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An Investigation into the Teaching and Learning of Argumentation in First Year Undergraduate Courses: A Pilot Study

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

A fundamental role of universities is to develop independent and critical thinkers. An effective strategy to do this is a good command of argumentative skills. This paper presents the results of a one-year pilot study examining the teaching and learning practices of argumentation among first year undergraduates across three disciplines in UK universities. Data were drawn from surveys, interviews and documentary analysis. The results indicated that students were less likely to be taught the use of arguments at university than they were at school. Although argumentation was deemed as an important skill by students and lecturers, it was neither taught nor emphasised in most first year undergraduate courses. Only in history was the skill emphasised and practised. The course structure, mode of testing, the assessment criteria and the lecturer's own understanding of argumentation determined to a certain extent whether argumentation was encouraged. There was no consistency and conscious effort to develop such skills among undergraduates. There is some evidence that where argumentative skills were encouraged students were more critically aware. If we agree that argumentative skills contribute to the development of a better quality of knowledge and cultivation of a rational and human society, then it should be encouraged and supported. The role of universities as simply a vehicle for the transmission of knowledge needs to be reconsidered, and how students are assessed and evaluated needs to be reviewed.

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1. INTRODUCTION

A fundamental role of higher education is to develop in young people a set of skills that will enable them to become independent thinkers, able to make informed decisions and engage in useful debates about moral and ethical issues [1,2]. Traditionally, such skills had been central to the goals of higher education, and valued as key attributes of graduates [3]. They enable students to reason, think critically and present information in a logical and coherent way. Some have argued that argumentation should be a central component of education [4,5], and that the teaching and learning of argumentative skills should be made a priority in higher education [6,7].

In the early 2000s, to ensure that such skills were being taught at university level, the Teaching Quality Assurance (TQA) and Quality Assurance Agency (QAA), which monitor and assess the quality of provision in higher education institutions, were introduced. Their main aim was to ensure that graduates from UK universities were equipped with such thinking skills. The QAA was particularly concerned that science students were unable to *'construct reasoned arguments to support their position on the ethical and social impact of advances in biosciences'* [8]. It argued for the need to teach arguments as *'much of what they are taught is contested and provisional, particularly in the light of continuing scientific advances.'* [8, p4], and that as students were *'expected to be able to debate issues in a mature and critical manner, including engagement in moral and ethical themes*' such skills were essential [9].

In 2011 the reform in science education explicitly made the teaching of argumentative skills its goal calling for the promotion of argumentative skills through teaching and debates in the classroom [10]. In the US a nationwide study involving several higher education associations identified critical thinking as one of the key learning outcomes for all undergraduates regardless of their major [11]. Despite these initiatives there is little evidence that such changes have happened in practice [12,13,14)]. A report in the Independent [15] bemoaned the lack of argumentative skills among undergraduates in UK universities. Poets and authors called it a scandal that many of our supposedly brightest could not follow a logical train of thought or string a coherent argument. In a study in America involving over two thousand students, Arum and Roksa [12] found that many students graduated not knowing how to distinguish facts from opinion, or make clear written argument or objectively review conflicting reports.

In recent years with the increasing marketisation of higher education and the shifting emphasis towards universities as a business enterprise, questions arise as to whether argumentative skills are still relevant, and whether they should still be valued as necessary attributes of graduates. Or, should there be a focus on a whole new range of skills to meet the changing role of universities. Universities are now increasingly seen as research institutes rather than institutes of teaching and learning. Their aims are now more about attracting research income and raising the research profile. Some fear that this may be happening at the expense of teaching. A quick search of the internet revealed quite surprising results. None of the first four UK universities searched mentioned developing thinking individuals as one of their main aims.

Perhaps the aim of universities as institutions that develop independent thinkers is assumed. No matter, there is no denying that such skills are still very relevant today, if not even more so than before, given the proliferation of information in our global and technological world. Young people need to be able to evaluate the integrity and validity of information they are confronted with, weigh the evidence presented to them, and make judgements about what to believe and what not to believe [16]. Driver et al. [4] and Saddler [5] argued that an effective strategy to foster the development of such skills is the use of argumentation.

Walker [17] explained that the role of argument is central to the construction of scientific knowledge and students need to be able to use evidence and justify the choice of evidence with appropriate rationale. Undergraduates are expected to read academic and research papers. The ability to critically analyse academic literature efficiently requires certain skills, such as interpreting data, judging the reliability of the evidence, recognising assumptions and unwarranted conclusions. Although academics

use these skills daily, they are rarely taught in an explicit and systematic way [18]. Lecturers in first year introductory courses often find that there is pressure to cover the content and little attention is paid to the acquisition of argumentation skills [18].

A national survey in America [19] indicated that it was better to teach students to synthesise information than memorise facts. Many studies have suggested beneficial effects of explicit instruction in critical thinking on learning [20,21, 22,23,24]. Kozeracki et al. [22] described a specially designed course to train undergraduates in the critical analysis of scientific journals. The results showed that students trained under the programme were better able to read and present scientific research. They were also more confident and more likely to be successful in gaining admission to graduate programmes of their choice compared to their peers in the traditional seminar programmes. Hoskins et al. [23] developed a pedagogical tool called CREATE to teach students to read and interpret research findings. They found that students taught critical thinking showed improvements in their ability to read and analyse academic literature. Gehring and Eastman [24] conducted a study where undergraduate science students were taught using an inquiry-based learning. They reported that the explicit teaching enhanced students' skills in applying and identifying valid sources of information. Hermann [21] described her own experience of teaching undergraduate biology students using the Ann McNeal's method of teaching students to read primary literature.

Unfortunately, for studies to enhance critical awareness, all these studies to determine the impact of explicit teaching failed in the most basic requirements for scientific experiments. Even more ironic is that these were conducted by science lecturers who should know better about the importance of controls, pre-post-comparisons and the use of independent measures. All these studies had no comparison groups and almost all were small-scale, some involving one class (taught by the researcher themselves). The majority used pre-post test comparisons of pupils' self-report and subjective evaluation of student's work by the instructor who was not blinded, for example, [21,23,24]. The course contents were invariably subject-related pertaining to understanding and analysing text closely related to the discipline. A systematic review of effectiveness of critical appraisal skills for training clinicians [25] also found evidence of benefits of teaching critical appraisal skills, but almost all the studies had serious methodological flaws. Only one study employed a randomised controlled design. It is apparent from these research articles that these teachers of critical thinking themselves were unable to apply critical thinking in their own research and teaching. Another review of empirical studies on the effects of critical thinking interventions reported serious weaknesses in research design and results varied with different measures used [26].

This suggests that while there have been attempts to explicitly teach critical thinking, it is often not done very well. Academics themselves are not critical and lack the generic skills of critical thinking. There is thus even more justification for argumentation and critical thinking to be emphasised at university level.

Some argue that as subject disciplines differ in the kind of knowledge required, the skills demanded should also be different, and therefore argumentative skills may not be relevant to all disciplines. Others argue that the ability to read research article is an essential skill for all undergraduates and should be introduced at an early stage in academic study so that sufficient time is given to develop such skills [27]. Early studies, for example, Berrill [28] suggested that there were variations across disciplines regarding whether such skills were taught (implicitly or explicitly) and how they were taught.

While it is acknowledged that argumentation is a useful skill, it is rarely emphasised in undergraduate courses. Few studies have actually examined the course structure of undergraduate study to understand the role of argumentation in the teaching and learning practices at university.

The aim of this paper is to examine the teaching and learning practices in three diverse disciplines (biology, electronic engineering and history) in two UK universities to understand the role of argumentation in each discipline and the extent to which it was emphasised. It is hoped that an understanding of these practices can go some way to addressing the concern about the lack of critical ability among our graduates.

This paper looks at first year students' perceptions of argumentation and their experiences and engagement with argumentation. It draws on the results of an

earlier pilot study by Andrews et al. [29]. A follow-up analysis of the 2016 first year course modules in the three disciplines (biology, engineering and history) was also carried out to see if there had been any changes in the emphasis on argumentation skills in the ten years since the pilot study. For wider comparisons, the course modules of three other Russell Group universities were also examined to see if the practice was not just limited to the two institutions studied.

For the purpose of this paper, we define argumentation broadly to include Toulmin's model of argumentation, which involves understanding assumptions, making claims that are supported by evidence and making conclusions that are warranted by the evidence or data presented. Since skills in making arguments also involve critical evaluation, which includes the ability to weigh conflicting evidence and the ability to provide alternative explanations [30,31,32], the term argumentation also includes critical thinking or critical evaluation. These two types of skills are not mutually exclusive. Andrews [33] argues that both critical thinking and argumentation are closely related and both have implications for teaching and learning in higher education. Critical thinking demands the ability to make arguments and Toulmin's definition of argumentation involves critical thinking skills. Therefore, we define argumentation as the ability to question existing theory/belief, put forward alternative explanations, present evidence and make critical evaluations of issues on the basis of reason and evidence.

2. METHODS

A combination of methods was used to investigate the practices and views and context within each discipline. This included a questionnaire survey, focus group interviews with students, semi-structured interviews (both with students and lecturers) and document analysis. For this paper, the focus is on students' and lecturers' experiences relating to the teaching and learning practices of argumentation. Hence much of the evidence will be drawn from the interview data.

2.1 Focus Group Interview

This was a pre-pilot activity to explore students' learning experiences and to identify issues that would inform the design of the survey instrument. These interviews were conducted with second year undergraduates prior to the questionnaire survey at the beginning of the academic year. Since second year students had just completed one full year as first year undergraduates they were felt to be the most appropriate to tell us about their learning experiences. These students were also not involved in the questionnaire survey so including them in the focus groups would not influence the questionnaire responses.

The focus group questions aimed to find out about students' understanding of the term 'argumentation'. We asked them what they understood by the term 'argumentation' and whether they had opportunities to use them in their first year study, and if so, when they might use them and how often they used them. The focus groups also provided opportunities to test the questionnaire items in terms of readability, ambiguity and sense, and to test for validity. Draft questionnaire items were presented to students to elicit their responses.

2.2 Questionnaire Survey

The purpose of the questionnaire survey was to:

- Establish students' views about the relevance of argumentation skills in their course;
- Explore students' experience of argumentation in their course, and to
- Examine differences in curricular structure in the teaching and learning of argumentation

The questionnaire (see Appendix) also asked for students' demographic background information, their university entry and subjects of study at A-level or equivalent. These questions sought to identify factors that could help explain differences in students' ability and experiences in the use of arguments. Four additional items were included as a quick test of students' critical awareness related to academic publications. However, for this paper we focus only on those questions pertaining to the frequency of use of argumentation, and when these were used. These questions helped to establish the degree to which argumentation was emphasised in the course. The interview data provided answers to why this might be the case.

The questionnaires were distributed to the whole cohort of first year undergraduates in the three disciplines in key lectures or during tutorials.

2.3 Documentary Analysis

To further understand the structure and emphasis of first year courses in each discipline, course modules, time-tables, undergraduate handbooks and assessment guidelines were also examined and analysed. Information about the methods of teaching, learning outcomes expected and assessment criteria was then extracted from these documents.

2.4 Semi-structured Interviews

Semi-structured interviews were conducted to get a deeper understanding of how different disciplines approached their curricular. Two to three students and two lecturers from each discipline in each institution volunteered to talk to us about their experiences. These interviews enabled us to have a clearer understanding of how the term 'argument' was understood and used by lecturers and students. The interviews provided rich data that helped us understand the subtle nuances that were not possible to extract from questionnaire responses.

Lecturers were asked about the general aims of their course, what they understood by the term 'argumentation and whether argumentation skills were relevant to their course of study, whether they should be taught and how they might be introduced. They were also asked if they ever explicitly taught such skills to their first year students, and the reasons for their answers.

Similar questions were posed to students asking them what they understood by argumentation. After an explanation was provided by the interviewer, the students were asked if argumentation or critical thinking skills were emphasised on their course, whether there were opportunities for them to use such skills and if they thought such skills should be taught as part of a generic skill or whether they should be taught explicitly in a structured way.

2.5 Analysis

Because of the small number of cases in some categories, the five-point scale responses in the questionnaire were first collapsed into 3-point scale. Two analyses were conducted. The first was a simple frequency count of the students' report about their exposure to arguments, the kind of activities they were engaged in and the kind of feedback they received. A simple cross-tabulation analysis was also carried out to compare students' attitude and their ability to use arguments.

Interview transcripts were transcribed and categorised into themes using an interview matrix to facilitate the process.

2.6 Sample

The sample for the survey included first year undergraduates in three disciplines (biology, history and electronics engineering) in two UK institutions. A total of 525 questionnaires were administered. Of these 237 were returned, representing a response rate of 45%.

Table 1. Sample and response rates for survey

Subject	Number given out	Number returned	Response rate
Biology	168	106	63%
Electronic engineering	116	52	45%
History	241	79	33%
Total	525	237	45%

2.7 Findings

The survey showed that first year undergraduates were more likely to report being taught argumentation at school than at university, but an overwhelming majority were of the opinion that argumentation should be taught earlier before they even entered university.

Despite the Eurydice report and the QAA efforts to make the teaching of argumentative skills explicit for science undergraduates, only a quarter of biology students reported receiving instruction on argumentation at university, while half of engineering and history students said they had explicit instruction on argumentation in their first year. History students were also more likely (70%) than their counterparts in engineering (58%) and biology (42%) to report that there was a need to use and learn argumentation at university (Table 3).

Fig. 1 shows that despite the expected role of universities to produce graduates with a critical mind, there was little evidence that this was happening across the board, at least not in the first year of university. Only in extended writing and in seminars did students frequently hear or make arguments. Even so only 70% of students reported making arguments in extended essays.

Slightly over 30% of students were engaged in argumentation when reading academic papers, suggesting that the majority were not approaching academic literature with a critical mind.

Although the majority of students (92%) surveyed considered the ability to construct an argument as an important skill, only history students were systematically and practically engaged in the use of argument as part of their course. Almost all history students (94%), compared to only 31% of biology students, reported being exposed to arguments in lectures and in their course reading. Only 20% of engineering students reported hearing arguments used in lectures and only 24% read about arguments in their course materials. Engineering was generally not regarded by students as a discipline that lent itself readily to the use of arguments.

To understand the practices across the three disciplines with regards to their emphasis on argumentation, we examined the course structure, course content and assessments in the three disciplines. Interview data from students and lecturers / tutors substantiated what we found from these documents.

Table 2. Number of participants in interviews

	Biology	Electronic engineering	History
Focus groups	12	9	3
Student in-depth interviews	4	2	6
Lecturer interviews	4	5	5

Table 3. Instruction on argumentation at school and university (% agree)

	Biology	Engineering	History
Is there formal instruction on the use of argumentation at university?	26	52	49
Is there formal instruction on the use of argumentation before university?	65	50	53
Should you be given guidance on using argumentation at university?	42	58	70
Should you be given guidance on using argumentation before university?	86	73	82

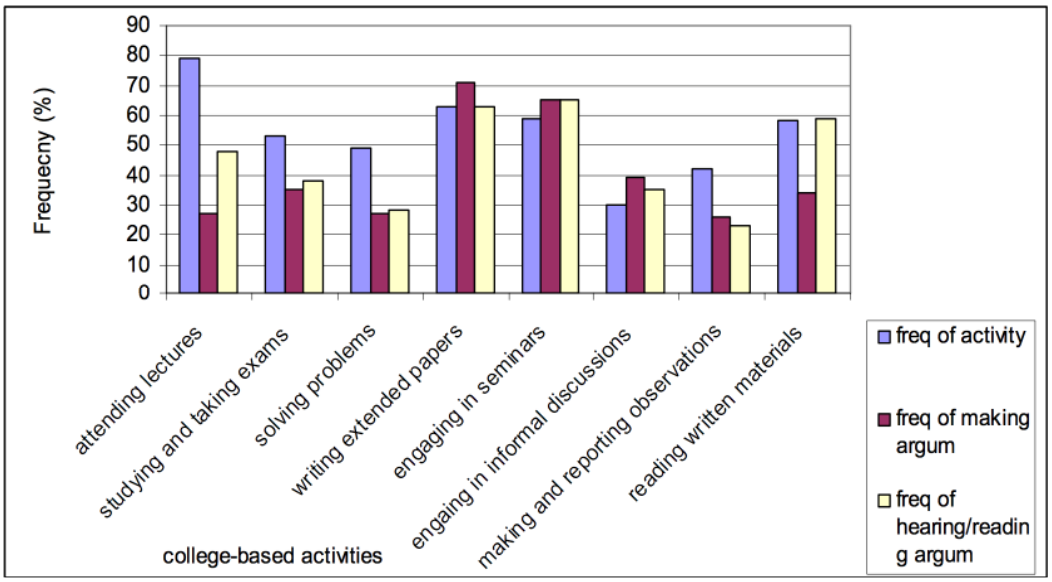

Fig. 1. Frequency of first year academic activities

2.8 History

The first year history student handbook highlighted the crucial role of argumentative skills, where the ability to construct an argument was paramount to success in the discipline. Students were actively encouraged '*to use persuasion, cite evidence to support their contentions and be a soap salesman as well as a lawye*r.' Learning outcomes in course modules also provided good evidence of the kind of skills emphasised in the discipline. Examples included:

- Exploring, analysing and engaging in history debate;
- Present ideas and respond to arguments;
- develop critical reading;
- Apply methods of literary criticism;
- develop critical skills;
- Expound general overview to ground exposition in sound evidence and cogent argument;
- Cite evidence to support your contentions.

The use of arguments was central to the teaching and learning of history. Such skills formed the main emphasis of the curriculum, in students' written work and in their end-of-year assessments. As one lecturer said:

> *The term 'argument' is very much taught in the field, and especially when giving feedback to students on their essays. The role of argument is central to History: "it's the discipline".*
>
> *History lecturer A*

> *The role of argument is a high priority in History. With first years, I tend to work with a survey text supplemented by articles and chapters. Students mainly write essays. The 'essay' is an attempt to bring in all the information they have been exposed to and to answer a central question regarding the state of debate about a topic.*
>
> *History lecturer B*

Interviews with students suggested that there were ample opportunities for history students to learn and use arguments, particularly in seminars and discussions.

> *I think oral presentations in seminars are great, […] and if someone's challenging it, and even if you have to agree at some point that that person is better on that particular point, the point you have to take onboard, I think it'll just you know help you to develop further.*
>
> *History student*

Argumentation was also actively encouraged in class through the use of debates:

> *I regularly use debates e.g. line-up debates where there is a spectrum of positions. I sometimes take questions and dissect them with them. I use role-play – not directly for argument "but it is for argument" to empathize with others' point of view.*
>
> *History lecturer A*

> *I see what we do [in the first year] as questioning summaries, critiquing the bases of evidence, what are the limitations of the evidence, i.e. a critical reading of secondary works.*
>
> *History lecturer B*

Andrews' [34] case study of the use of argumentation among history undergraduates found a high degree of awareness of the importance of argument and argumentation among history students and this was consistently drilled into them.

2.9 Engineering

In contrast, the learning outcomes of first year engineering course focused on mathematical skills and knowledge transmission. It was very content-based, focussing very much on the teaching and learning of the fundamental knowledge of engineering, in particular mathematical skills. The list of outcomes included:

- Knowledge acquisition, e.g. understanding sound transmission;
- Analyse circuits;
- Write programs;
- Design filter network;
- Undertake basic calculations

This emphasis on teaching the fundamentals was repeatedly highlighted by academics in the department.

> *At the undergraduate level, we teach the very fundamental stuff, very prescriptive. I don't think the definition of argument you have in mind, I don't think it happens to a*

great extent in electronics, or at least in the bit of electronics I teach. I teach the fundamentals of electronics, which is conceptually very difficult.

Electronic engineering lecturer A

The first year we teach them more fundamentals and then in the second year they can start to use the fundamentals and then we can teach them further.

Electronic engineering lecturer B

One academic suggested that the modules would have to be revamped to allow for more discussion and debates.

Engineering design might be an appropriate place to put argument. For example, the new low-energy high efficiency bulbs, the ones which are spiral with fluorescent lamps, they contain mercury, they contain electronic circuitry, they may last 8 times longer and take about a fifth of the power but to manufacture them actually take a lot more power and to recycle them or to destroy them might be actually more environmentally damaging than the light bulb. This is a very good argument because you could put figures forward and opinions and so on.

Electronic engineering lecturer A

2.10 Biology

Unlike history and engineering, course modules within biology were more varied and opinions among lecturers differed depending on which fields they were in. For example, in modules like Population and Environment and Genetics there was scope for the practice and use of argumentative skills as one student pointed out.

[…] some of the modules like there's one next term called Population and it's Environment, they set up seminars and debates so you get into groups and you have to go and find out about a topic and maybe you're given a slant you have to look at and then you report back and may be you have to argue about it, debate about it. I think a lot more of the, for example, genetics and ecological and conservationist areas there's more room for debate …

Biology student A

Although there was scope for the use of arguments within some modules the focus in certain modules was very much on the dissemination of 'facts' or knowledge.

Most of the subjects we do in tutorials don't have ethical implications. For example, my current tutor is teaching about cancer, it's all about the facts. You could go into a bit of the ethics like how pharmaceutical companies are developing drugs to get money, but the core focus is on the facts. At the end of the day that's' what counts. I guess as a biologist, sometimes you use the word 'argument' because you can have conflicting evidence so you need to decide which one is more important and then you have to explain yourself, you have to like convince the reader or marker why you think that bit of evidence is more important than the other. Yeah, I would say in biology there is quite a lot of argument there. But not at an undergraduate level, perhaps at a higher level there is more of challenging existing theories.

Biology student B

According to some students there was opportunity in assignments and in tutorials where the use of arguments could be practised, but this was often not explicitly encouraged.

I did an essay on the function of a particular cell called the Y-helper cell. Basically a lot of research had been done on how it's activated and its effects on other cells. It's all about structuring the argument […].

[…] in science there's a lot that we don't know and so a lot of time people are finding out new things and they might put a case forward of how something behaves or in any part of biology might put forward a case, like a theory and that can be argued for or against it. It can be contested or so I think a lot of people always forget that it's not just facts, it's an ongoing process of learning and finding out.

[…] I've a Genetic tutor and we're spending quite a lot of time not learning about Genetics but looking at the social and ethical impacts of like genetic findings and genetic diseases. We did a role-play as genetic counsellors. So I think there is room for debate and like arguments, especially maybe

like kind of conservation and like kind of population and the environment. These are the kind of areas that you can debate over certain issues.

It was clear that in biology, although there were opportunities for using argument, it was not always taken up. These were missed opportunities. Disappointingly there was not more emphasis on the use of arguments as one would have expected in the field of science. There was little evidence in this study to suggest that first year biology students were actively engaged or encouraged to speak or challenge conventional beliefs. This was surprising as science is a field which one would think lends itself best to the development of argumentation.

Perhaps it was not so much the discipline itself, but the way the subject was taught. There was evidence that within biology differences existed among lecturers in their attitude towards argumentative skills. Lecturers' personal interest, social and moral belief, their background, the way they delivered their lessons and whether they themselves had the confidence to allow students to think innovatively beyond just knowledge acquisition very much determined the extent to which arguments were used or not:

I think there are the same opportunities in nearly all the modules, but some people will actually keep the argument out of the module because they just want to teach the facts. You'll find that individual lecturers will vary between choosing to work in an area where there's lot of argument or whether they choose to avoid arguments. Clearly those who avoid arguments will not incorporate such ideas in their teaching.

Biology lecturer B

Students' experiences collaborated with the lecturers' views suggesting that the extent to which argumentation was emphasised or not very much depended on the individual tutor.

I think it depends on what tutor you have because some tutors would be more interested in that kind of thing than others, but I think the essays, there is scope for arguments and depending on… I don't know what some tutors would do, but like if you're looking at bird flu and they split the tutorial group in half. Half of the group have to look from the side of, 'there's nothing to worry about, nothing bad is going to happen.' The other side will look at like, 'Oh my god we are going to die of bird flu.' So there's a lot of conflict of ideas and what people think.

Biology student A

I think it depends on the tutor. The tutor I have got this term is very aware of the social aspects of science and like implications of scientific findings and all of that and that is a really hot topic for debate and is quite current really. I'm sure other tutors do do that but like because you only have one a term it is potluck whether you get someone that like is kind of aware about like being able to make debates and things.

Biology student B

What was surprising was the suggestion that biology and indeed science, contrary to popular understanding, was not naturally an area open to debates because scientists were influenced by their own beliefs and value systems.

Scientists never really like to talk about argument. They argue all the time but it's not a term which they will feel comfortable with. They are humans, I always try to emphasise to students that scientists are humans first and scientist second. Therefore, their normal social interaction tends to come out. If they like arguing, they'll argue. They get quite vehement about it and their logic is sometimes distorted by their passions and their beliefs and their own views. That's the weird thing about scientists. There is a wonderful book called, the Brief History of Everything. To me the staggering consistent message is that scientists are anything but the kind of people that they're portrayed as being. They are not as logical as they should be. And people have discovered something and everyone else just ignore something that doesn't' fit in with what they are thinking. And why does that happen time and time again, and I think part of it is that if they were better at argument, and if they recognise that this was part of the subject, we'd make far better progress. So that's why I think it's actually important to get scientist to be better at it because it helps the subject.

Biology lecturer B

Biologists were also perceived as not comfortable in arguing.

> *Well my guess is that students who are opinionated and like arguments and debate have not chosen to be biologists.*
>
> *Biology lecturer B*

These findings suggest that although students and lecturers across the three disciplines perceived the use of arguments as important, argumentation was not as widely practised or emphasised as one would expect in higher education courses, although there were implicit references to its use in some disciplines. There were clearly opportunities for the use of arguments in the three disciplines. So why was there still so much focus on the teaching of facts and rote memorisation? The answer lies largely in the way learning is measured or assessed. So despite the QAA's [8] emphasis on the need for argumentative skills to be taught at universities, not much progress had been made in practice.

2.11 Assessments

The ability to construct an argument was considered an important skill by almost all the students surveyed (100%; for history; 95% for biology and 64% for engineering), but this was only for passing exams. Students did not see it as necessary for their general intellectual development, nor a skill that would enable them to engage in current debates on moral and ethical issues or to question research reports they read. If the assessment criteria were based on students' ability to argue and debate on issues, as in history, they would be more likely to practice and use such skills. If students were not assessed on their ability to argue, as with engineering and to some extent biology, they were less likely to see the relevance of the skills or practise them.

In biology, for example, essays provided scope for the use of arguments, but students often did not apply such skills because their essays did not count towards their final grades.

> *[for] quite a lot of people I know, the essays (because they don't count towards the course and they are not officially marked…) are just something to get over with and they'd do so quickly the night before. Because essays for history are marked, [and] that's what counts towards the final grade, I think you are going to put a lot more effort into doing them.*
>
> *Biology student C*

> *Students are much better at passing exams - all directed at how to learn something in order to reproduce something to pass exams. Student expectations are now much more we'll tell them what they've got to know, exam them on that and then move on to the next bit of the course. I think it's the demand of the whole education system and schools. […] the idea that you might have a debate about something is true or false is less important because most students don't want to know the debate, they want to know whether the answer is true or false. That comes through to us.*
>
> *Biology lecturer B*

End-of-year examinations for first year biology courses also did little to encourage the use of arguments. Exams were largely in the form of short-answer questions consisting of fact-based, knowledge recall, short-answer type of questions that required factual statements or a 'yes' and 'no' answer. There was little emphasis and demand for critical evaluation. The comment below very much encapsulates what many thought:

> *Our own exam system here has been changed so that there is more emphasis on factual recall, partly because of student numbers. It's easier to mark an exam where students just have to say yes or no or give a particular fact rather than constructing an argument. Therefore, the number of assessments to do with constructing an argument has declined.*
>
> *Biology lecturer A*

According to the 2016 course module description in institution A assessments in the first year involved short questions and answers. Only further on in the course did essay questions feature in exams. The university website explained that exams were designed "*to assess conceptual understanding as well as important facts about the subject. The exams also contain problem-solving questions which we think should be fundamental to any scientific discipline*." No explicit reference was made to transferable thinking skills. It was not clear what the problem-solving questions were. In institution B the course content for 2016 emphasised real world skills and experience through practical and fieldwork. Assessments included theory exams (which accounted for 75-80% of the final mark) and course work (e.g. practical reports, field reports and online tests and exercises). There

was no mention of explicit teaching of critical reading skills.

In engineering, assessments were invariably in the form of clear-cut right or wrong answer type of questions. There was limited scope for interpretation and discussion as some students had suggested.

S: No I was just sort of saying the term 'argument' or sort of arguing your views is more sort of to be done in subjects like history, e.g. you've got your piece of evidence or whatever and to a certain extent it is open to interpretation, whereas in electronics/engineering and possibly the sciences it's more of a right…

B: It's more of a right or wrong answer.

S: It's more of a right or wrong answer because you got to obey certain rules.

The 2016 course modules in institution B described the assessments as closed book exams (for more mathematically based courses), short technical reports (largely practical work), portfolios (such as programming exercises or media report / blog), project-based presentations and technical report. Although formative assessment was used, it was for identification of mistakes students made in their projects. In addition, students had to complete an online Academic Integrity module which covered academic ethics, appropriate referencing and sourcing for materials. Again there was no mention of skills relating to assessing evidence in academic papers. In institution assessment was via exam and coursework and project work. Students were encouraged to read widely and develop their critical ability, but there was no mention that such skills were being taught. The course content emphasised design and project work.

In history, on the other hand, the ability to argue well was seen as essential for a good pass. History exams, unlike biology were more open with scope for debates. Marking criteria were based on students' ability to put together a good argument.

> *…exams for history were open exams and you had two days to write two essays. But for biology you just go in for an hour and a half or whatever and it's closed and you have to answer the questions on the paper.*
>
> *Second year biology student who did history in the first year*

> *For history students, it is crucial to learn to argue. They have wider reading, but don't always solve the structural problems in argument. Argument is central to a 'good' degree.*
>
> *History lecturer A*

The 2016 course modules for first year history in institution B emphasized research skills and knowledge of historical periods. It explicitly stated that critical reading and source analysis were among the core skills taught. Students were expected to develop core skills relating to research and academic writing, such as bibliographic referencing as well as critical analysis of source materials. Most of the teaching was largely through lectures, seminars and a couple of workshops. Short essay and course work contributed 100% of the final assessment. In addition students had to complete a 1,500 word critical review as part of the formative assessment. However, it was not clear if this contributed to the final grade. The course module description in institution B was rather sketchy but emphasized core understanding and basic skills in research skills and historical writing.

A quick look at the first year course modules in two other Russell Group institutions showed the same picture. For example, at Durham University the first year history lectures aimed to "*introduce broad historical questions and offer contextualisation and critical commentary; seminars provide an opportunity for students to develop their critical skills through discussion for which they have prepared in advance*." (https://www.dur.ac.uk/courses/info/?id=9170&title=History&code=V100&type=BA&year=2016#learning). The first year biology course emphasised knowledge content. It stated that most of the contact time would be devoted to lectures "*to allow the effective delivery of large amounts of knowledge, which forms the factual basis of a science subject. At level 1 the emphasis is on core knowledge across the broad spectrum of the sub-disciplines of biological sciences*." (https://www.dur.ac.uk/courses/info/?id=10113&title=Biological+Sciences&code=C103&type=BSC&year=2016#learning).

Similarly, the engineering course was delivered mainly through a combination of lectures, practical classes and design activities. The website explained that the "*lectures provide key information on a particular field of study, and*

identify the main underpinning engineering concepts in that area."

https://www.dur.ac.uk/courses/info/?id=8549&title=General+Engineering&code=H103&type=BENG&year=2016#learning. However, there was scope for interpretive skills during practical sessions, but it was not clear what these skills were. It was also not clear how students were assessed, but possibly through project design work and oral presentation of their project.

At the University of Birmingham the first year compulsory history module for 2016 included research skills, note-taking, referencing and participation in class debate. The teaching and learning of argumentative skills were not explicit but implied. (http://www.birmingham.ac.uk/undergraduate/courses/history/history.aspx#CourseDetailsTab). All first year biological sciences students had to take the same modules. The module on evolution included topics on the origins of altruism and genetic determinants of evolution. This module lends itself very well to the teaching of critical thinking. The electronics and electrical engineering course at Birmingham University was delivered through a combination of lectures, laboratory work, small tutorials, project work and enquiry-based learning (group activity and research reports and presentations which were either individual or group). The emphasis was on physical and mathematical principles. (http://www.birmingham.ac.uk/undergraduate/courses/eese/electronic-electrical-engineering.aspx#LearningAndTeachingTab)

In summary, the attitude towards teaching and learning of arguments in higher education depends very much on the first year course structure, the personal conviction of individual lecturers and their style of delivery. In biology and engineering much focus was on content and information transmission in the classroom. In history, on the other hand, there was a consistent emphasis on the use of arguments and critical evaluation. But most of all, it is the way first year courses were assessed. In some disciplines assessments clearly do not require students to argue or be critical. It may be that the large class sizes in first year courses necessitate the use of short answer and multiple-choice type of questions which require heavy fact memorisation. These are perceived to be easier and quicker to mark. Extended writing requiring synthesis of facts and interpretation of data that test argumentative skills are considered time consuming to grade, and thus avoided. One therefore questions whether existing modes of assessments requiring rote learning chunks of facts are indeed a valid test of learning.

2.12 A Simple Test of Critical Awareness

To assess the level of students' critical awareness we asked four simple questions [35,36].

The findings showed that history students were the most critically aware: not accepting findings from research papers just because they were recently published. They were the most sceptical about research that was not warranted by evidence. Only history students were more likely to disagree that good research should be substantiated by numerical data. The majority of students could not see that although quantitative information may help to frame arguments, such arguments are open to evaluation or interpretation and misinterpretation. They do not in themselves mean that the argument is correct [37]. Although good research needs to be substantiated by evidence, this evidence does not necessarily have to be numerical.

Table 4. Critical awareness in reading academic papers (% disagree)

	Biology (n=106)	Electronic engineering (n=52)	History (n=79)
Accept findings if recently published	33	15	56
Accept findings if peer reviewed	20	8	33
Good research should be substantiated by numerical data	9	4	30
If argument is convincing conclusions must be true	86	48	86

The least critical of all were the engineers. Erduran and Villamanan [38] also reported similar findings. In their study they found that few students were able to accurately interpret experimental data and only a third of their arguments and reports were valid, and conclusions were drawn that were not supported by the evidence in the data. Previous studies have also shown that science students were generally not very good in reasoning skills, partly because they had never been explicitly taught how to develop effective scientific argument [39,40].

The results of this small test were very revealing. They showed that the majority of the undergraduates rarely questioned or challenged the findings or even the methods used when reading research literature. Either they did not have the skills to do it, or had not been encouraged to be critically aware. The latter is more likely to be the case because if we were to ask students to buy a mobile phone, they would have no problems weighing the pros and cons of the different models. They would also have no problems making critical judgements about the choice of student accommodation. Somehow, when it comes to reading academic papers, students lose that ability to judge and simply accept what they read just because it is written by a professor. This phenomenon, also known as the 'white coat' syndrome, was illustrated in a paper on the effects of heredity on intelligence by the psychologist Cyril Burt. Tucker [41] showed that even famous psychologists uncritically accepted Burt's findings despite the lack of evidence. It was only after Burt's death that evidence emerged that he falsified his data. As Lochhead and Clement [42] said, we should be teaching students how to think instead of what to think so that they can make informed decisions about what is true and what is not. The high level of critical awareness among history students suggests that exposure and emphasis on argumentative skills in the class does help develop critically aware individuals.

3. DISCUSSION

3.1 Implications for Policy and Practice

This study shows that although students and academics recognise that there is a place for the teaching and learning of arguments in university introductory courses, it is rarely made explicit. One explanation could be the belief among some lecturers that first year students need to be taught facts first before they can learn to argue, and partly the way courses are assessed that limit the use of arguments. If we believe that a key attribute of graduates is the ability to argue, then the teaching and learning of argumentative skills should be made a priority. This will have implications for the way first year courses are taught and assessed. In the 1980s Browne [43] argued that if we wanted to foster a culture of critical thinking in higher education, changes needed to be made in the general university atmosphere, curriculum materials and modes of assessment. The same sentiments are echoed here today. We need to:

3.1.1 Rethink the way courses are assessed

Because of large classes in first year undergraduate courses multiple-choice or short-answer type tests are often favoured by lecturers. Such tests are good at testing students' ability to memorise chunks of information but less valid for testing their ability to interpret information and presenting and constructing evidence. They encourage lecturers to teach to the test. Lecturers feel that they have to teach students according to how they will be assessed in order for them to get good grades. Students likewise think that understanding the issue tested is less important than being able to memorise and regurgitate facts.

New ways of teaching and assessments would have to be developed. There are a range of strategies to overcome the over-emphasis on teaching 'facts' and the use of recall type tests. One is to make assessments not solely reliant on tests, and introduce formative rather than summative assessments. These assessments could be supplemented with termly assignments which necessitate students to practice the skills of argumentation and which will be graded. Their marks should count towards a portion of the students' final grades. In some universities and some courses, this is common practice, but to encourage a wider use of argumentation more weight and credence could be given to assignments. Cynics would argue that this will not work as it means more marking for teachers. Marking extended essays is time-consuming. There will always be resistance from the teaching staff. Also teachers may still be concerned about whether students have learnt the basics.

One way to overcome this is to treat teaching and testing as complementary activities. For example, lectures and seminars/tutorials (small

group classes) provide the opportunities to challenge students and get them to evaluate evidence and question assumptions, while tests could be used to check for understanding of basic facts. To encourage the use of argumentation in class discussions, students' participation in these small group discussions could be assessed and marks awarded. This is to discourage over-reliance on summative tests alone.

3.1.2 Consider changing teaching styles

Some may argue that assessments of class participations are difficult to implement especially in large groups. Alternative versions could be conceived. Teaching staff need to be creative. For example, set up situations where debates are graded to encourage the use and practice of arguments. Use small group discussions (for example, tutorials/seminars) as opportunities for examining and presenting conflicting evidence to encourage debates and arguments. Students could be given time to gather 'facts' or information and they will be assessed on how they argue their case. A simple diagnostic tool indicating the kind of skills needed not only facilitates assessments but also gives an indication to students as to what skills are desired. For a start lecturers could model some of the behaviour they want students to aspire to. In practice this is often not easy as interview data suggest, teaching staff do not always have the capacity to teach argumentative skills.

3.1.3 Train and provide necessary support for academics

If lecturers themselves do not know how to construct arguments, it is hard to imagine that they could design courses and assignments that would train students to argue. This has implication for staff development and recruitment. To implement the strategies suggested so far would require the support of university leaders and administrators in the form of training, resources, time and encouragement.

3.1.4 Re-focus the role of university

Evidence from this case study and others suggest that our university courses are very good at teaching young people what to think but not how to think [44]. To change the existing instructional practice would also require a re-evaluation of the purpose of teaching and learning and more broadly, the aims of universities.

This has implication for wider reforms in higher education. We need to remind ourselves of the fundamental role of universities. Questions we need to ask are: Is the role of university to train young people to think or is it for the transmission of knowledge? Is subject matter knowledge more important than generic knowledge on analyzing arguments? Are argumentative skills still relevant and should they be taught in introductory courses?

In the new global knowledge economy and digital age, students are constantly bombarded with information. The profusion of information-generating devices like the mobile phones, iPhones, iPads, Blackberry, and modern means of sharing and accessing information like google, twitter, blogs and instant messaging make it so easy for students to access information. Therefore, what students need is not more information, but the ability to sieve through those information, to be able to judge what is believable and what is not, to evaluate the evidence, to interpret the data received and reported and to critically appraise the quality of such evidence. It is a useful skill for young people to have to be able to evaluate the integrity and validity of information they are confronted with, weigh the evidence presented to them, and make judgements about them [16]. It is through the process of argumentation that knowledge can be developed and verified. Such skills are therefore even more necessary in the 21st century.

Perhaps because universities are now increasingly seen as an instrument of economic growth, a business enterprise and less of a training institution that its fundamental role of developing thinking individuals is forgotten. Drew Faust, President of Harvard, in her speech at the Irish Royal Academy, reminded us that the role of education is to develop in individuals capacities to interpret information, to distinguish between knowledge and information [45]. She added that:

> Education measured only as an instrument of economic growth neglects the importance of developing such capacities. It misses the fact that we are all interpreters; it ignores that some things are not about "facts" but about understanding and meaning.

4. CONCLUSION

In summary, argumentative skills can and should be introduced in introductory courses at university. There needs to be a revamp of existing instructional practices and modes of assessments. The role of university lecturers as vehicles for the transfer of knowledge is no longer relevant. Academics should be inspirational educators able to inspire and motivate young people to question and argue and critically evaluate information.

The place of traditional teaching styles that emphasise knowledge acquisition should be reviewed. Argumentative skills should be integrated into content learning [46]. To the extent that argumentative skills contribute to the development of a better quality of knowledge and cultivation of a rational and human society, it should be encouraged and supported.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX

IMPROVING ARGUMENTATIVE SKILLS IN FIRST-YEAR UNDERGRADUATES

Dear Student,

This is part of the UK Higher Education Academy-funded study on improving argumentative skills in first-year undergraduates in the UK and US in three disciplines (Biology, History and Electronic Engineering). The aims of this questionnaire are to:

- identify your needs regarding the use of *argument;
- evaluate your experience of argument in the course;

(Here we take argument to mean 'writing or speaking where a person takes a position on some question and gives logical reasons and evidence for his/her own views'.)

Your responses are particularly valuable to the study and will provide a basis for future research in this area. We would be grateful if you could take the time to complete this questionnaire. Please feel free to expand on any of your answers.

Return this questionnaire even if it is only partially completed.

Every effort will be made to ensure confidentiality and proper conduct of the research. You and the department, and the institution involved will remain anonymous in any report that arise from this survey. If you need further information about the study, you may contact me below.

Yours faithfully,

_____

Institution:
Course/subject : Biology / History / Electronic Engineering
Name the modules taken so far : _____

_____

Please indicate your acceptance of participation in the study by signing below.

_____ Signature

_____ Date

Section A – Use of *argument in your course

**(Here we take argument to mean 'writing or speaking where a person takes a position on some question and gives logical reasons and evidence for his/her own views'.)*

A.01 This question concerns the demands of your course this year regarding the use of argument. Indicate your answer by putting a √ in the appropriate box.

Use of arguments in your course	**Agree**	**Not sure**	**Disagree**
a) To do well in written work, I have to be able to state my view and explain it clearly.			
b) It is important for me as a biology/history/engineering student to learn how to construct an argument.			
c) In my course we don't need to be able to argue well to get good grades.			
d) I don't know enough about my subject yet to learn how to construct an argument.			
e) If I can't argue well it's because I don't have a good grasp of the basic concepts or theory in my subject area.			
f) If I can't argue well it's because I don't have the language and writing ability to do so.			
Comments (if any):			

A.02 This question is to establish your general approach to reading any academic writing (or report), either in an academic (i.e. professional) journal or in any written text related to your course.

Approach to critical reading	**Agree**	**Not sure**	**Disagree**
a) It is reasonably safe to assume that we can accept findings of a report or article that has been published recently.			
b) If it's a report or article published in a reputable journal, it's been peer reviewed so we can accept the findings.			
c) A good piece of research should be substantiated by statistical or numerical data (e.g. official government data involving numbers, such as population statistics as opposed to case studies and detailed descriptive accounts)			
d) If the argument is convincing the conclusions must be true.			
Comments (if any):			

A.03 This question is to establish the need for any instruction on argumentative skills. Please tick in the appropriate box.

	Yes	No
a) Do you see a difference in the way you are expected to write in school and in university?	□	□
b) Do you think there is a need for any instruction on argumentative skills at university?	□	□

c) Have you been given any guidance or instruction, either directly or indirectly, on how to use argument (i.e. present evidence / logical reasoning) in academic writing?

(i) at university	□	□
(ii) before university	□	□

d) Is there any formal instruction (i.e. lessons structured within the course or in school) on how to use argument?

(i) at university	□	□
(ii) before university	□	□

A.04 Do you think that:

	Yes	No
a) the best way to learn how to make arguments is through ideas that operate within my subject (i.e. biology, history, or electronic engineering)	□	□
b) the best way to learn arguments is through general courses on speaking and writing rather than through the subject itself.	□	□

*Comments (if any):*_____

Section B – Your experience of argumentation in the course this year

B.01 This question evaluates your experience in your course (program of study) **so far this year.** Your experience may vary from module to module, but here we want you to reflect on your experience **in general**.

(a) Circle all the words and phrases that have been used in work or activities assigned on your courses:

discuss	*test*	*compare*	*research*	*reflect*
explain	*evaluate*	*analyse*	*prove*	*argue*
describe	*debate*	*investigate*	*estimate*	*model*
draw	*solve*	*give an example*		
give an interpretation				

(b) For which of these words and phrases, if any, would you need to give a statement or opinion supported by logical reasons and evidence? Please circle all that apply:

discuss	*test*	*compare*	*research*	*reflect*
explain	*evaluate*	*analyse*	*prove*	*argue*
describe	*debate*	*investigate*	*estimate*	*model*

draw solve give an example give an interpretation

B.02 For each activity, give a rough estimate of **how much time you have spent** on them and your judgement of **how often you have made or heard an academic argument of some type being made** during that activity. (Circle the number that most represents your answer).

(a) attending (class) lectures

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(b) Studying and taking examinations

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear arguments	1	2	3	4	5	Frequently read/hear arguments

(c) Solving problems or doing exercises (either on paper or online)

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(d) Writing extended papers/essays or reports

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(e) Engaging in group discussions (e.g. either in seminar or tutorial groups)

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(f) Engaging in informal discussions about course-related work with other students outside class

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(g) Making and reporting observations (e.g. in labs or in the field)

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(h) Reading written materials related to the course of study

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

(i) _____ (specify other common activity in your programme)

No time	1	2	3	4	5	Lots of time
Never make arguments	1	2	3	4	5	Frequently make arguments
Never read/hear	1	2	3	4	5	Frequently read/hear arguments

*Any other comments (Please feel free to write your comments, if any, here)***:**

_____
_____
_____

B.03 In the courses in your major field of study (i.e. biology, history or electronics), **estimate how often you have engaged in each of the following activities this year.**

(a) Memorised key ideas and facts

Never	1	2	3	4	5	Frequently

(b) Solved problems with clear solutions (i.e. instructors/tutors/lecturers know the solutions)

Never 1 2 3 4 5 Frequently

(c) Analysed mathematical data to identify basic patterns

Never 1 2 3 4 5 Frequently

(d) Analysed graphic data, maps or images to identify basic patterns

Never 1 2 3 4 5 Frequently

(e) Made complex interpretations of some basic information of any type of texts/written materials, observations, mathematical or graphic data)

Never 1 2 3 4 5 Frequently

(f) Proposed a solution for a problem that does not have a single or simple solution (i.e. solutions that cannot be simply marked correct or incorrect)

Never 1 2 3 4 5 Frequently

(g) Gathered evidence to make a written argument

Never 1 2 3 4 5 Frequently

(h) Gathered evidence to make an argument orally

Never 1 2 3 4 5 Frequently

(i) Created or made something (whether a poem, a mechanical device, a computer programme, a model or a dance)

Never 1 2 3 4 5 Frequently

B.04 For each of the following types of feedback, indicate **how often you have been getting the following forms of feedback in your courses** this year and **how useful that feedback has been in showing how your arguments can be improved**. Reflect on your experience of your course in general.

(a) Written comments from lecturer (instructor/tutor)

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

(b) Individual conferences with a course lecturer (tutor/instructor)

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

(c) Lecturer's (instructors') general responses to student work in class (either online or in some kind of general written reflection notes given in class lectures)

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

(d) Individual conference with a tutor or advisor in a campus learning or writing center

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

(e) Response from classmates (either structured or encouraged) by lecturer (tutor/instructor)

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

(f) Informal response from other students (i.e., not assigned by instructors)

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

(g) Other_____ (please specify)

Never 1 2 3 4 5 Frequently

Not useful 1 2 3 4 5 Very useful

Any other comments: _____
_____
_____
_____
_____

Section C – Information about yourself

This section is to obtain general background information. It is important as it enables us to compare the responses of people from different background.

C. 01 Age (in years): _____

C.02 Sex: Male □ Female □

C.03 Main language(s) spoken at home: _____

C.04 Please indicate your country of origin: _____

C.05 What type of secondary school did you attend?
State school in UK □
Private fee paying school in UK □
Secondary education outside UK □

C.06 What is your main university entrance qualification? For most of you it would be your A-level results or equivalent. If so, indicate your grades (e.g. ABB).

Type/Level (e.g. 'A'/AS level, GNVQ)	**(√)**	**Grades**
A level		
AS level		
Through Vocational qualifications (e.g. GNVQ)		
Through Access		
Other (specify)		

Thank you for completing the questionnaire. As a follow-up to this questionnaire we would like to have a chat with some students on this issue. If you would like to be involved in the discussion, please leave your name and contact details below:

Name : _____

E-mail address: _____

Telephone : _____
(optional)

Peer-review history:
The peer review history for this paper can be accessed here:
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