frontiers in Education

ORIGINAL RESEARCH
published: 30 June 2017
doi: 10.3389/feduc.2017.00026

Are Academics Wrongly Assuming Bioscience Students Have the Transferable Skills and IT Competency They Need to Be Successful Beyond the Degree?

Amreen Bashir [1], Shahreen Bashir [2] and Anthony C. Hilton [1]*

[1] Department of Life and Health Sciences, Aston University, Birmingham, United Kingdom, [2] Department of Languages and Social Sciences, Aston University, Birmingham, United Kingdom

OPEN ACCESS

Edited by:
Chris Howard,
University of Derby,
United Kingdom

Reviewed by:
Melissa Christine Davis,
Curtin University, Australia
Ben Roberts,
University of Derby,
United Kingdom

****Correspondence:***
Amreen Bashir
bashira6@aston.ac.uk

Specialty section:
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

Received: *09 January 2017*
Accepted: *02 June 2017*
Published: *30 June 2017*

Citation:
Bashir A, Bashir S and Hilton AC (2017) Are Academics Wrongly Assuming Bioscience Students Have the Transferable Skills and IT Competency They Need to Be Successful Beyond the Degree? Front. Educ. 2:26. doi: 10.3389/feduc.2017.00026

Acquisition and development of key transferable skills is an important requirement for all graduate employees. The aim of the current study was to investigate a potential skills shortage in bioscience students and, if revealed, explore ways of addressing it. A research questionnaire, which included mixed methodology, was used to collate information from a cohort of students across levels four, five, and six enrolled on biological and biomedical science undergraduate programs. A total of 131 students participated in the study. The questionnaire was designed to establish students' confidence using packages such as the Microsoft Office Suite and whether they required additional support with certain programs; further areas explored students' self-assessment of key skills such as written communication, referencing, self-confidence, presentation skills, and team working. No statistically significant gender differences (males $n = 49$; females $n = 82$) were observed in participant responses ($p > 0.05$). Of the total number of students included in the survey, 91% rated themselves as competent using Word and 64% felt least confident using statistical software and performing statistical analysis in Microsoft Excel. Comparing responses by year of study revealed no statistical differences in reported abilities ($p > 0.05$). These findings indicate areas of potential key skills shortages, particularly using data handling software, which may not be sufficiently addressed if prior knowledge is incorrectly assumed. Nearly half of students (50% of level six students) who were graduating felt unprepared performing statistical analysis in Excel. Inclusion of an IT component to support skills development in data handling software at Level 4 is recommended and teaching key software packages are necessary. Furthermore, opportunities for students to develop their presentation skills and report writing abilities are required. This in turn should improve the student experience and develop the transferable skills, which are increasingly sought by employers.

Keywords: graduate employability, IT skills, statistical analysis, biological, undergraduate, Microsoft Office, transferable skills, employable graduates

INTRODUCTION

Acquisition and development of key transferable skills are an important requirement for all graduate employees. The Quality Assurance Agency benchmarks relating to all subjects include various statements about acquiring transferable skills. Transferable skills cover many different areas, however, in the employment context can be broadly described as a skill set that is required for a career to allow participation in a flexible and adaptable workforce. The National Committee of Inquiry into Higher Education (Dearing, 1997) report stated that there were four key skills that were required for all graduates irrespective of discipline: communication skills, the use of information technology, numeracy, and learning how to learn (Fry et al., 2009). However, soft skills such as team working, personal skills, and the ability to work well with others are also critical, as they allow new graduates to make an immediate contribution to a business (Bennett, 2002).

It was quoted in the report of Sir Ron Dearing (1997) "*There is much evidence of support for the further development of a range of skills during higher education, including what we term the key skills of communication, both oral and written, numeracy, the use of communications, and information technology and learning how to learn. We see these as necessary outcomes of all higher education programmes*." This suggests that higher educational institutions have a responsibility to facilitate the development of many skills in their undergraduates. However, in order to encourage development in students, it is imperative that the current abilities of students are acknowledged. Students' mathematical ability is an area, which has received attention within the literature. Tariq (2002) reported a decline in basic numeracy skills among first-year bioscience undergraduate students, and later reported many disciplines, including the physical and biosciences, found their undergraduates were unprepared for the mathematical demands of the curriculum (Tariq, 2009; Tariq and Durrani, 2009).

In a society where there is an increasingly competitive global market, employability patterns are also changing; employees are expected to keep up with this change and take charge of their own careers and job security. However, the gap between higher education and industry seems to have stretched rapidly; with an increasing level of graduates who are unable to find jobs whereas, employers still report problems seeking skilled workers with the required knowledge and skills (Tran, 2013).

Internationally, great emphasis has been put on the acquisition of transferable skills with the process of acquiring them being both lifelong and developmental (Hager and Holland, 2006). Inevitably, there is debate on the definition of the term transferable skills and how students can attain these skills. One definition is to find skills, which can be applied across different cognitive domains and subject areas, or across a variety of social and employment situations (Tran, 2013). Therefore, the term "transferable skills" is used to cover an umbrella of abilities that are essential in contemporary life. These skills have a fundamental role in work, and education is perceived as a platform to prepare individuals for work (Hager and Holland, 2006; Tran, 2013).

An assumption of technological literacy in undergraduates can be problematic, especially considering the integral use of computers in higher education courses. Previous research reported 71.7% of medical students have access to a computer at home (Dørup, 2004). Thus, in light of this increased general exposure to the Internet and IT usage, it would be plausible to assume students would be more IT literate; however, this is not confirmed. There are many ways to define IT literacy; a commonality among definitions is that students need to be able to use basic computer functions and relevant programs in a resourceful way to achieve certain outputs (Wilkinson, 2006). Ezziane (2007) highlighted that IT literacy was paramount to today's empowerment and identified education as an important basis for its development. One use of computers includes their application in conducting statistical tests and this remains an essential part of students' curricula following secondary school (Mills, 2002). DeVaney (2010) explored students' anxieties and attitudes toward statistical courses. The findings revealed although technology was embedded into courses, some students may face technological issues involving the use of computers and specific programs; such as SPSS, which is used to conduct statistical analysis. The students who participated in DeVaney's research were enrolled on a statistical course, and it is currently unknown whether bioscience students face the same difficulties in using computers to conduct statistical analysis.

Writing skills are also a core part of Higher Education, with written communication considered as a critical student learning outcome, and the proficiency of a large proportion of assignments and examinations is tested through writing; therefore, students need to be able to effectively communicate and express they have understood the learning outcomes of the course (Sparks et al., 2014). Some authors have reported there being a "literacy crisis" in the UK, causing a concern across the Higher Education sector (Ganobcsik-Williams, 2004; Appleby et al., 2012). Others have described the shortcomings in student writing directly impacting the ability of students to learn (Davies et al., 2006). Irrespective of discipline, one of the key requirements listed in almost all job specifications is good written and verbal communication; this is indicated at the application stage and may be formally assessed at the interview. Data from employers echo that of higher education; one study sampled 431 employers from a range of industries and reported that 93% of respondents stated that written communication was a "very important" skill, yet 28% of respondents ranked the writing skills of graduates entering the workforce as "deficient" (Casner-Lotto and Barrington, 2006; Sparks et al., 2014). Throughout their career trajectory, graduates are expected to communicate daily, and identifying a potential skills shortage could highlight an area whereby further development at higher education is beneficial.

Students' perceptions about their own efficacy are important. Bandura's (Bandura, 1993) work on perceived self-efficacy highlighted the connections between students' beliefs about their own efficacy to monitor their own learning and conquer academic endeavors as being crucial in defining their own ambitions, their drive, and academic triumphs. Research has shown that international students who report feeling less confident in their ability to complete their educational programs also demonstrate less confidence in their academic ability (Telbis et al., 2014). In light of the current competitive labor market, it is important that students are able to confidently demonstrate their education and

experiences are relevant to the jobs they apply for to enhance the perceptions readers of their applications may form of them (Knouse, 1994; Tomlinson, 2008).

Aim and Rationale of the Study

There has been a body of literature dedicated to the potential mismatch between the skills employers require and those universities perceive to be important for future employment (Tanyel et al., 1999). The purpose of the current study, however, was to explore whether undergraduate students entering Higher Education come pre-equipped with the basic knowledge of software skills required for them to complete their studies. It is anticipated that the majority of students enrolled on science courses will have completed A-levels or equivalent. It has been noted that universities are sometimes quite inconsistent in that they are discontent students and do not have enough mathematical abilities but then have not expressed any maths requirements in their entry criteria (Higton et al., 2012). This is indicative of the potential discrepancy between the entry requirements for the degree courses and the necessary knowledge and skills students need to be successful. The overall aim of this study was to investigate the potential skills shortage in current bioscience students and explore ways of providing support if required. Due to the exploratory nature of the study, the research team did not formulate hypothesis in advance of the analysis.

RESEARCH METHOD: QUESTIONNAIRE SURVEY

A research questionnaire was produced and approved by the Centre for Learning Innovation and Professional Practice Ethics Committee at Aston University. This was used to collate information from a cohort of Life and Health Sciences students across levels four, five and six enrolled in biological and biomedical sciences. Furthermore, as the questionnaires were anonymous, students were able to answer controversial questions more openly and state areas of difficulties without feeling a sense of pressure. The questionnaires were conducted over a 2-week period at the start of laboratory classes and lectures and completed surveys returned at the end of each session. The questionnaire was designed to determine students' confidence using Microsoft and whether they felt that they required additional support with certain programs within the Office™ Suite. The questions asked aimed to determine a broad understanding of students' abilities to use programs as opposed to niche functions, e.g., participants were asked to respond as appropriate to the question; *How confident are you now in using the following programmes to create tables/graphs/statistical tests/PowerPoint presentations/writing reports?* The options included Microsoft Word, Microsoft Excel, Microsoft PowerPoint, or Specialist statistical software. Therefore, students were not asked about their confidence in performing any specific tests/functions using certain programs but focused on the output. Individual module requirements differ within the biosciences and this approach allowed students to reflect on the range of different tests/functions, which may be required by their degree programs. Questions required students to self-rank using Likert-type scales from "1" to "5" with accompanying statements such as "Poor," "Not very good," "Fair," "Good" and "Excellent."

RESULTS

Of the 150 questionnaires administered, 131 were completed and returned (87% return rate). The demographics of the responders are summarized in **Table 1**.

Subjects Taken at Further Education

The study determined that the courses students had previously completed as part of their further education prior to commencing their degree course. The results from the questionnaire demonstrated that of the students surveyed; 81.7% took A-levels, 12.2% completed a BTEC qualification, 4.6% completed an access course, and 1.5% completed the International Baccalaureate. Students were asked to report, which subjects they completed as part of their further education. The results indicated that 73% studied chemistry, 96% studied biology, 51% studied mathematics, 27% studied physics, 18% studied statistics, 15% studied IT/ICT, and 3% studied accounting.

Students were asked if they felt that the subjects they took in further education prepared them with the IT skills they required for higher education. Only 24.4% of students reported they "strongly agreed" they felt prepared, 29% "agreed," 21.4% stated they "neither agreed nor disagreed," 12.2% stated they "disagreed," and 13% stated they "strongly disagreed." This indicates that 25.2% of the students surveyed felt the subjects they took in further education did not adequately prepare them with the IT skills required for their higher education course.

A cross-tabulation was conducted to further explore the breakdown of courses students undertook at further education and the extent to which they felt prepared with the IT skills required by their higher education. Of the students who studied BTEC, 75% agreed that their further education prepared them with the IT skills they required. Of the students entering with

TABLE 1 | Demographic information of students who participated in study (n = 131).

	Frequency	Percent
Gender		
Males	49	37.4
Females	82	62.6
Course		
Biological sciences	69	52.7
Biomedical sciences	62	47.3
Year		
Four	67	51.1
Five	27	20.6
Placement	4	3.1
Six	33	25.2
Country		
Home/EU	128	97.7
International	3	2.3
Age range		
17–24	125	95
25–33	6	5

A-Levels, 53.3% agreed with the statement whereas only 16.7% of students who studied an Access course agreed. These data are presented in **Table 2**. There were only two international students in the sample; one disagreed with the statement and the other neither agreed nor disagreed. There were six access students, of which four students disagreed with the statement indicating they did not feel confident with the IT components of their course, however, due to the small sample size of participants within this group, it is difficult to draw any solid conclusions. A Chi Square test revealed that there was no statistically significant association between students who took BTEC and A-Levels at further education and whether or not they felt prepared with the IT skills required for Higher Education ($p > 0.05$).

IT Software Packages

Another aim of the study was to determine if students had sufficient prior knowledge of operating common business software packages prior to entering Higher Education (see **Table 3**). Of the students questioned, 83% reported that they were not formally taught how to use any specialist statistical software, and 32% stated they were not taught how to use Microsoft Excel.

Students were then asked to self-rank their confidence on a Likert scale using the same commonly encountered software packages. The findings can be seen in **Table 4** and demonstrate students were least confident in using statistical software (64%) and 91% of students reported feeling "confident" or "very confident" using Microsoft Word.

One section of the questionnaire addressed where students principally learnt key skills such as creating tables, graphs, statistical tests, PowerPoint presentations, and report writing. Only 42% of students stated through further education, 32% through university course, and 55% self-taught through books/internet.

The study asked students to self-rank their confidence in performing statistical analysis. The results revealed that only 2% of students reported feeling "very confident," 21% reported feeling "confident," 30% reported feeling "neither confident or not confident," 28% reported feeling " unconfident," and 19% reported feeling "very unconfident."

Self-Ranked Abilities

Students were asked to self-rank the key abilities listed in **Table 5** alongside five statements. A majority rated themselves highly with the statements of "good" or "excellent." However, for Harvard-style referencing, 29% ranked themselves as only "fair," 46% as "good," and only 15% as "excellent." Most importantly, results indicated that students were less confident when performing statistical tests in Microsoft Excel with 20% ranking themselves as "not very good," 37% ranking themselves as "fair," 39% ranking themselves as "good," and only 2% ranking themselves as "excellent." A similar pattern was observed for numeracy skills with 21% ranking themselves as "fair," 44% as "good," and only 28% as "excellent."

A Pearson's Chi Square test was conducted for each of the skills listed in **Table 5** to reveal if there were any differences in the self-reported confidence between males and females. Results revealed there were no statistically significant differences between the two genders ($p > 0.05$).

For the purpose of conducting a Pearson's Chi Square test, data obtained from the question asking students to indicate their abilities in a range of skills was recoded to exclude the neutral responses from the analysis. This combined "excellent" or "good" responses in one category and the responses "not very good" or "poor" in the other category. The Pearson's Chi Square revealed

TABLE 2 | Courses taken at further education and confidence with IT skills.

Scale	Further education level			
	A-levels (%)	Access (%)	International BACH (%)	BTEC (%)
1.00 Strongly disagree	13.0	33.3	–	6.3
2.00 Disagree	10.3	33.3	50.0	12.5
3.00 Neither agree/ disagree	23.4	16.7	50.0	6.2
4.00 Agree	29.9	–	–	37.5
5.00 Strongly agree	23.4	16.7	–	37.5

TABLE 3 | Programs in which student received no formal training prior to entry into Higher Education.

Program	Frequency	Percentage
Microsoft Word	23	17
Microsoft Excel	42	32
Microsoft PowerPoint	22	16
Statistical software	109	83

TABLE 4 | How confident students are now at using the following programs.

Program	Not confident		Fairly confident	Confident	Very confident
	1	2	3	4	5
Microsoft Word	8%	0%	1%	24%	67%
Microsoft Excel	3.1%	5.3%	24.4%	29.8%	37.4%
Microsoft PowerPoint	1.50%	3%	11.5%	25%	59%
Statistical Software	40.6%	24.2%	18.8%	8.6%	7.8%

TABLE 5 | How bioscience students self-ranked their transferable skills.

Ability	Poor (%)	Not very good (%)	Fair (%)	Good (%)	Excellent (%)
Written communication	1	2	11	55	31
Harvard style referencing	1	9	29	46	15
Statistical analysis using Excel	2	20	37	39	2
Numeracy skills	1	6	21	44	28
Spoken Communication	–	2	16	51	31
Self-confidence	1	5	25	46	23
Team working skills	1.5	–	5.3	49.6	43.5
Presentation skills	–	3.1	18.3	50.4	28.2

that there was no statistically significant association between Further Education course and whether or not students felt confident in their written communication skills $\chi(3) = 3.775$, $p = 0.287$. There was also no significant difference between further education course and self-reported ability to reference using Harvard style, ability to conduct statistical analysis using Microsoft Excel, numerical skills, spoken communication ability, and self-confidence ($p > 0.05$). There was a significant difference between Further Education course and ability to work in a team; $\chi(3) = 30.093$, $p = 0.001$. This is because within the access category ($n = 2$), there was an equal split between those who felt their skills were excellent and those who felt their skills were poor. Most respondents indicated their ability to work in a team was excellent. There was no significant difference between Further Education course and reported ability in presentation skills; $\chi(2) = 3.621$, $p = 0.164$.

Further analysis involved investigating students' self-ranked abilities by year of study. Overall, a Pearson's Chi Square test revealed no statistical differences in responses across the three levels in performing statistical analysis using computer programs and more specifically Microsoft Excel ($p > 0.05$). Although, a higher percentage of level four students (61%) ranked themselves as "poor" or "not very good" at performing statistical analysis using computer programs, compared to 22% of level five students and 41% of level six bioscience students.

Analyzing data on Excel forms a key part of laboratory practical report writing; however, only 34% of level four students reported their abilities as "good" or "excellent" compared to 48% of level five and 50% of level 6 students. Although level 6 students self-ranked their abilities more highly, this data suggest that nearly half of students who were near graduating felt unprepared with a task that is highly sought by from employers, particularly for research/academic related roles.

In the last section of the questionnaire, students were asked to highlight up to three areas in which they required additional support. **Figure 1** shows that overall 49% required support with Microsoft Excel (creating graphs/performing statistical tests), 37% required support with statistical analysis, 24% required additional support with report writing, 16% required support with presentation skills, 15% required support with referencing, and 13% stated they wanted support with mathematical skills. Interestingly, 98% of the students stated that they had not undertaken any courses externally/outside their degree program to improve their current IT skills (although a range of academic support services were available at the institution they attended).

DISCUSSION

Understanding the level at which individuals self-report their transferable-skills abilities is important. Previous literature has focused on conducting skills tests and has reported actual abilities of students, however, in higher education, academics often see a disparity between what students think they will achieve and the actual marks they attain. Moreover, higher education institutions often assume students come pre-equipped with certain skills that are required by the program from their preceding further education. Therefore, the current study was conducted to recognize how bioscience students self-ranked various key skills and to highlight areas in which students require additional support.

Within the sample who participated, there were disproportionate numbers of females to males; 62% of participants were female,

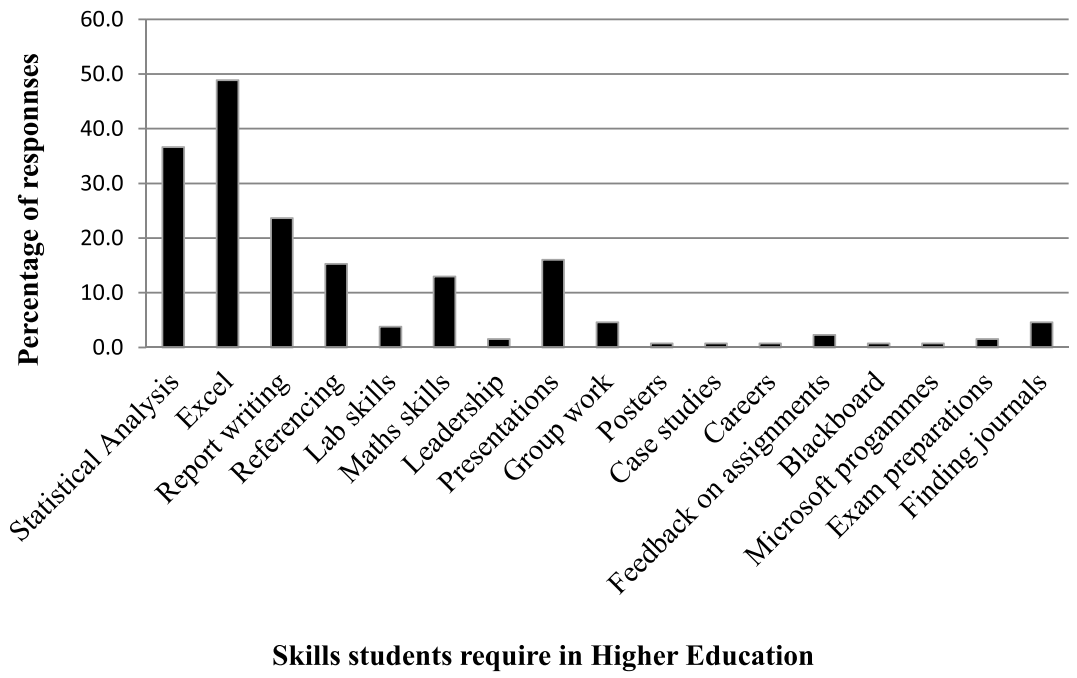

FIGURE 1 | Skills bioscience students identified where they required additional support.

this was anticipated as HESA reported that, in 2011–2012, more than 60% of students enrolled in Biological Sciences programs across the UK at undergraduate level were females. Furthermore, data revealed that not only did the total number of students enrolled on all courses increase by 13.5% between 2003–04 and 2011–12, but an increase of 38% was revealed in biological sciences, placing it within the top three courses to observe large increases in student number (Universities UK, 2013). With the large increase in student numbers, there are more pressures on higher education institutions to produce employable graduates who end up in positive destinations.

The use of IT is becoming increasingly important across all subjects throughout the educational life of a student. In 2002, The ImpaCT2 project concluded that in the UK prior to GCSE's, 67% of students had rarely used ICT in mathematics lessons, however, at GCSE, the figure rose to over 80% (Harrison et al., 2002). The study also reported that an increased level of ICT usage enhanced students' performance by over half in science at GCSE (Harrison et al., 2002). These findings indicated that because students were using computer programs so early in their academic years, they should already have basic skills such as creating appropriate graphs and selecting the correct analysis for data sets (Cox et al., 2004). However, the results from the current study revealed that a high percentage of undergraduate students required more assistance and they needed to be taught how to conduct statistical tests in specialized programs and Excel.

The findings from the current study demonstrated most students' IT skills were self-taught. Interestingly, BTEC students felt the most confident in their IT skills ability, followed by those who had completed A-levels (although this was not statistically significant, see **Table 2**). This finding suggests that BTEC courses may have intrinsic components, which sufficiently prepare students with the IT skills they need for higher education, alternatively, it could be BTEC courses that build students' confidence in this area hence their higher perceptions of their IT skills.

In contrast, the students who had completed an Access to Higher Education (Access) course reported feeling the least confident in their IT skills, which suggests that they may need additional support with IT skills. Previous research suggests that access students may experience difficulties in transitioning to Higher Education due to their personal circumstances (Reay et al., 2002). This article draws focus on the importance of mature students "*in the expansion and reform of higher education*" in the UK, as they are important in achieving the aim of widening participation (Reay et al., 2002, p. 5). It is essential to bear in mind that there were only six students who had completed an Access course and a larger sample would be needed to draw any firm conclusions. Within the Biosciences, there are courses such as the BSc Biomedical Science whereby universities request one A-level in a specific subject (typically biology), on top of the BTEC qualification; this is usually based on a professional or regulatory body requirement. Access for mature students aged 21+ is considered on an individual basis. Nevertheless, in order to successfully improve the teaching and learning experience for those students who may need additional support with IT skills, it is important that universities are sensitive to the individual abilities of students and their prior further educational background.

Being able to perform and apply mathematics is fundamental for undergraduate students across many STEM subjects (Tariq et al., 2010). There is a strong connection between mathematics and biology, as mathematical models provide scientists with important data relating to the growth, survival, and replication of microorganisms. In order to achieve their full potential, students require both functional mathematics such as analyzing data in the form of graphs and charts as well as more academic applications such as algebra and statistical analysis (Tariq et al., 2013). Of the students who participated in this study, almost all studied biology at further education, however, only 51% took mathematics. Coincidental with this, one of the key skills in which students reported the least confidence was statistical analysis for which numbers and the application of mathematics is required. Importantly, a study conducted by Croft et al. (2009) reported that students who lacked the required mathematical skills and enrolled on degree programs faced grave challenges as many endured academic failure and a loss of self-confidence. Further to this, the university also suffers in terms of student retention and progression, and inevitably, this affects the cost-effectiveness of the course (Tariq et al., 2013).

Recently, a report released by the United Kingdom's Advisory Committee on Mathematics Education (ACME) investigated the mathematical requirements of Higher Education courses and stated that in many disciplines, programs required a higher level of quantitative analysis, yet, many students lacked the mathematical skills required to succeed in their chosen discipline (Advisory Committee on Mathematics Education ACME, 2011; Tariq et al., 2013). Therefore, ensuring that students have an ample understanding of performing statistical analysis is essential in their progression through Higher Education.

Employers have also stated that in order to succeed in an interview, new graduates require strong communication and problem-solving skills because effective writing, speaking, and critical thinking enables the accomplishment of business goals. Furthermore, managers reported that 36% of graduates demonstrated a skills shortage in data analysis using Excel and other specialist software and the sooner graduates developed these skills the more employable they would become (Dishman, 2016).

Results from the current study showed that report writing and correctly referencing in Harvard style were two areas that students highlighted in which they would like more support. Up until students reach university, referencing sources is unfamiliar as it is not covered at A-level, therefore, some emphasis on this in further education would be beneficial in preparing students for university as the penalties for plagiarism can have serious consequences.

However, tutors simply showing students how to write reports and use correct referencing will not promote deeper learning. An article released by Appleby et al. (2012) investigated the literacies that undergraduate students acquired at university, and the association of these to employability. They interviewed students who had previously studied A-levels, where many students reported they were almost "spoon fed," largely copying information from the board without critical thought or application of knowledge. They were simply memorizing information in order to pass exams (Appleby et al., 2012). It is important that students seek additional

support in areas where they feel their skills are weak, however, ninety-eight percent of students in the current study stated they had not sought any additional IT support outside their degree course despite the provision of additional support being available through their institution.

The findings in the study by Appleby et al. (2012) also suggested that STEM employers were seeking graduates with a range of communication skills, in which written communication was included; however, other skills such as team working, problem solving, and maturity were more valued assets. Significantly, the employers in the study stated they preferred not to have "spoon fed" employees; having the ability to use references was not seen as a transferable skill whereas comprehending how to learn the new skills and the knowledge behind it was. This study also highlighted that students often worked on assignments in groups and offered each other help in developing written skills by proof reading and commenting on work—almost forming a network of academic support (Appleby et al., 2012).

Almost two decades ago, Harvey (2000) stated that graduate employability should not be the sole priority of Higher Education, stressing the need for students to become "lifelong learners." However, it is clear that students need more than just good grades to secure graduate employment (Salas Velasco, 2012). Employers require both *hard skills* (knowledge of the field and practical skills such as being IT literate) and *soft skills* (communication, teamwork, and leadership) (Salas Velasco, 2012). Previous research has established, even at a simple level, that there is a discrepancy between the important skills required by employers and the skills in the graduates they employ (Collet et al., 2015).

Reports have noted that companies did provide training to graduates in some of the skills they listed as essential to the post (communication, IT, organization, and teamworking); this shows that companies do commit to developing employees' skills in some areas. By demanding certain core skills at the application stage, employers reported an improvement in the quality of the subsequent applicants. Many higher education institution courses aim to embody key skills within courses to improve the employment perspectives of graduates, however, job advertisements only provide an objective measure of employers' demands; they do not describe the level of competence required in each skill area. Until there is an understanding of the definitive skills and attributes required by companies, universities cannot accurately predict what students need to know (Bennett, 2002).

The current study asked students to self-report their abilities in the absence of actual skills tests. This may be a potential limitation as students may have an inaccurate perception of their own abilities; for example, previous research has shown students tend to overestimate their mathematical ability (Pajares and Kranzler, 1995). In addition, assessing through the use of self-reporting is an indirect measure as students may be influenced by social desirability and may alter responses accordingly (Dunn, 2015). However, longitudinal data has suggested that students can provide reasonably accurate estimates of their own abilities at a single point in time (Bowman, 2010). This is further supported by research examining students' assessment abilities when peer marking work, whereby low achievers did not inflate marks in comparison to tutor grades (Stefani, 1994). Furthermore, it has been suggested that students with higher cognitive abilities are usually more able to accurately predict their performance than those with lower cognitive abilities (Truxillo et al., 2008). We can, therefore, have some confidence that those students reporting a high level of confidence in a particular skill ability would be more competent than a student ranking themselves as weak. It is particularly important for students to be able to convey their competencies and strengths when it comes to applying for jobs (Knouse, 1994). Students tend to have a realistic view of the areas in which they are weak and would benefit from additional support.

CONCLUSION

Overall, the results clearly indicate that it is sometimes incorrect to assume students are taught all the key skills they require at Higher Education during Further Education. Therefore, incorporating these key skills at Level 4 would be advantageous for students and tutors. Results from this study also indicated that teaching key software packages and providing more opportunities for students to make presentations are required. Not only will this improve the student experience and help in the transition from Further Education to Higher Education, these transferable skills are increasingly sought by employers as essential additions to core discipline material when seeking employable graduates.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Centre for Learning Innovation and Professional Practice Ethics Committee at Aston University with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Life and Health Sciences ethics committee at Aston University.

AUTHOR CONTRIBUTIONS

AB designed the study, executed the data collection and analysis. AB is the main author of the write-up of this research. SB contributed toward the write-up of the article and design of this study. AC contributed toward the write-up of the article and design of this study.

REFERENCES

Advisory Committee on Mathematics Education (ACME). (2011). *Mathematical Needs: Mathematics in the Workplace and in Higher Education*. London: ACME. Available at: www.acmeuk.org/media/7624/acme_theme_a_final%20(2).pdf

Appleby, Y., Roberts, S., Barnes, L., Qualter, P., and Tariq, V. (2012). Who wants to be able to do reference properly and be unemployed? STEM student writing and employer needs. *J. Learn. Dev. High. Educ.* 1–19.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educ. Psychol.* 28, 117–148. doi:10.1207/s15326985ep2802_3

Bennett, R. (2002). Employers' demands for personal transferable skills in graduates: a content analysis of 1000 job advertisements and an associated empirical study. *J. Vocat. Educ. Train.* 54, 457–476. doi:10.1080/13636820200200209

Bowman, N. A. (2010). Can 1st-year college students accurately report their learning and development? *Am. Educ. Res. J.* 47, 466–496. doi:10.3102/0002831209353595

Casner-Lotto, J., and Barrington, L. (2006). *Are They Really Ready to Work?* Washington, DC: Partnership for 21st Century Skills.

Collet, C., Hine, D., and Du Plessis, K. (2015). Employability skills: perspectives from a knowledge-intensive industry. *Educ. Train.* 57, 532–559. doi:10.1108/ET-07-2014-0076

Cox, M., Abbott, C., Webb, M., Blakeley, B., Beauchamp, T., and Rhodes, V. (2004). *A Review of the Research Literature Relating to ICT and Attainment*. London: DFES.

Croft, A. C., Harrison, M. C., and Robinson, C. L. (2009). Recruitment and retention of students – an integrated and holistic vision of mathematics support. *Int. J. Math. Educ. Sci. Technol.* 40, 109–125. doi:10.1080/00207390802542395

Davies, C., Swinburne, D., and Williams, G. (eds). (2006). *Writing Matters*. London: The Royal Literary Fund.

Dearing, R. (1997). *Higher Education in the Learning Society: The Report of the National Committee of Inquiry into Higher Education*. Norwich: Her Majesty's Stationery Office.

DeVaney, T. A. (2010). Anxiety and attitude of graduate students in on-campus vs. online statistics courses. *J. Stat. Educ.* 18, 1–15.

Dishman, L. (2016). *These Are the Biggest Skills That New Graduates Lack*. Available at: https://www.fastcompany.com/3059940/the-future-of-work/these-are-the-biggest-skills-that-new-graduates-lack

Dørup, J. (2004). Experience and attitudes towards information technology among first-year medical students in Denmark: longitudinal questionnaire survey. *J. Med. Internet Res.* 6, e10.

Dunn, D. S. (2015). *The Oxford Handbook of Undergraduate Psychology Education*. New York: Oxford University Press.

Ezziane, Z. (2007). Information technology literacy: implications on teaching and learning. *Educ. Techno. Soc.* 10, 175–191.

Fry, H., Ketteridge, S., and Marshall, S. (eds) (2009). *A Handbook for Teaching and Learning in Higher Education*. New York: Routledge.

Ganobcsik-Williams, L. (2004). *A Report on the Teaching of Academic Writing in UK Higher Education*. London: The Royal Literary Fund.

Hager, P., and Holland, S. (2006). *Graduate Attributes, Learning and Employability*. Dordrecht: Springer.

Harrison, C., Comber, C., Fisher, T., Haw, K., Lewin, C., Lunzer, E., et al. (2002). *ImpaCT2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*. Coventry/London: Becta/DFES.

Harvey, L. (2000). New realities: the relationship between higher education and employment. *Tertiary Educ. Manag.* 6, 3–17. doi:10.1080/13583883.2000.9967007

Higton, J., Noble, J., Pope, S., Boal, N., Ginnis, S., Donaldson, R., et al. (2012). *Fit for Purpose? The View of the Higher Education Sector, Teachers and Employers on the Suitability of a Levels*. London: Ofqual.

Knouse, S. B. (1994). Impressions of the resume: the effects of applicant education, experience, and impression management. *J. Bus. Psychol.* 9, 33–45. doi:10.1007/BF02230985

Mills, J. D. (2002). Using computer simulation methods to teach statistics: a review of the literature. *J. Stat. Educ.* 10, 1–20.

Pajares, F., and Kranzler, J. (1995). Self-efficacy beliefs and general mental ability in mathematical problem-solving. *Contemp. Educ. Psychol.* 20, 426–443. doi:10.1006/ceps.1995.1029

Reay, D., Ball, S. J., and David, M. (2002). It's taking me a long time but I'll get there in the end': mature students on access courses and higher education choice. *Br. Educ. Res. J.* 28, 5–19. doi:10.1080/01411920120109711

Salas Velasco, M. (2012). More than just good grades: candidates' perceptions about the skills and attributes employers seek in new graduates. *J. Bus. Econ. Manag.* 13, 499–517. doi:10.3846/16111699.2011.620150

Sparks, J. R., Song, Y., Brantley, W., and Liu, O. L. (2014). Assessing written communication in higher education: review and recommendations for next-generation assessment. *ETS Res. Rep. Ser.* 2014, 1–52. doi:10.1002/ets2.12035

Stefani, L. A. (1994). Peer, self and tutor assessment: relative reliabilities. *Stud. High. Educ.* 19, 69–75. doi:10.1080/03075079412331382153

Tanyel, F., Mitchell, M. A., and McAlum, H. G. (1999). The skill set for success of new business school graduates: do prospective employers and university faculty agree? *J. Educ. Bus.* 75, 33–37. doi:10.1080/08832329909598987

Tariq, V., Qualter, P., Roberts, S., Appleby, Y., and Barnes, L. (2013). Mathematical literacy in undergraduates: the role of gender, emotional intelligence and emotional self-efficacy. *Int. J. Math. Educ. Sci. Technol.* 44, 1143–1159. doi:10.1080/0020739X.2013.770087

Tariq, V. N. (2002). A decline in numeracy skills among biosciences undergraduates. *J. Biol. Educ.* 36, 76–83. doi:10.1080/00219266.2002.9655805

Tariq, V. N. (2009). Enhancing graduate employability: the importance of basic skills. *QUB Reflect. Newsl.* 1–3.

Tariq, V. N., and Durrani, N. (2009). Every student counts: promoting numeracy and enhancing employability a national teaching fellowship scheme project. *MSOR Connect.* 9, 7–11. doi:10.11120/msor.2009.09010007

Tariq, V. N., Durrani, N., Lloyd-Jones, R., Nicholls, D., Timmins, J. G., and Worthington, C. H. (2010). *Every Student Counts: Promoting Numeracy and Enhancing Employability*. Preston: University of Central Lancashire, 127.

Telbis, N. M., Helgeson, L., and Kingsbury, C. (2014). International students' confidence and academic success. *J. Int. Stud.* 4, 330.

Tomlinson, M. (2008). The degree is not enough: students' perceptions of the role of higher education credentials for graduate work and employability. *Brit. J. Sociol. Educ.* 29, 49–61. doi:10.1080/01425690701737457

Tran, T. T. (2013). Limitation on the development of skills in higher education in Vietnam. *High. Educ.* 65, 631–644. doi:10.1007/s10734-012-9567-7

Truxillo, D. M., Seitz, R., and Bauer, T. N. (2008). The role of cognitive ability in self-efficacy and self-assessed test performance. *J. Appl. Soc. Psychol.* 38, 903–918. doi:10.1111/j.1559-1816.2008.00331.x

Universities UK. (2013). *Patterns and Trends in UK Higher Education 2013, Universities UK Higher Education in Focus*. London: Universities UK. Available at: http://www.universitiesuk.ac.uk/highereducation/Documents/2013/PatternsAndTrendsinUKHigherEducation2013.pdf

Wilkinson, K. (2006). Students computer literacy: perception versus reality. *Delta Pi Epsilon J.* 48, 108–120.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The reviewer, BR, and handling editor declared their shared affiliation, and the handling editor states that the process nevertheless met the standards of a fair and objective review.