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The Assessment of Engineering Student Public Speaking Ability: What, How and Issues.

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Abstract: This paper discusses the assessment of public speaking as a generic skill in engineering students. The assessment is far from a new topic however there are a few fundamental questions surrounding this generic skill that remain unclear and subject to a number of measurement issues. The paper commences on the premise that public speaking is actually a meta-competence which sits in the middle of a hierarchy of skill definitions under the general umbrella of communication. Below it are skills such as: the ability to convey a technical subject to a lay audience; the ability to convey a technical subject to a technical audience; and a number of other variants. The paper then considers some of the issues with measuring it as a skill starting with why, as academics, we should measure it and what any statement of ability means. It looks at issues of measurement reliability and validity and some of the common sources of conscious and unconscious measurement bias. The paper will draw on the findings of 3 years experimental research at the University of York into the use of a marking rubric and how effective this is compared to the more common overall assessment methods. It will also report on the need for assessment of how well the student can defend their presentation and the more controversial question of whether, if a student shows complete incompetence in being able to defend their presentation whether they should pass or fail the overall presentation.

Keywords: Engineering education, Public Speaking, Assessment, Assessment bias, Students

1. Introduction

A search on the Internet for "Public Speaking" yields over 36 million references, including advertisements, images, hints and tips, informational articles, TED talks, you name it there is something related to public speaking. Narrowing the search to "'Public speaking" & Books' yields over 1.7 million hits. Narrowing down even more to "'Public speaking" & Books & pdf' yields over 600 thousand hits. A search of Google Scholar using "Public Speaking" yields 128 thousand hits. There is a vast amount of readily information on the topic, too much to systematically review without a considerably tighter focus.

The Wikipedia (2016) definition of Public Speaking is “*Public speaking (sometimes termed oratory or oration) is the process or act of performing a presentation (a speech) focused around an individual direct speech to a live audience in a structured, deliberate manner in order to inform, influence, or entertain them.*” By this definition public speaking is a form of “*imparting or transmission of something ...*” the stem of the definition of ‘communication’ OED (2016). Viewing skills in a hierarchical sense and using these definitions as a starting point would support an initial view that ‘communication’ is one or more levels of abstraction above public speaking.

The definition gives a starting point to a number of questions that arise in a detailed investigation

into public speaking as a skill. The primary context for this question is in the development of it as a generic skill in students within the Higher Education system.

At the fundamental level what is public speaking? Is it an Act or a Process, an art or science? Definitions of the term vary considerably, for example the online dictionary defines it as “*the act of delivering speeches in public*” dictionary.com (2016); speechmastery.com defines it as a process: “*The process of speaking to a few or many people with the purpose of informing, motivating, persuading, educating or entertaining the listeners.*” Speechmastery.com (2016); while the Merriam Webster’s definition allows it to be both in its definition: “*The act or process of making speeches in public*” Merriam (2016). The dictionary.com also defines it as “*The art or skill of addressing an audience effectively*” Dictionary.com (2016), as does Lucas (2009) in his aptly named book “*The art of public speaking*”, whilst others refer to it as an art and science for example in “*Between one and many: The art and Science of Public Speaking*” by Brydon and Scott (2010).

Two different methodologies were used to inform the discussion and results presented in this paper, firstly, using desk research, dictionary definitions and academic literature were reviewed to explore public speaking as a construct and how it fits into a hierarchy. No specific age range or academic level was used in this search although references at the Higher Education level were generally favoured. The second method involved the downloading of job advertisements from online job search sites in the technical areas of renewable energies and biomedical engineering. The objective of this side of the study is to open a window to one way in which employers express their need for public speaking as a skill. This part of the work does have an engineering related bias because only engineering and related job adverts were sought. A fuller description of the job advertisement side of the research is given in section 3. The following section briefly explores the literature side of public speaking.

2. Public Speaking

A review of some of the mass of literature on public speaking shows there are a number of different purposes to the presentation. Three general types seem to emerge, to Commemorate or entertain; to Inform; and to Persuade. When commemorating or entertaining the objective is to “*strengthen the bonds between audience members from recalling a shared experience or intend to amuse audiences through humor, stories, or illustrations*” Schreiber et al (2011). For this type of presentation a number of examples are given, including after dinner speeches (e.g. Boom (1992)), Award acceptance speech, Eulogy, Graduation opening, Wedding speech. Informational includes Classes or lectures and Conference presentations; Persuasion includes politician’s campaigns, public debates and sales pitches. Are these all the same types of presentation?

The audience is also important, Grippo (Book) said: “*use technical language on your visuals only if you are speaking to a technical audience; use common terms for a lay audience*”. From this can we infer that the skill of presenting to a technical audience is different to a lay audience? According to Peterson (2012) audience size also matters: “*The size of an audience affects speech delivery; a small audience can be addressed informally, while a large audience requires more structure.*” Does differentiating between a large and small audience merit different definitions? The issue of the audience was one of three ‘contradictions’ Dannels (2003) explored. When giving a presentation during their study programme “*Should students address an academic or a workplace audience, which they defined as purely technical or mixed, respectively? Should students speak as students*

working for a grade or as practicing engineers? Should students orally structure their presentations using the step-by-step design process their textbook identified or using the problem oriented focus they believed characterized workplace design?" Dannels (2003).

Manko (1969) states that speechmaking is not difficult, it just needs “planning and thorough preparation”. Perhaps herein lies the clue to a similarity between all these types of presentation, they all need planning and thorough presentation if the desired effect is to be fully achieved. But does that make them all the same?

3. Job advert analysis

The full text of 92 job advertisements were downloaded from the internet into the NVivo qualitative research analysis tool as ‘Internals’ for this analysis, comprising 36 Biomedical Engineering, 13 Hydro energy and 43 Solar Power adverts. Mentions of communications, write, speak and listen including all stemmed words were all initially coded into a single node. In addition the adjectives used to indicate the level of ability required or desired for these skills were also coded.

41 of the job adverts (44.5% of all adverts) had some of their text coded at communications. This was surprisingly low as the ability to communicate might be thought of as important in all jobs. To test to ensure nothing had been missed, a sample of the job adverts not coded at this node or any of its sub-nodes, were checked for missed references. None were found.

To refine the coding and start to develop a job advert derived hierarchy, the text at that node was reviewed and recoded to lower level skills where this could be done. On inspection it became clear that there were a number of 'dimensions' associated with communications as a skill, the dimensions, excluding the skill itself, and their sub-nodes are shown in Table 1

Table 1 Dimensions of "Communication"

Dimension	Sub-nodes
Audience level	All, Client, Senior Management or Board, Staff
Audience Type	Lay, Technical
Contexts	Articles for publication, Customer focused, Documentation, Proposals, Reports, Review of others' work, Specifications, Speeches, Technical Sales
Mediums	email, Telephone

The skills were coded into the following hierarchy:

- Communications
 - Communications (30)
 - Listening (1)
 - Verbal or Oral (12)
 - Presentation (3)
 - Written (20)

Mentions were coded at “Communications (30)” above when there was not further elaboration or definition of the meaning. In the above list the number in brackets is the number of times the term is used in the adverts. Where the term “Communications” is used the exact detail of what is being

sought is unclear. Clarity in this respect only emerges from the more richly expressed needs. For example in the Presentation sub-node, one advert states “*Effectively present information to a variety of people, including senior management, groups, and/or board of directors.*” This shows that the company, at least on the face of it, considers presenting to these different groups may be somewhat different. In a similar way “*Excellent verbal and written communication skills; including communicating with technical and non-technical clients and staff*” suggests the company recognises a difference in communicating with technical and non-technical people. Whether this extract from the advert also implies there is a difference between communicating to staff and clients may be a step too far, it may just be indicative of the nature of the role. Another advert states “*Strong communication skills in all forms including written, oral, email, telephone*” again suggesting an ability to communicate using a number of different mediums may, to them be different.

The context of the communication extracted from the adverts also offers some insights into differences employers needs. Contexts vary from: user documentation, as in “*Writing user documentation to a high standard*”, technical documentation, as in “*Technical writing for project documents*” and sales support materials, “*You're highly numerate and a brilliant communicator who enjoys using high quality sales support materials*”; Proposals; Reports; Specifications; and Articles for Publication. Reviewing of other’s writing is mentioned in one, “*as well as review of junior engineers' technical writing*”, arguably a different skill to writing oneself.

Some adverts inform the hierarchical nature of communications as a meta-skill, as in “*great communication skills - verbal, written, listening with a strong customer focus*”, others support this through the use of the ‘and’ conjunctive, as in “*Excellent verbal and written communication skills*” and “*Excellent communication and presentation skills*”.

In initial conclusion to the job advert analysis section of this review, the analysis supports the argument that communications is a higher-level skill and that public speaking, as expressed as ‘presentation’ falls within it. It further suggests that simply to give a presentation may be a simplistic view of what employers require and that dimensions such as audience level and technical ability are important and possibly viewed as being different.

4. Assessing Public Speaking ability

Lord Kelvin, in his “Electrical Units of Measurement” Kelvin (1883) said: “*I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be.*” Whilst this is an engineering related quotation the basic principle that if you cannot measure an entity you cannot control it or know whether you are developing it or not is fundamentally still valid. The same should apply to the assessment of a student’s ability in the generic skills. But how practical is this? To be able to assess an entity we need to be able to define it and then establish a measure that interested stakeholders all accept as

being meaningful, then the assessment methods to deliver said measure should be considered.

Higher Education is very used to assessing student ability, especially in technical skills. Assessment instruments, such as examinations, laboratory write-ups and assignments are mature as are the underlying quality control systems (through peer review, moderation and random cross-checking processes). The results are frequently in percentage form and from that translated into either a letter or numerical grade or a Grade Point Average. In all cases the scale onto which the student marks are mapped has accepted meaning generally to all interested stakeholders. The overall grade of the award, whether it is the UK system of 1st, Upper 2nd, Lower 2nd, 3rd and Pass class degrees, or alternative systems, has meaning to local employers who understand the quality implied when in conjunction with the name of the awarding institution. The same can be said for the detail within the student transcript, which details exactly how well (the warranted level of ability) the student has performed in each of the academic modules they have been assessed in.

This is in contrast to the generic skills where there is an understanding of what they mean, up to a point, but much less attention to detail in their specification and assessment. By way of example the Washington Accord, includes: “*Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions*” as a required graduate outcome of academic programmes, Hanrahan (2009). In this definition we again see the parts of a skills hierarchy underneath ‘communications’ with ‘effective’ as the ability level and ‘the engineering community’ (technical) and with ‘society at large’ (lay) audiences included. The conjunction used in the statement is ‘and’ implying that the student needs to be able to do all – to warrant this we should assess the student in presenting to a technical and a lay audience. Section 7.8 of the UK “Subject Benchmark Statements: Engineering”, 2015, states: “*An implication of defining output standards for engineering degrees is that all students graduating with such degrees are able to demonstrate that they have achieved these standards. Programme providers need to make clear how this is ensured.*” and section 7.9: “*Assessment is the means by which students are measured against benchmark criteria and also forms a constructive part of the learning process.*” Assessment, including for generic skills as these have a place in the benchmark statements, is therefore a requirement of academic programmes. The challenge now becomes what we measure and how we assess and certify the student ability. As a starter in this direction, what does industry want? A window into this is again through job adverts. Whereas academia may look to grades or percentages as the method of specifying ability the analysis of job adverts shows a very different way of specifying level of ability for both technical and generic skills. Table 2 shows the adjectives attached to each skill within the skills hierarchy as extracted from the job adverts. The table shows the number of times each adjective (rows) are mentioned for each skill sorted in descending order of total number. The total column being the total number of times that adjective is used across all skills. The adjectives used are, by definition descriptive, subjective and difficult to place in rank order let alone referencing them meaningfully to any externally warrantable scale.

Table 2 Adjectives used in conjunction with communication skills

	Communications	Listening	Verbal Oral	Presentation	Written	Total
Excellent	10		4	2	6	22
Strong	12	1	4		5	22
Good	1		1		2	4
Proficient(cy)			2		2	4
Fluent			1		2	3
Great		1	1		1	3
Clearly	2					2
Effective(ly)	1			1		2
High					2	2
High Standard					2	2
Proven	1				1	2
Brilliant	1					1

For public speaking, a considerable amount of effort has gone into the development of public speaking assessment rubrics with examples being the Public Speaking Competence Rubric (PSCR) developed by Schreiber et al (2012). A limitation of this rubric and of many others, is the lack of assessment of how well the student can defend what they are presenting (from a technical point of view). For Engineers, in Sales and Marketing, Business Proposals and more, the ability to defend and argue the case is important, which led to an evolution of the PSCR to include the assessment of the presenters' ability to defend their content Jackson et al (2014).

The modified rubric has been used for over 3 years at the University of York to assess undergraduate and taught masters level presentations using academic and student peer assessors. The detailed results of over 5,000 assessments have been used to test inter-assessor reliability, bias and the effects of assessor fatigue when a sequence of presentations are being assessed. Initial details of findings of analyses completed to date can be found in Jackson and Ward (2014), Ward et al (2016). The findings show that where the marking rubric has been used there is high correlation between marks awarded for the same presentation by trained academic markers, no statistical evidence of gender bias, and no predictable effects of marker fatigue.

5. Discussion

In the case of generic skills we are very close to being at stage 1 of the assessment process, still requiring clear definitions of the entity we are trying to measure. In the case of public speaking there is disagreement on whether it is an Art or Science or an Act or Process – these distinctions may seem trivial until we consider the approaches taken in different academic disciplines to assessment – in the Sciences there is more likely to be a right or wrong answer, measurement is a very important component of education. Is the same true in the Arts based subjects? Do we objectively try to measure the quality of a picture, an essay, a literary work?

Is public speaking an act or a process? Assessing it as an 'act', a one off activity is fine but is this a good predictor of how well the individual will give their next presentation – where the brief or 'scaffold' may be completely different. Ward (2012) argues that the ability to demonstrate the

student can follow the ‘Generic public speaking process’ to produce a good presentation is a more robust predictor of their future ability. The use of assessment rubrics is an effective way of assessing this ability, improve inter-marker consistency and reduce marker bias effects. However this does not affect the need to be clear what it is that is being assessed, for example is presenting to a technical audience the same as presenting to a non-technical audience? Two of the companies in the job advert state the ability to present to both types of audience is required, as in “*Excellent verbal and written communication skills; including communicating with technical and non-technical clients and staff*” and “*Experience writing speeches and articles for publications that conform to prescribed style and format both for technical review and in layman's terms.*” Indicators of a recognisable and desired difference.

The Engineering Benchmark Statements make it clear that all output statements must be met if the student is to be certified as meeting the overall standard. Where the benchmark statement is, itself a compound statement, we should also imply that the student needs to meet all aspects of the statement. In the case of public speaking this implies the student can present to a technical audience AND a lay audience. If, in addition to this assumption, the more predictive model of student ability to give presentations, that is the process rather than act view, is the ability to demonstrate competence in all stages of the process equally important? This begs the question if a student is unable to demonstrate achievement of a benchmark minimum ability in a component of an assessment should they fail that assessment? Two specific, and very controversial directly applicable examples of this are where a module is assessed by both a written assignment (perhaps a report) and a presentation. If the student fails the presentation do they fail the module? At a deeper level, if the presentation has a number of assessed components, one of which is the ability to defend their presentation in questioning, and they cannot, should they fail the presentation and/or the module the presentation is part of? In a short survey of academics in the Department of Electronics at York not one academic agreed that the student should fail if they could not defend their presentation – yet in Industry if the employee could not defend their presentation would this be acceptable? Compensation is clearly the academic desired way out here but is it right?

6. Conclusion

This paper does not offer answers, rather it is designed to expose some of the difficult questions that lie beneath the skin of Higher Educations’ part in the development of communications’ ability in students, in particular public speaking. The conclusion reached is that communication is a meta-competence with public speaking as a sub-competence. Academia regularly assesses student ability in public speaking but there are problems in what is assessed and the way in which ability is certified. Even with its experience in assessment, which for technical subjects is very mature, the assessment of public speaking skills is still relatively weak but improving. Industry, as it articulates needs through job adverts, is currently in a very different place to academia with definitions of ability firmly set in subjective adjectives. There is much room for improvement in this subject.

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