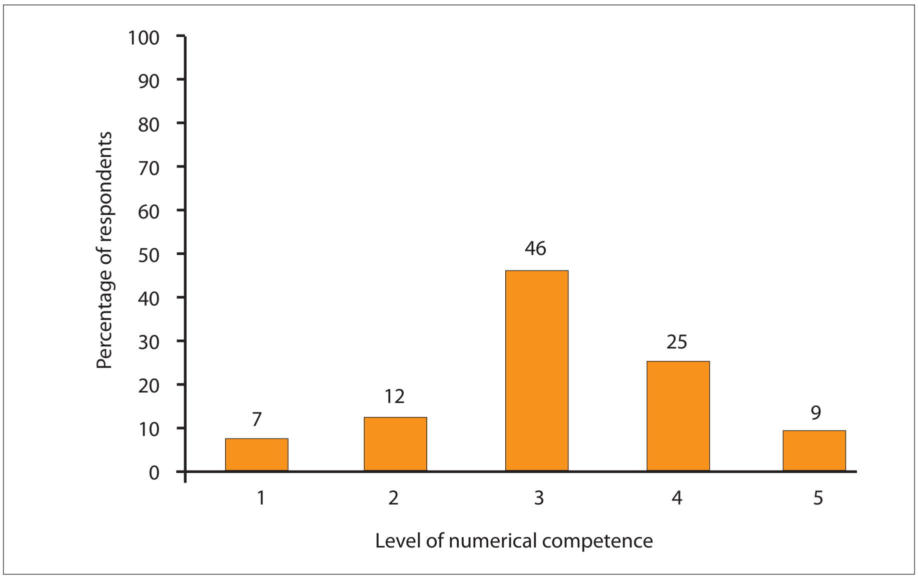


Fig. 32: History tutors' self-evaluation of numeracy skills

There is a conundrum here: history tutors are apparently relatively relaxed about their numerical proficiency and, according to the UK departmental survey, do not believe that enough is being done to teach numeracy. Yet, extant practice, as revealed by the survey and the follow-up interviews, suggests a profession reluctant to engage with numerical work in their undergraduate teaching. Care must be taken, of course, in making generalisations from categories such as 'average competency' (which claimed 47%); it may be that this is a 'catch-all' category towards which respondents inevitably gravitate and consequently it mirrors most measures of central tendency that obscure as much as they enlighten. Perhaps, as well, tutors interested in numeracy matters were more inclined to complete the questionnaire. Nevertheless, the fact that just over one-third of history tutors describe themselves as above average/highly competent does not suggest a profession bereft of numerical understanding.

It would seem reasonable to assume that the indications from these findings are that there is a pool of skill that is being under-utilised and that current numerical provision in undergraduate history programmes cannot be explained simply in terms of a lack of staff competence. It is interesting to note that only half of those tutors who expressed confidence in their numeracy skills are actively engaged in teaching aspects of numeracy and, of these, 38% had no involvement at all in teaching quantification at the undergraduate level. It may be concluded that there is sufficient proficiency within the profession to teach numeracy skills but that other factors are preventing it from being expressed in the classroom.

History staff attitudes towards numeracy

A further question probed tutors' attitudes and confidence levels in the handling and application of numerical techniques and invited them to comment on numeracy skills that concerned them. A number of respondents expressed a lack of confidence in their ability to use statistical techniques such as regression analysis, probability, sampling and so on but were nevertheless involved in teaching aspects of numeracy. For example, a tutor described their knowledge of mathematics as 'rudimentary' but they still taught a module which involved some basic statistical functions. A particularly interesting response was from a tutor who commented: 'My numerical deficiencies are manifold, but I can honestly say that they have not materially weakened my ability to teach relevant aspects of numeracy.' This is a reflective comment on the 'level' of numeracy skills required to teach history undergraduates and equates with the supposition, expressed elsewhere in the report, that what is relevant to the history student is the ability to use and understand a basic set of quantitative techniques. Hence the assertion of a tutor that 'I have good basic numeracy skills but cliometrics and econometrics have proved to be beyond my ability level' is not a reason for doing nothing. Rather, the reference to 'good basic numeracy skills' is to be welcomed and their employment in the service of curriculum development encouraged.

Tutor views on the importance of numeracy skills for the undergraduate historian

Tutors were asked whether they thought it was important to improve their students' numeracy skills. An overwhelming majority (84%) responded positively. The reasons they gave clustered in three main areas:

- Numeracy skills form part of a set of skills that undergraduate historians require. One tutor commented, '*All historians are quantitative historians; we use quantitative expressions all the time – 'few', 'probably', 'most'*. Another added, '*Historians need to count before they can evaluate what they have counted*'. History is an evidence-based subject, '*therefore in order to produce an accurate and balanced answer it is most important that students have both good numeracy skills and an understanding of the data/statistics they are dealing with*'.
- Numeracy skills are important 'life skills'. One tutor observed that, '*There is absolutely no way of understanding modern politics or society without being able to enumerate, even at the most basic level. How much? Why? Can we trust the numbers?'* Another remarked that numeracy is '*an essential life skill, especially as so much of (the) media is innumerate and misreading of data is rife*'.
- Many respondents commented on the importance of numeracy as a transferable skill and its relevance for employability. A typical comment was: '*Amongst the transferable skills we teach our students, numeracy is an important one… Through equipping students with such skills, we are enhancing their employability following graduation.'* Some tutors also made the connection between numeracy as a transferable skill and its relevance both to the subject and broader life skills: '*Enhanced employability is the most important factor; but also because their (student) ability to understand claims based on number(s) is essential to good citizenship as well as good research.'*

Other tutor responses

While the comments above are positive, articulating the relevance of developing the numeracy skills of history undergraduates, there were also a few doubts raised by the remaining 16% of the sample:

- A handful of respondents averred that the weak numeracy skills of students were the very reason for not integrating quantitative skills in the curriculum. To do so could hinder their academic progress more generally.
- Several others, while acknowledging that numeracy may be important, awarded it a low priority in the undergraduate curriculum. '*It is a transferable skill and also important for certain kinds of history, but would be low down in my list of priorities in relation to, for example, critical reading, writing skills*'. Another tutor accepted that the numeracy skills of students should be improved but asserted, '*I am not sure that this is something that can necessarily always be delivered through the history curriculum and it may not be desirable to do so. While some types of historical research do lend themselves to the delivery of this key skill, others do not and to attempt to do so could distract from teaching some of the core skills of the historian.'*
- Finally, in any sizeable survey, there is the inevitable 'outlier'; one tutor was firm in their resistance to teaching numeracy: '*I would resign if I was expected to do this!*'

8.2.8 The website survey

The survey of websites was conducted partly to check and supplement the information assembled via the questionnaire to UK history departments and partly to explore what was being done in those departments that had not responded to the questionnaire. To facilitate analysis, the results of the survey were recorded on a spreadsheet, with supplementary information recorded separately. Given the variable range of source material and the relatively limited amounts of information that many websites provide, the findings need to be treated with some caution. Even so, since history department websites normally itemise at least some of the transferable skills that history courses seek to develop, whether or not numeracy is included amongst them is an indicator of the degree of importance with which it is regarded.

Numeracy mention in undergraduate provision

Of the 91 websites searched, specific reference to numeracy or quantitative techniques could be found in only 14 cases (15%). Of these, eight related to general statements about the development of these skills within the programmes offered; the other six made mention of their use within specific history modules. In one of the specific cases, it was stated that the sources examined 'may' include statistics.

Such a small number of general references to numeracy provision certainly suggest that very limited attention is being paid to it, even allowing for any fears that website reference to quantification may act as a deterrent to prospective students. This said, it is likely that specific modules are doing more to engage students with numeracy than can be deduced from the summary website data alone, since those dealing with economic and business history and historical demography will include some quantification, as will modules dealing with sources and techniques. Nevertheless, modules of this type form a small proportion of the whole and most are offered as options, enabling students to avoid encountering any quantification if they so wish.

ICT use and numeracy

The survey revealed that while history programmes frequently aim to engage students with ICT applications, only in three instances was unequivocal mention found of the requirement for them to use spreadsheets and databases and, by implication, to deal with quantitative data. In one instance, the applications related to a second-level core module and in another to a second-level option. In the remaining case, the applications were noted in relation to teaching ICT skills in general, but were only included 'where necessary'.

The indications from the survey are that, while undergraduate history programmes encourage students to develop and use 'soft' ICT skills such as word-processing and internet use, they do not usually pay much attention to applications that deal with numerical analysis. It may be that rather more is being done in this respect than the survey findings reveal, but, if so, this seems more likely to be the result of individual initiative than of declared programme objectives.

Numeracy in postgraduate taught courses

The website evidence about numeracy provision in UK history courses is somewhat stronger with regard to postgraduate than to undergraduate provision. In total, 23 history departments incorporated a numerical dimension in their masters' courses. For the most part, reference is made to quantitative techniques and in a few cases to statistical analysis.

The extent and form of the numeracy inputs to MA courses showed considerable variation. They generally comprise elements in core research methods modules and may be linked with ICT inputs. Few instances were found of quantitative elements occurring in the content-orientated modules offered. How far practical work is associated with this provision is unclear from the website evidence.

That numerical components feature more strongly in postgraduate compared with undergraduate history courses may well reflect the requirements of research funding bodies. Additionally, there may be an attempt to achieve progression, with numerical analysis being seen as an advanced form of historical analysis and therefore best located at postgraduate level. That said, current provision at undergraduate level provides very little upon which to progress.

Numeracy and employability

It is commonplace for history department websites to mention that the various skills history students are taught are highly valued in terms of future employment. Additionally, mention is made of how these skills are valued in the wide range of careers into which history students go. Work placements are frequently offered too. However, only in one case was specific mention made of numeracy being a skill that history students could develop with employability in mind.

8.2.9. International departmental survey

Number and location of responses

Around 500 individuals in overseas history departments were contacted and 91 responses were received. In 13 cases, more than one faculty member replied, giving rise to a few minor discrepancies that had to be resolved through further enquiry. Allowing for the multiple responses, information was obtained from 73 history departments in various parts of the world.

To facilitate the analysis, the returns were grouped into broad geographical areas, namely South America, North America, the Middle East, Western Europe (outside the UK), Eastern Europe, Asia, Australasia and Africa. The number of responses obtained for each of these areas is set out below (Fig. 33). Just over half came from North America and a further 16% from Australasia. The varying rate of response reflects the number of institutions available to survey in each area, as well the ease with which contact could be made, especially because of the language constraints in non-English speaking areas.

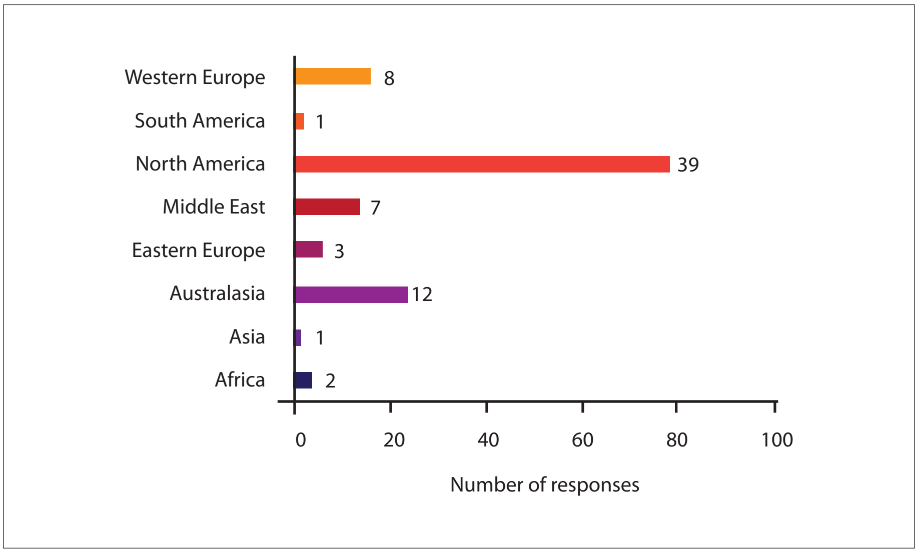


Fig. 33: Geographical distribution of overseas responses

Undergraduate numeracy skills and programme aims

In overall terms, only in 35% of cases (N = 26) did responding institutions offer history programmes that deliberately included the development of undergraduates' numeracy skills, though, as the following section reveals, nine of those which did not have this aim nonetheless reported that some tutors incorporated numerical elements into their teaching.

Marked geographical variation is evident in the results obtained. In both Western and Eastern European universities, high proportions of respondents stated that their programmes developed undergraduates' numeracy skills. The figure for the former was 78% and for the latter 67%. Given the small number of European responses received, this finding must be treated with caution, though it is in line with that from the UK, where two-thirds of history departments reported that they incorporated numeracy into their teaching. Elsewhere, the figures were much lower - in North America, for example, less than one in five. Here, degree programmes are broader, with numeracy skills delivered outside the history programme. Thus, one of the North American respondents observed: '*The college requires such a [numeracy] course; the department does not'* and another: *'We assume that numeracy will be ensured by the broad series of requirements for a BA.'* Yet whether, as a rule, historians in European universities feel a stronger responsibility to develop their students' numeracy skills than their American and Australasian counterparts is by no means certain.

The extent of numeracy teaching

With regard to the nine departments which did not aim to teach numeracy but where some of their tutors did incorporate numerical elements into their teaching, there was some variation in how this was done as the North American responses noted below reveal:

> *We don't emphasize numeracy skills as a specific goal - we don't teach cliometrics in any of our courses. However, all of us place heavy emphasis on the ability to use numerical data as part of historical analysis. This latter component is a feature of virtually all of our classes.*

Again, individual instructors may introduce some numeracy component, although this can be quite limited. When I taught second year students last year I included no numeracy (other than a brief discussion on pre-decimal currency). At the third year level I use some numerical examples but no assignments. At the fourth year and graduate levels I spend some time with statistical evidence and statistical argument, discussing how to read and present numerical evidence.

Clearly, individual tutors are taking the opportunity to incorporate numerical elements into their teaching and they may do so to a considerable degree, even without the stimulus of a programme aim. In this context, it is worth remembering that tutors in the USA have a greater degree of autonomy over the content of their courses than their counterparts in the UK. Yet the point should not be overstated. Tutors willing to include numerical aspects may comprise only a small minority of the teaching team, whilst, as the second respondent notes, the numerical inputs they deliver may be quite limited. These observations might equally apply in departments with the stated aim of teaching numeracy. Again, the impression is of limited and fragmentary provision with little evidence of progression through students' programmes of study.

Means of developing students' numeracy skills

Several of the 25 respondents to this question noted that they used more than one means of developing students' numeracy skills. As Figure 34 reveals, the most popular method used for doing so, which occurred in 60% of cases, was as part of a broader course/module on historical skills.

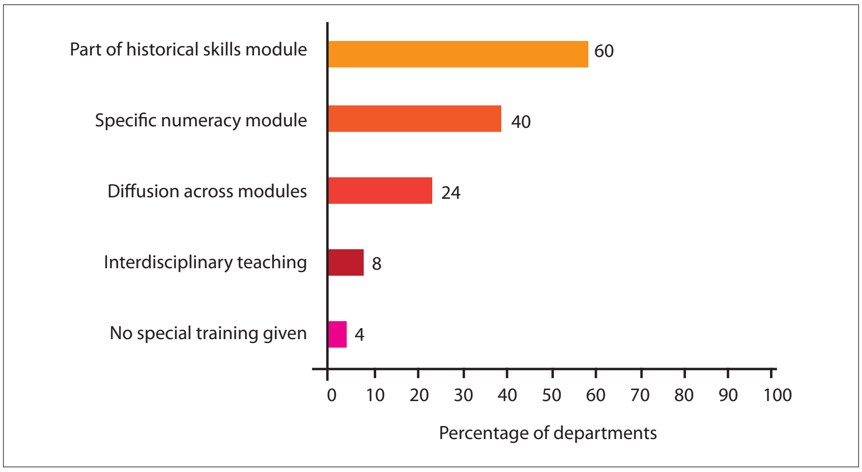


Fig. 34: Means of developing students' numeracy skills

Only in 24% of cases were numeracy elements being diffused across a range of modules. Rather more frequent, occurring in 40% of cases, was the use of specific courses or modules dedicated to numeracy learning. Compared with the UK approach, therefore, far less reliance was being placed on the diffusion approach, but rather more on the use of specific numeracy modules.

Responsibility for managing the development of numeracy skills

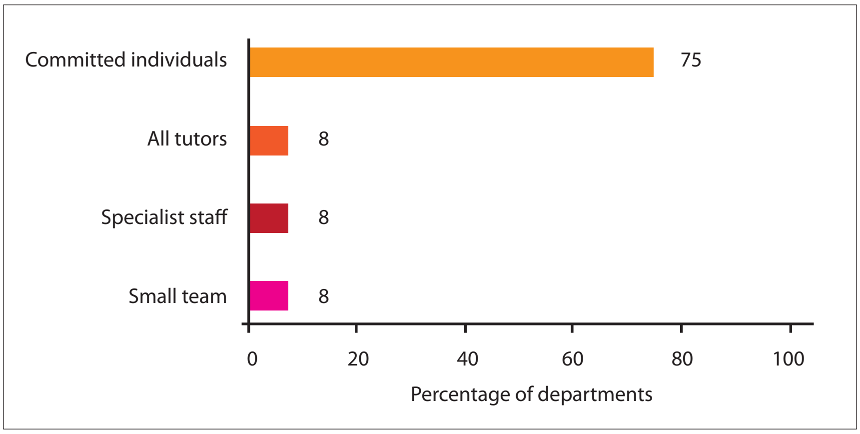


Fig.35: Responsibility for managing the development of numeracy skills

An overwhelming majority of the respondents (78%; N = 27) stated that the development of numeracy skills within their history course/programme is managed by committed individuals (Fig. 35), even in those that included numeracy as a programme objective.

The pattern shown by these data is similar to that of the UK, though with an even more marked reliance on the contributions of committed individuals. The notion of teaching teams as a whole having responsibility for incorporating quantification into history degree programmes does not appear to be widespread.

Location of numeracy in programmes

Respondents were asked to say at which level or levels numeracy skills were located in their programmes and whether these inputs were compulsory, optional or both. The results are shown in Fig. 36. At level one compulsion (54% of cases) outweighed optionality (38%), though not to a very marked degree. At each level thereafter, the proportion of compulsory numerical elements diminished steadily, and were absent entirely at level four. Very few departments reported the provision of both compulsory and optional numeracy inputs at any level.

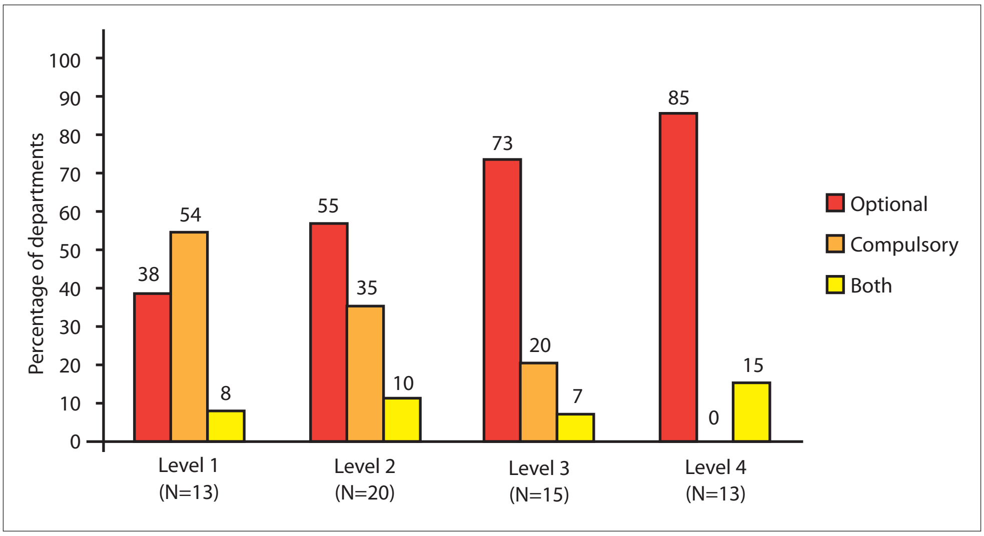


Fig. 36: Year-wise distribution of numeracy skills learning

In some overseas programmes, numerical methods are seen more as a feature of postgraduate than undergraduate teaching, as the following observations from North American respondents reveal:

> *Several faculty use such methods in their own research, but teach them mainly to graduate students.*
>
> *Not all fields have the evidentiary base that supports the use of statistical skills. There's more attention to this at the graduate level, but undergraduate majors focus on writing and analytical skills.*

These observations accord with those obtained from the website survey of UK history departments, which found that numerical inputs were reported to occur rather more frequently at the postgraduate level.

Progressive development of numeracy skills

Only 34% of 29 respondents claimed to develop numeracy skills in a progressive way through their undergraduate history programmes. The figure for Western Europe (excluding the UK) was 29% and for Australasia 25%. The corresponding return for the UK was 17%. Overall, therefore, the indications are that, in the countries surveyed, relatively small proportions of history departments are concerned to develop undergraduate skills in a progressive way.

Individual tutors may well adopt a progressive approach to incorporating numerical aspects into their teaching, as shown by the North American respondent quoted earlier, even if this is not a part of overall programme aims. Indeed, it seems that individually-managed, rather than programme-planned, progression in numeracy teaching is the more likely to prevail.

Numeracy skills assessment strategies

When asked about their assessment strategies for measuring the attainment of undergraduates' numeracy skills, less than one third of the 32 who responded indicated that they used any. For North America, the figure was just eight per cent. In some cases, as the following examples reveal, students do undertake practical numerical exercises as part of their assessed coursework:

> *Students are shown how to create tables in SPSS, and then asked substantive historical questions that require construction of similar tables, and interpretation of those tables.*
>
> *The answer to this question is rather 'maybe' than 'yes', in the sense that we do assess the attainment of numeracy skills but perhaps not in the framework of an overarching *strategy* but rather through a few well-proven group and individual exercises measuring the degree to which the students have mastered the basic numeracy skills included in our training in 'theory and methods' of historical research.*

Other respondents mentioned the use of occasional class tests and one the setting of a stage two exam that required students to answer one question with a numeracy skills element.

Using computers to develop numeracy skills

As Fig. 37 reveals, only in a minority of cases was it reported that students were required to use computer applications, especially statistical packages and spreadsheets. The use of databases was reported as being used more commonly than spreadsheets and statistical packages and was also the most likely to be compulsory. Thirty-two departments were using databases to develop numeracy skills, compared with 29 using spreadsheets and 22 using statistical packages. It must be remembered that these constitute only a minority of the 73 departments surveyed. Given, too, that the use of these packages is largely optional, the indications are that overseas history departments are making relatively little use of computer applications to develop their students' numeracy skills.

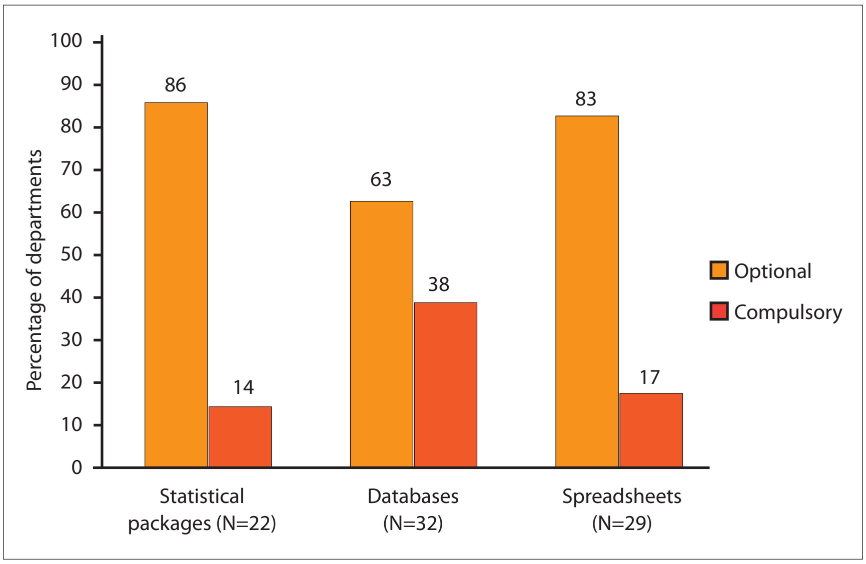


Fig. 37: Use of computers to help develop students' numeracy skills

Doing more to improve students' numeracy skills

Asked if their history programmes should be doing more to improve their students' numeracy skills, 68% of the 91 respondents stated that they should. The figure is appreciably lower than the 90% of UK respondents who took this view, though geographical variations arise. The Western European figure of 89% (N = 11) is on a par with the UK figure. Others, however, were lower: for the Middle East 75% (N = 6); for Australasia 68% (N = 13); and for North America 63% (N = 30). The comparatively low figures for Australasia and the United States may reflect the broader provision at undergraduate level, with students having opportunity to deploy their numeracy skills in other subject areas.

Reasons for the limited numerical inputs in history courses

Insights into why overseas history tutors may be reluctant to incorporate numeracy into their course provision were obtained both from a question asking why numeracy was not a programme aim and from general comments respondents were invited to make. In the former case, 29 responses were received and in the latter 49. Many of these comments parallel those made by tutors in UK history departments (see section 8.2.5), sometimes even to the extent of using the same language.

In a few cases, respondents were unable to explain why numeracy was not included in programme aims or the possibility of doing so considered. A particularly revealing response in this context came from a history department in a North American university in which defining teaching objectives was a matter of concern:

> *In our department numeracy is handled as an elective choice for individual professors. I suspect all of us would point to exercises, mini lectures, exam questions, etc. that connect to numeracy. But it is not a defined outcome for any of our levels. Why not? Because it never occurred to us. All 8 of us are social or cultural historians, so that may have something to do with it. But it is also true that in the larger conversations going on about departmental outcomes, numeracy is not on the table. So you're the first to poke at us*

Reference to the prevalence of social and cultural history carries with it the implication that numeracy teaching is best left to those who have both the interest and expertise to deal with quantitative matters, including economic historians. In the absence of such historians, numeracy teaching may not enter the collective consciousness of teaching teams, at least to the extent that it should feature as a key programme aim.

Aside from the absence of interest and expertise amongst tutors, other reasons suggested for the absence or limited presence of numeracy teaching in undergraduate history courses were:

1. Leaving numeracy teaching to non-historians

Where broadly-based arts degree courses are offered, as in Australia and the United States, the argument is made that expertise outside history departments can be relied on to deal with quantification. The following observations from two North American respondents illustrate the point:

> *As part of the normal General Education Requirements at a liberal arts college, all students, whether or not they are history majors, have to take two courses in social science, which would include training in quantitative methods. Departments such as Sociology, Political Science and Psychology handle this aspect of undergraduate education.*
>
> *We do encourage students to work across disciplines and many get statistical training through their courses in political science, sociology and economics.*

2. Resistance from students

Several respondents expressed concern about the reluctance of students to engage with quantification. The following - two from Australasia and one from North America - are typical:

> *We have found that very few of our undergraduates are comfortable learning quantitative methods and the best students are invariably double-majors from the Social Sciences.*
>
> *However I have tried to teach students how to read balance sheets and economic data sheets - but it's clear that by-and-large Art students have difficulties with numeracy. The best I can do at times is to get them to understand numeracy by understanding their own finances. It is a problem.*
>
> *I am loathe to spend too much time on any kind of number, including dates, in the courses I teach. It turns the students off and this aspect is not what I want to stress in my courses.*

3. More pressing concerns

Several respondents mentioned that they had priorities in their teaching other than dealing with numeracy. For example, one from Australasia remarked in some detail on his main objectives, pointing out that these kept him fully occupied:

> *I teach courses about parts of the world unfamiliar to the students, and place a lot of emphasis on teaching geography. I also teach several courses about countries where English is not the dominant language, notably German- and Russian-speaking parts of the world, and see my primary objective as spreading cultural literacy about these areas. I want students to develop empathy for non-Anglophones, to see the world through foreign eyes. I see this as particularly important when teaching the history of countries that have previously been at war with the student's country, and often portrayed as 'bad guys' in secondary education and popular media. Finally, I see the main analytical skills that students ostensibly gain from a degree in the humanities in terms of writing skills and public speaking. These objectives keep me plenty busy! My own research is not highly quantitative, and other colleagues at my institution work intensively with numerical methods. While accepting that numeracy is important, I don't feel bad that I concentrate on other things in my own classes.*

The issue of grappling with students' literary skills as a priority was also mentioned by others. Another comment from Australasia was that, '*Quantification is important for some kinds of historical analysis, but we are still struggling getting students past the more basic forms of historical learning*'. A Western European respondent observed that: *'The students are not really tested on numeracy skills. It's bad enough having to correct them at every turn with their basic literacy!'* The impression left from such comments is not one of hostility as such to the idea of teaching numeracy to history undergraduates, but rather that other objectives are deemed to be far more important.

4. The lack of a need to teach numeracy

It was argued by some that history students already have sufficient skills to cope with any numerical demands that the undergraduate curriculum makes on them. The respondent from Africa observed that the basic numeracy skills students required for university entry were *'usually sufficient for the elementary quantitative tasks set for our general undergraduates'*. Likewise, an Australian respondent remarked: *'We assume that students have the basic skills in this area when they arrive.'*

Aside from the point about numeracy teaching occurring outside history courses, several of the 29 responses received about why numeracy teaching was not taking place mentioned staffing constraints. In part, they centred on a lack of interest amongst history tutors in teaching numerical/quantitative methods, at least as far as undergraduate provision is concerned. Thus, amongst the North American responses were the following:

> *Most faculty think it's not important to studying history.*
>
> *Little interest among faculty – all the 'numeracy' folks went cultural.*

Commenting from the student perspective, one Australasian respondent maintained that most students in his department tried to avoid courses that involved numeracy skills and another, also from Australasia, that it was assumed undergraduates already possessed these skills when they arrived on campus.

8.2.10 Employability Issues

The survey of current students reveals that they enter university with a reasonable range of basic numeracy skills from having studied mathematics to GCSE-level. However, the numeracy test issued to level one undergraduates indicates that, for many of them these skills are already beginning to fade. The issue arises, therefore, of the advantage that can be derived from giving history students opportunity to revive and apply their existing numeracy skills rather than trying to enhance them. The potential benefit of this course of action in terms of the students' future employability is reinforced by the finding that, for the most part, the level of numerical capability demanded of graduates by employers is fairly basic. History is well-equipped to perform this task of 'keeping warm' a range of numeracy skills:

- they are important to historical inquiry – as evidenced by quantitative history – and should not therefore be neglected;
- there is ample historical data that is susceptible to quantitative investigation and which can thereby help with the honing of these skills;
- the receptiveness of the history profession to active learning approaches should encourage the adoption of methodologies that assist student engagement with numeracy skills.

Moreover, there is a widespread recognition across the history profession of the need to do something. An overwhelming majority (84%) of tutors in our survey thought it was important to improve their students' numeracy skills. Many of them also remarked on the importance of numeracy as a transferable skill and its relevance for employability. These positive findings, however, are offset by more troubling evidence. Hence, for example, departments trumpet on their websites their commitment to teaching transferable skills that will assist history graduates in finding employment and in their future careers. It is telling, however, that only one department made specific mention of numeracy in connection with student employability. Moreover, while there is a general recognition that more needs to be done and that most history staff have reasonable confidence in their own numerical competence, there is a reluctance to act. The ambivalent attitude of history staff to numeracy is therefore a critical issue. The question naturally arises, do they have a duty to prepare their students for employment – especially where mathematical skills can be shown to be apposite for history?

Undergraduates also recognise the value of numeracy to their future employability. Eighty-five per cent of the current students who responded to the questions on this issue felt that developing numeracy skills would enhance their employment prospects. Once again though the position is not as straightforward as the survey data suggest. The focus groups provided a rather more ambiguous picture. While they rated highly the value of numeracy to employability, some students still did not think it should be included as part of a history degree programme. That said, the key point to emerge from the various surveys of student opinion is that there is a general willingness on their part to engage with numeracy skills if it is made clear to them why they are necessary and that their value in terms of employability can be a selling point – indeed, more so than their value in terms of historical inquiry.

A student in one of the focus groups remarked that he would not apply for a job that required too much in the way of numeracy skills. As the review of history graduate employment shows, this perspective is not untypical of history students generally. For the most part, they do not apply for jobs that demand numeracy skills. Those that become numerical clerks and cashiers and IT professionals or enter business, finance, industry, sales and marketing are the exception to the rule. The focus group comment cited above suggests that the low uptake of such jobs reflects an innate aversion among students who elect to take history degrees. Even so, the general absence of numeracy skills in history programmes can only mean a narrowing of horizons for students – their career opportunities would surely be advanced if their skills were augmented. Thirty-one per cent of the respondents to the graduate survey believed that more numeracy training on their history programme would have increased their career opportunities. Nearly two-thirds (63%) of the same respondents also said that they thought their history programme should have given more emphasis to numeracy. However, the fact that almost seven in ten graduates did not see any need for further provision of opportunities for numeracy skills development suggests they are not perceived as being of much relevance to historical studies or in employment or both.

The numeracy skills that graduates are finding most useful in their jobs are ones that are routine at GCSE level, reinforcing the point about the value of a history degree in keeping these skills 'warm'. This is being done to some extent; the numeracy skills graduates thought their undergraduate degree had helped them develop the most included the three skills they also were finding the most useful in their work, namely 'interpreting graphs and charts', 'calculating percentages' and 'presenting tables of statistics'. Also, almost two-thirds thought that their history degree programme had helped them to develop their ICT skills. However, these apparently positive findings require qualifying. The ICT skills acquired were mostly the 'soft' ones that require no numerical competence. This is confirmed by the website survey which found little evidence that undergraduate history programmes pay much attention to involving students in ICT applications that deal with numerical analysis.

Moreover, in terms of their overall experience, from school to employment, the graduates reported that their undergraduate history programme had played the least part in developing their numerical competence. University is not only contributing little to the numeracy skills of history undergraduates, but evidence elsewhere in the report also shows that it is not helping to keep their existing skills active. This has implications for its students in terms of their ability to study history not just at undergraduate level but as preparation for postgraduate study of the discipline and for their employability in general.

In his analysis of first employment destinations, Nicholls (2005a, 2005b) concluded that the proportional distribution of history graduates by employment has been more or less constant over time with three sectors accounting for, on average, over 55% of jobs – namely, the clerical, retail and managerial sectors – while aggregating the several types of 'professional' employment produced a fourth, accounting for a further 20%. There are some differences in the destinations of the graduates surveyed by the project but the overall pattern is broadly similar. History graduates therefore enter the type of careers where employer numeracy tests are most frequently used, namely managerial, professional, associate professional and administrative occupations. Thirty per cent of the graduates in the graduate survey said that they were required to take a numeracy test as part of their recruitment and selection process. Failure in these tests, or reluctance to apply for jobs that make use of them because of perceived weakness or 'number fear', limits the career opportunities of history graduates. This is unlikely to diminish as the resort to tests spreads and it is a cause for concern that university history departments seemingly do little to prepare their students for them.

The question of *which* mathematical skills students need to enhance their employability is a complex one – complicated by the differential needs of employers, degree-subjects, the prior experiences of students and so forth. Indeed, because of these complexities, employer demands for 'oven-ready' graduates who (pardon the mixed metaphor) can 'hit the ground running' are unrealisable. (Atkins, 1999) Nevertheless, when employers specify the numeracy skills they expect graduates to have, these are usually fairly modest ones. The type of mathematical skills that many say they regard as important, and which figure in their numeracy tests, are integral as well to mainstream quantitative history, namely, understanding the concept of number, handling fractions and decimals, working with ratios and proportions, calculating percentages and rates, numerical problem-solving, data interpretation and using spreadsheet software (see section 8.1.1). For example, Richard Wainer at the CBI defined numeracy as the ability to 'do simple mental arithmetic, not having to rely on calculators or tills, interpret data, extract relevant information from graphs and so on. It's pretty simple stuff.' (Keating, 2007)

This section of the report must conclude with one serious matter that militates against its findings and recommendations on enhancing the numeracy skills of history graduates in order to improve their employability. The subject of a degree in the case of non-vocational occupations is relatively unimportant. Approximately 60% of job advertisements are non-specific as to degree qualification. Employers place more emphasis on class of degree and still more on the graduate's university (reinforcing the advantages of social class and educational background). The irony of this can be seen in the fact that, while new universities have been more pro-active than the old in embracing the employability skills agenda, it is the latter which employers invariably tend still to favour. The task of persuading employers that any particular degree programme is addressing their demands for skilled graduates is not at all straightforward and poses serious obstacles to delivering the sort of changes recommended by projects like this one.

In conclusion, the employability agenda is fraught with problems stemming in large part from the contradictory positions taken up by the key players. Students see the value of numeracy skills to their future employment but don't want to practise them; tutors recognise the need to incorporate them in their programmes but find all sorts of reasons for not doing so; employers trumpet the need for better graduate numeracy but their inclination in their recruitment policies to favour some sectors of HE over others is a disincentive to those in the latter willing to meet this need.

8.2.11 Good practice website

In a discipline such as history, quantitative analysis is a means to an end, but it is a means worth investing in, equipping students with a set of skills that apply to historical study, to career development, and to a more critical understanding of contemporary society. It is also the case that demonstrating the value of quantification is crucial if history undergraduates are to engage with it as an accepted part of their programme of study. The investigation identified a small minority of departments that had successfully inserted numerical work in their single-honours degree programmes. Examples were received from 13 departments (eight pre-1992 and five post-1992) and they varied in detail, content and approaches. In addition, a number of text-based and online sources and guides to quantitative techniques are available that include exercises using historical source materials and which are aimed at helping history undergraduates develop their numeracy skills. The project team are in the process of creating a website that will direct tutors and students to these materials (subject to permission) and which will offer some advice on how they might be incorporated into the undergraduate curriculum. The website will also invite contributions from across the sector in the hope that it will quickly become populated with examples of good practice that will serve as a readily available resource for history teachers. The Higher Education Academy History Subject Centre has kindly agreed to host it. This section of the report is therefore provisional as work on the website is still in its infancy but below we describe the principles that a course team might apply in re-designing their programmes and include examples of the models of good practice that will be included on the website.

Guiding Principles

- Students should engage with numerical work in their first year of undergraduate study and it should be recognised as a skill which is on a par with other historical skills, for example, as in Model A below.
- Numeracy must have more than a token presence in the curriculum.
- To enable a progressive engagement with quantification, serious consideration should be given to providing a compulsory element at level two and to the possibility of extending numerical work in a student's final year of study, perhaps by way of the dissertation or project. The ‘hybrid’ model D suggests one way in which progression of this sort might be achieved.
- Numerical exercises should be contextualised within the historical literature and demonstrate the value of quantification to the student’s understanding of the topic. The exemplars in the texts identified in Model E illustrate how this can be done.
- Numerical components should be summatively assessed. Assessment is a key aspect of student learning and an assessed exercise should enable students to demonstrate both their understanding and application of a basic set of quantitative techniques.

Models of Good Practice

Below are examples of models that will form the basis for more detailed case studies posted on the website. As work continues on this part of the project, it is likely that more will be added.

Model A: curricula designed to enable the progression of a quantitative component from level 1 to level 2. A numerical component is inserted into a core 'skill' module in the first year of study and is then extended into the second year. The numerical component typically forms part of a range of approaches centred on a broad historical theme.

Model B: numerical work forms an integrated part of an optional module which can be offered at any level as a specialism of a member of staff or a small team. The content tends to focus on economic themes but other aspects of history are sometimes explored, for example, demography or voting patterns. The model does not guarantee progression.

Model C: an ICT module (core or optional and at any level) which uses practice-based work to analyse, interpret, and present a range of historical evidence using numerical techniques. Applications typically involve spreadsheets, databases and statistical packages. The issues for course teams is whether to offer such modules as core or optional, whether or not to make them part of an essentially ‘self-directed’ programme of study, and whether or not to include such ICT modules at every level of the programme in order to develop numeracy skills progressively.

Model D: a ‘hybrid’ of Models A, B, C and E which uses elements from each to ensure progression through all levels of the undergraduate programme.

Model E: a selection of textual or online sources, ranging from the relatively undemanding to the more advanced, that history tutors can draw upon at all levels of the programme to give their students experience of applying quantitative techniques to historical sources. This might be described as a ‘distributive’ model that will enable tutors who are uncertain about their and their students’ numerical competence to begin by incorporating some small scale provision into their modules while allowing the confident ones to be more adventurous.

9. Outcomes

At the outset, the project team set itself ten objectives. These were of differing levels of importance in terms of their wider value and their potential impact on teaching, learning and/or research communities. Some were specifically concerned with gathering empirical evidence, others with the evaluation of that evidence and dissemination of the findings and conclusions arising from that evaluation. The team were undoubtedly successful in realising their evidence-gathering objectives, but much more important in terms of assessing the value of the project are the objectives concerned with the findings and their evaluation, for it is these that are more likely to impact upon, and have real and potential benefits for teaching, learning and research communities within the higher education sector. This distinction should be borne in mind in the following assessment of the ten project objectives.

Objective 1: to identify the range of undergraduates' pre-university mathematics qualifications.

Originally, the project team had intended obtaining this information from central university records, particularly in the case of UCLan. However, this proved impossible due to the lack of information regarding undergraduates' pre-university qualifications held on the university's central database system. An alternative strategy had to be adopted which involved including appropriate items in the two surveys of undergraduates (for UCLan students and UK history undergraduates) and in the numeracy test for history undergraduates. The data obtained allows some understanding of the extent to which secondary level education in the UK, especially the attainment of GCSE Mathematics, provides (in)adequate preparation in terms of numeracy skills for undergraduates studying a diversity of first degree courses, including history programmes, but particularly those that incorporate more in the way of numerical or quantitative elements.

Objective 2: to assemble empirical data on the nature and level of numerical knowledge and skills required of undergraduates, including national and international data for history.

Objective 3: to identify and evaluate current practices in teaching, learning and assessment for enhancing numeracy in relation to subject benchmarks.

These objectives were realised via the online surveys distributed to graduate employers and UCLan tutors, and the questionnaires sent to all HEIs teaching single-honours history programmes in the UK and to history departments in a sample of overseas institutions. The follow-up interviews with a sample of UCLan tutors, and visits to selected UK history departments helped to cement and supplement the broad picture that emerged from the surveys.

Returns from the employer survey highlighted the extent to which employers are using numeracy tests in their recruitment procedures, and those numeracy skills that employers value and in which they expect their graduate recruits to be competent. Results from the employer survey should help inform institutional strategies aimed at enhancing graduate employability.

With regard to history, the picture was one of a limited engagement with numeracy skills and a retreat from quantitative approaches to history in tandem with the decline of economic history. Within UCLan, disciplines exhibited the full range of engagement with numeracy skills, ranging from extensive intra-curricular engagement in some disciplines (e.g. biosciences, nursing, and business studies), to very little, if any engagement in other disciplines (e.g. art and design). In the case of some disciplines, such as English, intra-curricular engagement proves extremely difficult. Results from this study suggest that students in such disciplines (as well as significant numbers of students enrolled in other subjects) would benefit from HEIs ensuring that extra-curricular opportunities are available for undergraduates to develop and practise the numeracy skills essential for them not only to attain graduate employment, but also to work efficiently and effectively in their future jobs.

The surveys and follow-up interviews also revealed evidence of good practice and the recognition by some disciplines (e.g. history, nursing, psychology) of the need to improve students' numeracy skills. It was possible for the team to build on these outcomes, most notably in framing its recommendations for encouraging history departments to engage with teaching numeracy skills and devising a website that disseminates 'good practice' which can be used by the whole of the HE history community. Other recommendations build upon the good practice evident within disciplines such as nursing and psychology at UCLan.

Objective 4: to identify the learning support needs of undergraduates and, where appropriate, propose changes in curricula and/or teaching and assessment strategies to improve their numeracy skills and promote progression in numerical competency.

The principal methods used to achieve this objective were surveys, focus group discussions with undergraduates, interviews with individual tutors, and in the case of history discussions with the wider history community at conferences and workshops.

Within the UCLan strand of the project, participating undergraduates and tutors identified a wide variety of teaching, learning and assessment strategies currently used to support the learning needs of students with regard to improving their numeracy skills, although the extent of the diversity varied amongst disciplines. In addition, undergraduates provided an indication of their preferences when it comes to being supported, either within their degree programme or more centrally within the university. Although sample sizes were relatively small when compared with the total undergraduate and tutor populations with UCLan, such data proved invaluable and enabled evidence-informed recommendations to be formulated.

With regard to history, the methodology had limitations in terms of pointing to a clear and unequivocal course of action. The meetings revealed very different viewpoints as to the value of teaching numeracy in history programmes and some not inconsiderable resistance among both tutors and students to any attempts to insinuate numeracy into the history curriculum. It is difficult, however, to conceive of an alternative methodology that would have produced a consensual view on curricular reform and teaching strategies. Nevertheless, the team were able to reach certain recommendations based on the feedback from both teachers and students. The most important finding is that there is a bias towards learning support methods that are embedded within the history curriculum and against any 'bolt-on' approaches. A critical project outcome, at least as far as the history community is concerned, then, is that, freestanding institutional study skills programmes would find little support and that, if the project is to have any significant impact on undergraduate history programmes, it will be by way of the modest, manageable, achievable changes recommended. In other words, the advance of numerical study in undergraduate history programmes should best be considered as a gradual process that sets out to demonstrate the value of a quantitative approach to the understanding of history and aims to change tutor and student perceptions so that numeracy is recognised as a normal item in the historian's tool-kit. This is not to deny that institutional schemes could play a useful supportive role, and not just for students who might welcome some 'remedial' help but also for those seeking to enhance their numeracy skills, perhaps, for example, with regard to dissertation preparation and ICT applications, but any attempt to force dissemination by way of compulsory 'bolt-on' modules would be counter-productive, leading to resistance from both tutors and students.

Objective 5: to trial and evaluate materials and methodologies developed.

Least progress of all was made in the realisation of this fifth objective. Due primarily to staffing constraints there was time to evaluate only some of the many generic resources available.

Our exploration of other universities' recommended websites for mathematical/numeracy support, carried out by the undergraduate intern, revealed just how many resources are available, from individual's lecture notes to materials developed using commercial software. Since materials generated by the MSOR community (e.g. *mathtutor*) were the most widely used, it seemed sensible to begin with a trial of some of these. Within our limited trials these materials have satisfied some of our students' needs. We are continuing with our trial of a weekly one-hour drop-in session, based upon advice received from the CETL at Loughborough and Coventry regarding the establishment of a point of contact for maths support. Although results of the student survey revealed that drop-in sessions were not at the very top of the students' list of preferences, the extent of student enquiries at the 'i' and WISER suggested that it was important that we establish a focus for numeracy support within the university and the credentials from which to recommend online and other support materials to undergraduates.

The history team had hoped to trial and evaluate curricula ahead of completing the report but were defeated by the pressure of time. At the time of writing, work is ongoing to create a website of 'good practice' that will contain materials for use across the HE history community. It is also intended to obtain feedback on this and the other recommendations from colleagues at forthcoming conferences. The team are confident that the materials will be accessible and usable by the history community in the very near future. Assessing their value and impact is something that could be usefully developed (see section 11).

Objective 6: to survey employers to establish the numeracy skills demanded of graduates in relation to different types of employment.

This objective was achieved by means of an online survey distributed to graduate employers throughout the UK. A number of strategies were used to boost the number of returns to 165 and these have been summarised in sections 6 and 7 of the report. Returns from the employer survey highlighted the extent to which employers are using numeracy tests in their recruitment procedures, and identified to what extent employers expect graduate competency in a range of specific numeracy skills that they value. Results from the employer survey also highlight the importance of graduates' numeracy skills and should help ensure that these skills are not neglected when institutional strategies aimed at enhancing graduate employability are drafted and implemented.

Objective 7: to identify practices that might be adopted for developing generic numeracy skills across the HE sector.

The online surveys for undergraduates and tutors at UCLan, followed by focus group discussions and individual interviews with tutors, revealed few examples of practices that might be adopted for developing students' generic numeracy skills. Most examples of good practice were focussed on ensuring student competency in those numeracy skills of direct relevance to the discipline. For example, the use of supplementary podcasts in psychology, and drop-in sessions combined with more regular help, practice and assessment of numeracy skills in nursing. However, a colleague at one of UCLan's partner FE colleges had authored a small (A6) handbook, '*Numeracy Aid*' which aimed to give individuals who are lacking confidence in their numeracy skills a quick and easy reference (Wills, 2007). This pocket-sized guide was distributed to participating students, and copies made available at WISER (UCLan's study skills support unit).

Many HEIs provide something in the way of central numeracy support and hope that those students who need it most will avail themselves of the help. It is important that any generic numeracy help is highly visible and that students are aware of when and where they can obtain help and what sort of help is available. In terms of online support, students need to be made aware of what materials are available and how they can access these. In addition, it is important to recognise that those students in greatest need of support are often the least likely to seek help. Emphasising the importance of numeracy skills to future employability may encourage such students to come forward.

Objective 8: to recommend strategies for implementing the practices identified in objective 7 above, using UCLan as a model.

Any good practices identified through addressing objective 7 above have been incorporated into the recommendations (see Section 12).

Objective 9: to evaluate the approaches used and the potential for adopting project findings across the HE sector.

This final report fulfils objective 9, namely to evaluate the project along with its findings and their potential for adoption across the sector.

Objective 10: to disseminate the project findings, internally and externally, through various media, using external partners where appropriate

Appendix 2 provides a summary of all dissemination activities and details of publications to date. Many of the items listed may be downloaded from the project's website at www.uclan.ac.uk/information/services/ldu/every_student_counts.php

Main beneficiaries:

The main beneficiaries of the outcomes of this project are:

- Students through:
  - curriculum changes and modifications to teaching, learning and assessment strategies aimed at enhancing students' numeracy skills within disciplines (where possible and appropriate)
  - direction to additional paper-based and online resources to support revision, self-directed learning, increased opportunities for practice, and self-assessment
  - any central support service provided (e.g. the drop-in sessions reintroduced at UCLan).
- Academic tutors (including support staff) and research communities through a greater awareness of:
  - the importance of students' numeracy skills to their future employability
  - factors which influence the nature and extent of students' engagement with numerical elements of the curriculum (e.g. attitudes, approaches to learning, maths anxiety)
  - additional paper-based and online resources aimed at supporting students' self-directed learning, as well as increased opportunities for practice, and self-assessment.

10. Conclusions

Results of the employer survey highlight the importance that many employers place in graduates' numeracy skills and their increasing use of numeracy tests as part of their graduate selection procedures. Thus, it is vital that universities ensure that their undergraduate populations are equipped not only with the numeracy skills necessary for progression and success within their academic discipline, but also with those numeracy skills necessary for them to attain graduate employment and to be effective subsequently in their workplace.

The contributions to the project made by undergraduates across a diversity of academic disciplines at UCLan supported the findings of previous studies in terms of students' conceptions of mathematics, their attitudes towards and approaches to learning mathematics and developing numeracy skills and the nature and prevalence of mathematics anxiety. Although, when prompted, many undergraduates recognised opportunities which exist outside the university environment for them to develop and practise their numeracy skills, results of this study highlighted a general lack of awareness amongst undergraduates and tutors of the importance of numeracy skills to students' attainment of graduate employment and their subsequent importance in the workplace.

Contributions by undergraduates and tutors at UCLan revealed the extent and diversity of existing opportunities for intra- and extra-curricular numeracy skills support across a variety of academic disciplines, as well as students' preferred methods of support and potential barriers to increasing support within some areas or disciplines.

The history strand of the project revealed that history students over-estimate and are over-confident about their mathematical capabilities and are generally resistant to their incorporation into history degree programmes. Their deficiencies are nevertheless fairly minimal although the mathematical skills they have learnt at GCSE have 'cooled' somewhat by the time they enter university. Keeping warm and ticking over mathematical skills acquired at school would meet the requirements of most employers and widen opportunities for history graduates. The team found that there are tutors across the HE history sector capable of delivering these basic skills. Moreover, the abilities to quantify, calculate and measure are not inimical to the discipline but are an integral part of historical investigation and reporting. A plethora of historical data is susceptible to quantitative analysis. The means whereby the situation may be remedied are therefore present. What is lacking is the will to do so. It is the team's belief that the modest and incremental approach recommended for history is practical and attainable in the prevailing context.

The problems associated with supporting individuals in maintaining or furthering their numeracy skills are complex and should not be underestimated. Evans (2000) summarised four interrelated concerns about mathematics learning and use:

1. problems of application or 'transfer', e.g. from school to university, from university to the workplace;
2. problems of participation and preparation, e.g. the significant decrease in individuals studying maths beyond GCSE (Grove and Lawson, 2006), and lower standards of preparation for those making the transition to HE;
3. inclusiveness problems, i.e. the under-representation of particular groups studying mathematics beyond GSCE, e.g. females and some ethnic groups;
4. affective problems, e.g. the perception that maths is 'hard' or 'boring', maths anxiety, dyslexia and dyscalculia.

All the above must be considered when devising strategies aimed at addressing any numeracy skills deficit, as must the most appropriate pedagogic methodologies for supporting mathematical skills development within the varying contexts experienced by undergraduates (Cox, 2006).

11. Implications

The results of this research project and its conclusions have implications for HEIs in terms of:

- increasing HE professionals' awareness and recognition of the importance of numeracy skills to their undergraduates' future employability;
- helping HE professionals recognise some of the key factors that may influence their undergraduates' engagement with numerical elements of the curriculum and/or success in employers' numeracy tests, including undergraduates' conceptions of mathematics, their attitudes towards and approaches to learning mathematics and developing their numeracy skills, the nature and prevalence of mathematics anxiety, and the influence of students' past or current course experiences;
- the teaching, learning and support strategies HE professionals need to put in place to ensure that their undergraduates have the necessary numeracy skills to enhance their prospects of graduate employment, whether in their chosen academic discipline/vocation or in an alternative career pathway.

Undergraduates and tutors from UCLan who participated in this project represented a very wide range of academic disciplines (although with varying numbers of participants in each), from those in science, technology and health, to those in the arts, humanities, social sciences and management. The project's findings and conclusions, therefore, have implications for a wide range of disciplines, beyond just the four disciplines included in the original project proposal.

Much of the evidence presented should provide the necessary driving force to encourage curricular changes and/or the provision (or modification) of central support facilities which (i) emphasise the importance of numeracy skills not only to some specific disciplines (e.g. STEM subjects and nursing) but also to future graduate employability (regardless of academic discipline), and (ii) offer a range of 'numeracy' support strategies which cater for a diverse undergraduate population.

Providing central student support

Due to delays in accessing *mathtutor* little progress has yet been made in developing the signposting to resources beyond the *mathtutor* site. Some students would have liked to see particular topics covered in the drop-in sessions, rather than bring their own issues. In a recent bid for funding to continue providing maths/stats support (submitted to SIGMA) UCLan is seeking funding to run sessions which cover the topics needed for success in employers' numeracy tests, as well as to increase the number of drop-in sessions.

The need for more and better teaching materials in history

The project has demonstrated the limited engagement with numeracy skills in history programmes and the limited number of extant examples of good practice, despite the fact that quantitative source materials are readily available and the analysis of them a critical part of historical inquiry. There is a very real need for constructing teaching aids using historical source materials and making them accessible for easy adoption by programme teams. A modest start has been made with our good practice website and by the History Subject Centre providing easy online-access to Mark Freeman's *Quantitative Skills for Historians* and Richard Rodger's *Making History Count*, but this is an area ripe for future development work. Structured teaching materials available in a range of formats – online and paper – would be a great boon to the teaching profession and would greatly assist the incorporation of numeracy skills in history courses.

The need for an external driver in history

Despite the evident value of quantitative approaches to the study of history, because of 'numerical phobia' among teachers and students, it is highly unlikely that there will be much change to existing provision without some form of external pressure or incentive. The subject benchmark statement's wording regarding numeracy skills may have to be revisited, though any attempt to make it less permissive would lead to bitter and bloody conflict within the profession. As things stand, external quality agencies cannot enforce something that is not a requirement of the benchmark statement and the profession will not move without external pressure, and so there is an impasse which can only be broken by change on the latter front.

The need for training (history)

It is a conclusion of this inquiry that, as things presently stand, modest changes to assist students in keeping their mathematical skills 'ticking over' are the most practicable. The success of this strategy is dependent on persuading sufficient members of a largely reluctant profession that the goal is achievable and worthwhile and that their efforts will be supported. It is dependent therefore on HEIs putting in place an infrastructure that will facilitate progress for those who would benefit from it – staff development, training programmes, small teaching grants and so forth. The more radical change suggested in the previous paragraph would entail a more extensive training and support infrastructure.

The need for the history profession to re-examine its responsibilities with regard to the place of quantification in the undergraduate curriculum and to preparing undergraduates for both postgraduate study and employment

All three elements can be advanced as arguments for just such an engagement and this report has reflected upon the merits of each. This is not just a matter of changes to teaching and learning; it is also one of education more generally for our findings show that undergraduates will be more willing to engage with quantitative processes if their importance is explained to them. These reflections can be used to inform the critical and much-needed debate on how numeracy skills might best be both taught and sold to students.

Further research

In terms of building upon the results of this research project, future areas of investigation may include:

- Further exploration of academic discipline (faculty) differences in students' use of particular learning approaches. For example, why do undergraduates from the arts, humanities and social sciences appear to adopt deeper learning strategies than science undergraduates? Is this because the teaching and learning environment (e.g. workload, teaching strategies, assessment methods, etc) in the arts, humanities and social sciences is more conducive towards fostering deep learning?
- Identifying the types of teaching strategies and learning environments that are conducive to enhancing students' confidence in mathematics and the development of numeracy skills, since higher levels of confidence in their numerical competence have a positive influence on students' attitudes towards the development of numeracy skills and also decrease their levels of maths anxiety.
- A longitudinal study, tracing the nature of changes in students' attitudes towards mathematics and numeracy from their entrance into university through to completion of their final year, since results of this study suggest that students' attitudes are not static but changeable. Such a study might help identify those factors that can potentially promote more positive attitudes.
- More qualitative research studies to identify why those students most in need of support are usually the least likely to avail themselves of the support available to them. Specific strategies are required to reach this group of students.
- Further research into the assessment of numeracy skills within history.

12. Recommendations

This section summarises all the recommendations that have emerged from this research project. Recommendations emanating from the two strands of the project are presented separately and use different formats, representing differences in the presentation of the supporting data which may be found in *Section 8: Outputs and findings* (references to page numbers and/or sub-sections have been provided as appropriate).

The project team recommends that the lead institution, UCLan, consider establishing a working group whose remit would be to review those recommendations pertinent to the university and to formulate a strategy for their implementation. The working group should include representation from the Learning Development Unit, WISER, Futures, Learning and Information Services (LIS), and CETH, as well as student and academic representative(s).

Higher Education Institutions and/or UCLan

RECOMMENDATION 1 (p.38): In supporting the development of students' numeracy skills, HEIs (including UCLan) should advocate the adoption of teaching and learning strategies that encourage students to develop more cohesive rather than fragmented conceptions of mathematics. That is, they should help students to view anything mathematical as more than just 'working with a lot of numbers, rules and equations', but as a tool which can help them better understand and work more productively within their academic discipline, future workplace and everyday lives.

RECOMMENDATION 2 (p.41): UCLan should capitalise on the positive attitudes towards numeracy skills that many of its students have demonstrated, their recognition of the usefulness of mathematics/numeracy, and their motivation to enhance their numeracy skills, to help students in all subject disciplines recognise the usefulness of mathematics/numeracy, particularly in the context of their future employability. The university should aim to build students' confidence and competency with regard to numerical elements of their curricula and/or with regard to employers' numeracy tests. The recognition that some students possess very negative attitudes towards mathematics and the further development of their numeracy skills should be accompanied by appropriate measures to try and motivate such students.

RECOMMENDATION 3 (p.44): HEIs (including UCLan) should ensure that tutors are aware of the nature and potential level of mathematics anxiety within their student population and its potential to impact upon student performance, particularly amongst mature, female students and those possessing no (or a low standard of) formal pre-university mathematics (or -related) or numeracy qualifications. In addition, students' perceptions regarding the relevance of mathematics/numeracy influence their attitudes towards the subject, with positive attitudes associated with recognition of its relevance. It is, therefore, important that any intra- and extra-curricular activities aimed at enhancing students' numeracy skills emphasise the context and relevance of these skills.

RECOMMENDATION 4 (p.46): In supporting the development of students' numeracy skills, HEIs (including UCLan) should advocate the adoption of teaching and learning strategies that take into account variations in students' approaches to learning, but should, wherever possible, encourage students to use deep, rather than surface approaches to learning.

RECOMMENDATION 5 (p.47): Since almost 50% of student and tutor respondents in the UCLan surveys appeared unaware of employers' increasing use of numeracy tests and approximately 80% were unfamiliar with the types of tests used, the university should do more to raise awareness amongst colleagues (academic and support staff) and students and provide and publicise greater access to sample numeracy tests.

RECOMMENDATION 6 (p.48): Although UCLan does currently provide some opportunity for students to attempt the type of numeracy test increasingly used by graduate employers in their selection procedures, few students in the current study appeared to be aware of this provision. UCLan should provide more opportunities for students to attempt such tests, advertise such opportunities across the university, and provide students with constructive feedback on their performance with a view to increasing confidence, particularly amongst more mature students and/or those with lower levels of formal mathematics (or -related) qualifications. Such opportunities should be supplemented with workshops and/or drop-in sessions to address any weaknesses identified and to cover those topics commonly encountered in such tests. For example, many employers' numeracy tests involve candidates' interpreting data presented in a variety of formats and/or completing basic arithmetic calculations (with or without a calculator). Thus, any strategy, whether discipline-specific or aimed at improving candidates' performance in employers' tests, should ensure that such skills are developed.

RECOMMENDATION 7 (p.52): HEIs (including UCLan) should ensure that all their undergraduates have the opportunity and are actively encouraged to become proficient in a range of basic numeracy skills, particularly those valued by employers and often tested in employers' recruitment tests (see recommendation 6 above). Such opportunities may be intra-curricular (e.g. in those disciplines whose subject benchmarks already require the development of students' numeracy skills), or extra-curricular to accommodate students whose disciplines are unable to easily integrate numeracy skills within their curricula (e.g. English).

RECOMMENDATION 8 (p.58): Given the responses of undergraduates and tutors in the UCLan surveys, UCLan should encourage and support the greater adoption and use of ICT to support the further development of students' numeracy skills and to provide students with more opportunities to practise their numeracy skills. For example, through the use of *eLearn (WebCT)* and/or *QuestionMark Perception* to develop and deliver online self-assessment and summative tests (where appropriate); use of Minitab, SPSS, Excel; development of new or use of existing CBL materials such as *mathtutor* and/or direction to appropriate web sites providing support materials.

RECOMMENDATION 9 (p.58): UCLan should ensure that all tutors (including postgraduate demonstrators) delivering numerical elements of the curriculum and/or responsible for providing additional numeracy support to students, possess appropriate levels of knowledge, experience and confidence. To this end the university should consider establishing a programme of workshops and/or a forum at which tutors could exchange examples of good practice, discuss advantages/disadvantages of specific practices, and support one another in addressing particular issues or problems associated with supporting the development of students' numeracy skills.

RECOMMENDATION 10 (p.61): HEIs (including UCLan) should take care when considering the introduction or expanding the use of diagnostic numeracy tests, since their indiscriminate use can emphasise a 'deficit model' with regard to students' numeracy skills, promoting a lack of confidence (and in some cases encouraging maths anxiety) amongst students.

RECOMMENDATION 11 (p.63): Some disciplines within UCLan may wish to consider using a greater diversity of tasks in the assessment of their students' numeracy skills, in order to cater for students' different learning approaches. The introduction or increased use of class tests and examinations for both formative and summative assessment of numeracy skills may be appropriate for some disciplines, since these can provide less opportunity for collusion or plagiarism between students. In addition, some disciplines may wish to explore the use of *eLearn (WebCT)* and/or *QuestionMark Perception* to develop and deliver online self-assessment and summative tests, where and when appropriate.

RECOMMENDATION 12 (p.64): Since responding students expressed a preference for peer support (i.e. help from friends on the course), in disciplines where tutors have insufficient time to devote to extensive one-to-one tutoring, departments within HEIs (including UCLan) should explore the design and introduction of peer-tutoring schemes or sessions, as well as greater use of ICT (e.g. direction to appropriate websites, access to CBL materials and/or online self-assessment tests).

RECOMMENDATION 13 (p.72): Since, with regard to students' learning, 'one size will not fit all', institutions (including UCLan) should ensure that the diversity of students' preferences, needs and circumstances are taken into account when devising strategies aimed at better supporting students' numeracy skills development, either within curricula at departmental level and/or centrally at university level.

RECOMMENDATION 14 (p.72): HEIs (including UCLan) should ensure that the development of their undergraduates' and postgraduates' numeracy/quantitative skills is included in any appropriate existing or future institutional strategies, and establish coherent and consistent information throughout the university, enabling students to be readily directed to the numeracy skills resources (online and physical) which can support them in their academic studies and/or in enhancing their employability.

History discipline

RECOMMENDATION 1: Numeracy skills should be incorporated in history courses and not 'bolted on' to them

The best methods for teaching numeracy skills to history undergraduates require careful consideration. The students themselves, though not entirely uniformly, were inclined towards the incorporation of limited numerical elements into courses. Some thought that such provision could be made by way of optional economic history modules for those who wished to engage with quantification. There was no support for 'bolt on' modules provided by either the degree programme or the institution as part of a wider generic skills course (8.2.2). This sentiment was echoed by tutors during the follow-up visits (8.2.6). 'Bolt on' provision might be used to provide remedial or additional support but, if compulsory would be resented, if optional would probably not be effective.

RECOMMENDATION 2: History programmes should incorporate basic numeracy skills that revive and keep 'ticking over' the skills that students bring with them from school

Most history students have a mathematics qualification at GCSE level or above (8.2.1, 8.2.3, 8.2.4). This level of pre-university knowledge forms the basis for our 'ticking over' recommendation. Moreover, competence levels had declined in the interim period between school and university. Given that the students who participated in the numeracy test were asked to apply fairly basic mathematical skills of the type they would have encountered at school, the overall results revealed quite low levels of mathematical ability (8.2.3). The graduate survey uncovered a related issue – the likely effect of neglecting numeracy at university. The perception of respondents was that school, which was given the very high rating of 4.6 out of 5 on a competency scale, was by far the most important influence on the development of their numeracy skills. In contrast, undergraduate provision scored the lowest mean rating (2.0). The implication is that, during their undergraduate years, respondents were at best 'marking time' and at worst slipping back with regard to developing their numeracy skills (8.2.4). Asked if the courses they were taking should keep their numeracy skills 'ticking over', do more than this or not address the matter at all, the general view expressed by the focus groups was in favour of a 'ticking over' approach (8.2.2). Moreover, to embark on a more ambitious programme of teaching new or more advanced mathematical skills would most certainly be met with resistance from both tutors and students and would therefore be counterproductive (8.2.1, 8.2.5, 8.2.7). In any case, such 'upskilling' is unnecessary. In terms of historical study, higher level skills could safely be left to the postgraduate level provided there is a sound base upon which to build, while in terms of general employability, the concern of the vast majority of history students, incorporating modest changes in the curriculum to keep basic numeracy skills 'ticking over' would help meet the demands of most employers of history graduates. The type of mathematical skills that many employers say they regard as important, and which figure in their numeracy tests, are integral as well to mainstream quantitative history (8.1.1, 8.2.10). The responses to the tutor survey suggest that history teachers are eminently capable of delivering such a modest programme and that they believe, as well, that improving the numeracy skills of students is important – though their own commitment to doing so is open to question (8.2.7). History is well-equipped to perform this task of 'keeping warm' a range of numeracy skills by virtue of the primary source materials available for interrogation, the willingness of many of its practitioners to espouse active learning approaches and its tradition of economic and quantitative analysis (8.2.10). With regard to the last of these, despite the decline in the teaching of economic history and in the number of economic historians, many departments still have a reservoir of staff skilled in quantitative approaches and whose talents could be usefully deployed in the realisation of this recommendation. A starting point for implementing it is our good practice website (8.2.11).

RECOMMENDATION 3: History programmes should make better use of ICT to cultivate students' pre-existing skills

The survey of current undergraduates revealed that the great majority have used spreadsheets. This extant knowledge can be drawn upon to keep warm some of their existing numeracy skills, for example the ability to prepare original charts and graphs from the data they have derived through investigating primary evidence. The students also reported a general facility in preparing statistical tables and calculating percentages and averages (8.2.1). A similar confident self-evaluation featured in the graduate survey which indicated as well that these applications were useful to their later employment. That history undergraduates can generally be expected to be familiar with using spreadsheets and that they are highly likely to use spreadsheets in the workplace, reinforces the point about the value spreadsheets can have in developing numeracy skills (8.2.4). Use of ICT in teaching numeracy could easily be done in a more systematic, planned and progressive way (see Recommendation 4). At present this is not the case; while most UK history departments provide students with the opportunity to use one or more ICT applications, the majority of students can avoid doing so if they wish, apart from the 'soft', non-numerical applications (8.2.5). This evidence from the survey of departments is confirmed by the website survey which revealed that, whilst history programmes frequently aim to involve students with ICT applications, only in three instances was the requirement to use spreadsheets and databases and, by implication, to deal with quantitative data unambiguously specified (8.2.8). Nevertheless, there is an opportunity to use ICT as one conduit for delivering numeracy; students recognise its contemporary importance, they have engaged with it in some form in school or home, it can readily be identified as a 'life skill' and consequently its 'relevance' can act as a form of gravity pulling in numerical activities.

RECOMMENDATION 4: Numeracy skills should be incorporated in history programmes to ensure student progression

The survey of UK history departments revealed that only a very small number of programmes incorporate numeracy skills in a progressive way. Less than a quarter of respondents (or 12% of the 91 HEIs surveyed) said they were doing this and none were doing so in a systematic way through all three or, in the case of the Scottish universities, four years of the degree-programme. Not a single department was found to have a compulsory numeracy skills element in every year. This, and other evidence, suggests that the majority of history undergraduates can pick their way through their programme in such a way as to have little or no need for numeracy skills (8.2.5). This finding was supported by evidence from the follow-up visits. Even in departments that, the general survey had suggested, were teaching more in the way of numeracy skills than most, it was nevertheless being done in a spasmodic way with little evidence of progression from level one through to levels two and three (8.2.6). Progression also needs to be considered in regard to students who go on to postgraduate study. The departments visited were keenly aware that the lack of provision of numeracy skills was especially critical at the postgraduate level where the ability to demonstrate more than a passing acquaintance with quantitative techniques is required by funding bodies (8.2.6). It may be that many departments regard leaving numeracy skills to the postgraduate level as appropriate in terms of progression. The authors of this report believe that this is leaving things too late and that the inclusion of basic numeracy skills developed progressively through the undergraduate programme would provide a much sounder platform for postgraduate study, not to mention future employment.

RECOMMENDATION 5: The teaching of basic numeracy skills to history undergraduates must be reinforced through assessment. Funding of pedagogic research on this vital issue and on approaches to teaching numeracy in general is urgently needed

The survey of UK history departments uncovered only 17 that claimed to be using assessment strategies to measure the attainment of numeracy skills (8.2.5). The website survey and the international survey (8.2.8 & 8.2.9) found very little evidence of extant good practice that might usefully be disseminated across the sector. The question of how best to assess, both formatively and summatively, the progressive acquisition and demonstration of numeracy skills by history undergraduates is one that is crying out for pedagogic research, though there are practical examples both in UK and overseas history departments that could be used as a starting-point. We would recommend that departments, the History Subject Centre and the Higher Education Academy consider funding pedagogic research on this critical subject that would lead to the development of teaching packages and aids, including online IT materials and courses. The Subject Centre has made an excellent start here with its publication of the guides by Rodger and Freeman alluded to earlier but much more needs to be done.

RECOMMENDATION 6: For numeracy skills to be successfully incorporated into the history programme, it is essential that students are convinced of their importance

The general feeling expressed in the student focus groups was that numeracy had limited value in the study of history (8.2.2). The message of the value of quantification in historical study is either not being conveyed or not getting across. The students also said that they would look at tables of historical data if they felt their understanding would be enhanced by so doing, otherwise they would skip over them. The point was made that the relevance or practical application of mathematics had not been made clear to them and that there would be more incentive to engage with quantitative skills if the reason for doing so was made clear (8.2.2). The focus groups and the current undergraduates surveyed also recognised the advantages that numeracy can bring in terms of their future employability (8.2.1 & 8.2.2). Emphasising the importance of developing numeracy skills in employability terms would therefore persuade some, though not all, students of their value. Currently, history tutors are doing very little to proselytise the usefulness of numeracy skills either to the understanding of history or as a transferable skill. The survey of departmental websites revealed that only 15% made any specific reference to numeracy or quantitative techniques (8.2.8). The history profession's inability to 'remember' numeracy when listing valuable employability skills speaks volumes in a Freudian way about its 'number-phobia'. Departments therefore might usefully revisit the information they provide on their websites and in their programme brochures regarding core skills, transferable skills and employability.

RECOMMENDATION 7: External agencies should provide both leverage and assistance to ensure the wide adoption of numeracy skills

The history benchmark statement includes a permissive recommendation with regard to teaching numeracy skills but it has not greatly influenced the content of undergraduate programmes in relation to these skills. The survey of UK history departments reveals just how little they are doing in the way of systematic numeracy skills teaching. Of the respondents, over 90% admitted that they should be doing more to improve their students' numeracy skills (8.2.5) but there is a big gap between tutor sentiment and a willingness to act. This report can exhort and, within its limited remit and authority, make modest proposals that would be effective *if they were adopted.* However, it is most unlikely that exhortation will be enough if the profession is left to its own devices. At the moment, it can continue with impunity to bury its collective head in the sand. Comments in the UK department survey and the follow-up interviews provided evidence that departments face little institutional or external pressure to consider numeracy provision. Undergraduate programme reviews have paid little attention to the acquisition of student numeracy skills, there has been an absence of any 'steer' from faculty or university or from external agencies such as external examiners (8.2.6). There seems to be an irrational fear among many history tutors about 'compelling' the inclusion of numeracy in the undergraduate history students' skills-set. It is our contention that the basic skills we have identified are within easy grasp of the great majority of tutors and students and that such skills should be accepted as part of *the normal range appropriate to the understanding of the discipline* and of the transferable skills related to a graduate's career opportunities and life-skills.

In the meantime, it is encouraging to report that the Higher Education Academy's History Subject Centre has agreed to host the 'Good Practice' website, which will include examples of ways to incorporate a range of numerical skills into history undergraduate programmes and a guide for teachers and students on how best to make use of the materials. The Subject Centre has also invited the three historians on the project team to take forward their recommendations during 2010/11 as part of a major project on 'Graduates with Impact'.

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14. Notes

1. Bristol Online Surveys may be accessed via http://www.survey.bris.ac.uk/

2. 'UNITE' is a North West based initiative providing support to small to medium enterprises (SME's) through the use of free, 4-week undergraduate and graduate placements. It is funded by the European Union and supported by UCLan, University of Chester, Lancaster University and St Martin's College.

3. SHL produces psychometric assessment tests, including numerical reasoning, for employers to use to evaluate and compare various abilities in job applicants (http://www.shl.com/default.aspx). Psytech International develops psychometric tests and assessment software for use in occupational selection and assessment, vocational guidance and staff development (http://www.psytech.co.uk/). ASE is a publisher of a range of test material including GMA – a graduate and managerial assessment (http://www.previsor.co.uk/). OPP offers personality assessment tools and psychometric qualification training for HR professionals, psychologists and development practitioners (http://www.opp.eu.com/Pages/home.aspx). Kenexa-PSL is a psychometric test producer providing tests for employers to use as part of their recruitment and assessment process (http://www.kenexa.com/).

15. Appendix 1: Glossary of acronyms

AGCAS	Association of Graduate Careers Advisory Services
AGR	Association of Graduate Recruiters
BOS	Bristol Online Surveys
BTEC	Business & Technology Education Council
CBI	Confederation of British Industry
CBL	Computer-based learning
CETH	Centre for Employability Through the Humanities
CIHE	Council for Industry and Higher Education
CIPD	Chartered Institute of Personnel and Development
GCSE	General Certificate of Secondary Education
GNVQ	General National Vocational Qualification
HEA	Higher Education Academy
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institution
HR	Human Resources
ICT	Information and Communication Technology
IoD	Institute of Directors
LDU	Learning Development Unit (UCLan)
MMU	Manchester Metropolitan University
MSOR	Mathematics, Statistics and Operational Research
NCETM	National Centre for Excellence in Teaching Mathematics
NMC	Nursing and Midwifery Council
NTFS	National Teaching Fellowship Scheme
QAA	Quality Assurance Agency for Higher Education
QTS	Qualified Teacher Status
SHU	Sheffield Hallam University
SIGMA	Centre for Excellence in Mathematics and Statistics Support
SME	Small and Medium Enterprises
UCLan	University of Central Lancashire

16. Appendix 2: Publicity and dissemination activities

Publicity:

1. *Onrec.com* (2007) £200,000 granted for study to tackle student numeracy issues, 11 September 2007
2. *UCLan Faculty of Health Newsletter* (2007) Every Student Counts: Promoting Numeracy and Enhancing Employability, November 2007
3. *UCLan Research Newsletter* (2008) £200,000 granted for study to tackle student numeracy issues, June 2008

Workshops:

1. Durrani, N. and Tariq, V. N. (2008) *Need Sum Help? Promoting Numeracy and Enhancing Employability.* A presentation at UCLan's Faculty of Health Learning, Teaching and Research 3-day Event, 28-30 April 2008.
2. Tariq, V. N. (2008) *Numeracy still matters: from the classroom to employment.* A workshop and presentation delivered at Queen's University Belfast, 31 October 2008, by invitation as part of QUB's Guest Speaker Series.
3. Durrani, N. and Worthington, C. (2009) *Every Student Counts: Promoting Numeracy and Enhancing Employability.* A presentation at the Faculty of Health & Social Care Teaching and Learning Group Meeting, 10 September, UCLan.

Conference presentations (oral and poster):

1. Durrani, N. (2008) *Numeracy and employability: linking higher education to the world of work.* A presentation at the UCLan University Conference 2008, 23-27 June 2008.
2. Tariq, V. N. *et al* (2008) *Every Student Counts: Promoting Numeracy and Enhancing Employability.* A poster presented at the UCLan University Conference 2008, 23-27 June 2008.
3. Timmins, J. G., Nicholls, D., Lloyd-Jones, R. and Durrani, N. (2008) *Every Student Counts: Promoting Numeracy and Enhancing Employability Preliminary Findings for History*. A poster presented at the UCLan University Conference 2008, 23-27 June 2008.
4. Durrani, N. & Tariq, V. N. (2008) *Employers' and students' perspectives on the importance of numeracy skills in the context of graduate employability.* A presentation at the CETL-MSOR Conference 2008, 8-9 September 2008, Lancaster University.
5. Worthington, C. (2008) *Every Student Counts: Promoting Numeracy and Enhancing Employability.* A presentation delivered at the Maths Gap Workshop, as part of Anglia Ruskin University's SUMS Project, 16-18 December 2008.
6. Nicholls, D., Timmins, G. & Lloyds-Jones, R. (2009) *Number and number: the current state of quantitative history teaching.* Paper presented at the Subject Centre for History, Classics and Archaeology's 11h Annual Conference on Learning and Teaching in History 1-3 April 2009, Lady Margret Hall, Oxford.
7. Durrani, N. & Tariq, V. N. (2009) *Campus-wide: comparing undergraduates' conceptions of mathematics and their attitudes and approaches to developing numeracy skills.* An oral presentation at the CETL-MSOR Conference 2009, 7-8 September 2009, The Open University, Milton Keynes.
8. Durrani, N. & Tariq, V. N. (2009) *Campus-wide: comparing undergraduates' conceptions of mathematics and their attitudes and approaches to developing numeracy skills.* A poster presentation at the CETL-MSOR Conference 2009, 7-8 September 2009, The Open University, Milton Keynes.
9. Brightman, M. (2009) *Signposting Numerical Support.* A poster presentation at the University Research Internship Scheme (URIS) poster exhibition, 14 October, UCLan
10. Durrani, N. & Tariq, V. N. (2009) *Relationships between undergraduates' mathematics anxiety and their attitudes towards developing numeracy skills and perceptions of numerical competence.* A paper presented at the ICERI 2009 International Conference of Education Research and Innovation, 16-18 November, Madrid, Spain (a virtual presentation).
11. Timmins, G., Lloyd-Jones, R., Nicholls, D. & Durrani, N. (2009) *Every Student Counts: History teaching and numeracy.* A poster presented at the ISSOTL Annual Conference, 22-25 October, Bloomington, Indiana.
12. Timmins, G., Lloyd-Jones, R., Nicholls, D. (2010) *Adding Value. Improving the skills of history students.* A paper presented at the

12th Annual Teaching and Learning in History Conference, 23-25 March, Lady Margaret Hall, Oxford.

13. Lloyd-Jones, R., Nicholls, D. & Timmins, G. (2010) *Quantitative easing: addressing the deficit in teaching quantitative history.* A paper presented at the American Economic & Business History Annual Conference, 27-29 May 2010, Braga, Portugal.
14. Brightman, M. (2010) *Signposting Numerical Support.* A poster presentation at the CETH Conference 2010 - Employability in the Curriculum: Beyond the Bolt-On? 22-23 June, UCLan.

Articles:

1. Lloyd-Jones, R. Nicholls, D. & Timmins, G. (2008) Every Student Counts: promoting numeracy and enhancing employability. *History ISSOTL Newsletter*, Autumn 2008.
2. Durrani, N. & Tariq, V. N. (2009) Employers' and students' perspectives on the importance of numeracy skills in the context of graduate employability. *Proceedings of the CETL-MSOR Conference 2008*, 8-9 September 2008, pp. 18-24, Lancaster University.
3. Durrani, N. & Tariq, V. N. (2009) Relationships between undergraduates' mathematics anxiety and their attitudes towards developing numeracy skills and perceptions of numerical competence. *Proceedings of the ICERI Conference 2009*, Madrid, Spain, 16-18 November 2009, pp.87-94. ISBN 978-84-163-2955-7
4. Tariq, V. N. & Durrani, N. (2009) Every Student Counts: Promoting Numeracy and Enhancing Employability A National Teaching Fellowship Scheme Project. *MSOR Connections* 9(1), 7-11.
5. Durrani, N. & Tariq, V. N. (2010) Comparing undergraduates' conceptions of mathematics with their attitudes and approaches to developing numeracy skills. *Proceedings of the CETL-MSOR Conference 2009*, 7-8 September 2009, The Open University, Milton Keynes (in press).
6. Tariq, V. N. & Durrani, N. (2011) The importance of undergraduates' numeracy skills to their future graduate employability. Submitted to the *Journal of Education and Work* July 2010.
7. Tariq, V. N & Durrani, N. (2011) Factors Influencing on undergraduates' self-evaluation of numerical competence. Submitted to the *British Journal of Educational Studies*, September 2010.

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