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Reflections on Practice

Equipping Our Undergraduates With Essential Generic Skills For Future Competitiveness: Why, What, When, and How?

LAM Siew Hong and Alex IP Yuen Kwong

Department of Biological Sciences, National University of Singapore

Correspondence:

Name: Dr. LAM Siew Hong
Address: Department of Biological Sciences, 14 Science Drive 4, Singapore 117543
Email: dbslsh@nus.edu.sg

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ABSTRACT

Generic skills are transferable skills across disciplines, essential for lifelong learning and are applicable in multiple settings. Graduates with such skills are perceived as being more employable and employers expect university education to produce graduates equipped with these skills. In line with the NUS vision of producing future-ready graduates, a survey and discussion forum were conducted with the participation of academic staff from the Department of Biological Sciences (DBS) at the National University of Singapore (NUS) to examine their perceptions regarding the importance of generic skills, whether our undergraduate students were lacking in these skills, and whether academic staff were teaching these skills. While all participants were in agreement that these skills are important, there were mismatches between the academic staff's perceptions of students lacking these generic skills and their expectations of students learning these skills in the modules they taught. We identified potential teaching and learning challenges of these skills, and further proposed pedagogical solutions and an action plan using an "explicit embedding and bolt-on" approach to address these challenges as well as to enhance the teaching and learning of these essential generic skills to our students.

INTRODUCTION

Generic skills are regarded as a common set of transferable skills that can be applied across multiple settings or contexts, from learning, work, to life in general (Clanchy & Ballard, 1995; Barrie, 2004). Being generic, these skills facilitate undergraduate learning and training across disciplines, and will further equip undergraduate students with lifelong learning skills when they graduate (Murdoch-Eaton & Whittle, 2012). Graduates with these skills and attributes have increased employability as they are perceived by potential employers to be able to adapt, perform and progress better in the modern workplace (Atkins, 1999; Rayner & Papakonstantinou, 2015).

Studies have also shown that employers expect university education to produce graduates with such skills, competencies, abilities or attributes which would ensure that these students would succeed in a globalised knowledge- and innovation-driven economy that is rapidly changing and making similar demands on the skill sets of its workforce (Jongbloed, 2002; Tomlinson, 2008; Sarkar, Overton, Thompson, & Rayner, 2016). A 2016 report entitled *Future of Jobs Report* by the World Economic Forum (WEF) highlighted the changing demands of general work-related practical skill sets and the concerns of employers, in particular whether current employees and prospective new hires had or were able to learn these skills in order to perform tasks successfully (World Economic Forum, 2016a, p. 20). It is therefore a challenge to universities to prepare their graduates, not just to equip them with the generic skills and competencies that are relevant in the workplace but also to ensure that they have the ability to adapt and learn new skills as members of the future workforce.

The development of human resource into a highly skilled workforce to meet evolving socio-economic needs is an issue which is of national interest to Singapore (SkillsFuture Singapore, n.d.). Although there have been discussions in the literature highlighting the concerns on whether higher education should be market-driven and the implications of doing so (Lynch, 2006), the authors of this paper argue that a pragmatic balance should be struck between the roles of higher education in servicing the state economy and in meeting her social responsibilities. This balance would need to be persistently sought after and purposefully maintained. In this context, producing employable graduates

with the cognitive flexibility to learn new skills and adapt cooperatively to changes would serve both the economic and social needs of the nation, especially when confronted with the fourth industrial revolution whereby reskilling and upskilling of the workforce become critical, failing which may result in under-/unemployment and growing social inequality within the society (World Economic Forum, 2016a).

The employability of graduates is a priority for the National University of Singapore (NUS), as reflected by the Times Higher Education's 2016 Global University Employability Rankings which found that NUS graduates were ranked as the 15th most employable in the world, which is an improvement of two positions from the previous year (National University of Singapore, 2017, p. 28). In delivering the 2017 keynote lecture for the Higher Education Policy Institute at the Royal Society in London, Professor Tan Chorh Chuan, then President of NUS, highlighted the "concerns over mismatches between the skills graduates leave university with, and the needs of industry and employers" and emphasised the "need to consider what are the essential skills our graduates need to be successful and employable across a lifetime" ("Asia's impact on global higher education", 2017).

NUS has developed a framework to nurture future-ready graduates with the right mindsets, skills and competencies to increase their employability and to develop successful careers. The framework includes formalised structures such as the Centre for Future-ready Graduates that offers career readiness programmes, and modules within the broader undergraduate curricula that focus specifically on quantitative reasoning, questioning, and communication skills. In addition, there are also non-academic platforms and extra-curricular activities, such as those offered by clubs, societies, student exchange and exposure programmes, which allow students to develop generic skills in residential or non-residential and local or overseas environments. While the existing framework in NUS is extensive, we are in an equally favourable position at the faculty and departmental level to enhance the development of generic skills because as academic staff, we have direct and continuous interaction with the students throughout their undergraduate training. In fact, we have more contact time with students, and are in a better position to systematically provide support for skills development as well as to strategically contextualise the learning of these skills within our curriculum.

SURVEY, FINDINGS, AND REFLECTIONS

In complementing the university's vision to produce future-ready graduates, as the Chair (IYK) and co-Chair (LSH)[1] of the Department Teaching Committee (DTC) in the Department of Biological Sciences (DBS), the authors of this paper conducted an exploratory survey to determine the perception of DBS academic staff on the following:

1. the importance of equipping our undergraduates with generic skills,
2. the lack of these skills in our undergraduates, and
3. the development/requirement of these skills in their modules.

Twenty-six academic staff from DBS participated in the survey, which was followed by a discussion forum which together, helped the authors to gauge the level of interest, identify potential challenges and propose possible solutions in equipping DBS undergraduates with essential generic skills.

The survey was carried out online using the NUS Integrated Virtual Learning Environment (IVLE) platform. The survey was done together with the online registration for a departmental workshop and discussion forum with the theme "Equipping DBS Undergraduates for Future Competitiveness". Email invitations and reminders regarding the registration and participation of the survey were sent to all DBS academic staff three weeks before the event. The survey participants comprised 5 female and 21 male academic staff, and they included 4 professors, 1 professor in practice, 6 associate professors, 7 assistant professors, 3 senior lecturers, 4 lecturers and 1 instructor. Over 30 academic staff attended the discussion forum which examined how they could equip undergraduates with generic skills that would enhance their future competitiveness.

The survey consisted of 4 questions (Q1 to Q4) related to 10 items on skills, abilities or qualities. These 10 items overlapped with some of the 16 literacies, competencies or qualities listed in a 2015 WEF report entitled *New Vision for Education: Unlocking the Potential of Technology* (World Economic Forum, 2016b). Additionally, they were broadly in line with the 6 key skills listed by the UK Assessment and Qualifications Alliance (AQA) (Assessment and Qualifications Alliance, n.d.; Washer, 2007) and the 7 key competencies in the Australian Mayer Report (Mayer, 1992). We summarised the survey findings for Q1 to Q3 in Table 1, while the findings for Q4 were summarised in Table 2. Further reflections on the survey findings and the discussion forum had helped us identify potential challenges and propose possible solutions and action plans highlighted in Table 3.

[1] The Chair (IYK) refers to Alex Ip Yuen Kwong, and co-Chair (LSH) refers to Lam Siew Hong.

Table 1

Generic skills and the perceptions of participants

Generic Skills	Q1* Mean Rating (± s.d.)#	Q2** Mean Rating (± s.d.)##	Q3*** Count (Percentage)###
1. Analytical Skills	4.6 (0.6)	3.4 (0.90)	25 (96.1%)
2. Collaboration Skills	4.5 (0.6)	2.3 (1.01)	17 (65.3%)
3. Communication Skills	4.6 (0.5)	2.7 (1.12)	18 (69.2%)
4. Computer Skills	4.3 (0.6)	2.6 (1.24)	7 (26.9%)
5. Creativity	4.7 (0.6)	3.2 (1.16)	10 (38.4%)
6. Critical Thinking & Problem Solving Skills	4.8 (0.4)	3.5 (0.86)	22 (84.6%)
7. Ethical and/or Civic Awareness	4.4 (0.6)	2.6 (1.14)	11 (42.3%)
8. Independence & Resourcefulness	4.5 (0.7)	3.1 (1.13)	19 (73%)
9. Quantitative Thinking	4.2 (0.7)	3.3 (0.88)	14 (53.8%)
10. Scientific Thinking (Scientific Literacy)	4.2 (0.7)	3.1 (0.95)	25 (96.1%)

*Q1: How would you rank the following abilities and/or qualities in terms of their importance in equipping our undergraduates for their present educational needs and future competitiveness?

**Q2: Which of the following abilities and/or qualities do you find that our undergraduates are lacking?

***Q3: Which of the following skills and/or qualities are developed/required as part of the learning process, objectives and/or outcomes of your current module(s)? (you may choose more than one)

#Likert Scale: 1="Least Important" and 5="Very Important"; s.d.=Standard Deviation.

##Likert Scale: 1="Not Lacking" and 5="Very Lacking".

###Percentage= Number of participants indicate skill required as part of learning in the module taught by them/Total number of participants (*n*=26).

The responses to Q1 indicated that most survey participants rated it "Important" and "Very Important" to equip DBS undergraduates with the 10 skills/abilities in order to meet their present educational needs and future competitiveness (Table 1). When the survey participants were asked in Q2 if these generic skills/abilities were lacking in our undergraduates, 6 of the items ("Critical Thinking & Problem Solving Skills", "Analytical Skills", "Quantitative Thinking", "Creativity", "Independence & Resourcefulness" and "Scientific Thinking") were rated as "Somewhat Lacking" and "Lacking". The remaining 4 items were rated as "Marginally Lacking" and "Somewhat Lacking". In response to Q3, 84.6% to 96.1% of the survey participants rated "Critical Thinking & Problem Solving Skills", "Scientific Thinking" followed by "Analytical Skills" as the top three skills/abilities students had to acquire/develop as part of the learning process, objectives and/or outcomes of their modules.

Upon reflecting on Q1, Q2 and Q3 together, it was noted that "Critical Thinking & Problem Solving Skills" and the related "Analytical Skills", which had a mean rating closer to "Very Important" for our undergraduates (Q1), had been perceived by survey participants as skills which are "Somewhat Lacking" or "Lacking" in our undergraduates (Q2). Perhaps of greater concern, as revealed in Q3, is that 84.6% and 96.1% of survey participants considered these generic skills as being an essential part of the learning process, objectives and⁄or outcomes of their modules. Likewise, this could be said of "Scientific Thinking", albeit to a lesser degree. There are two inferences that we could make from the findings. First, given that most of the survey participants considered these skills as being an essential part of the learning process, objectives and⁄or outcomes of their modules, they would be more perceptive and discerning of their students' abilities; hence, the findings are likely to be more representative. Secondly, if this is the case, we can further infer that either we have not been teaching these skills, or students have not been learning these skills effectively, or both. This could mean that the survey participants assumed that either our students had had prior training in such skills or they had picked up these skills by themselves. However, in actuality, the students might have no prior training and did not possess the intellectual readiness to acquire these skills by themselves, at least not to the level that would satisfy the survey participants' requirements or expectations.

To gain some insights into how these skills were taught or required in the modules offered by the survey participants, we examined their text responses to Q4, as summarised in Table 2.

Table 2

Approaches and/or examples of how generic skills are developed/required in modules

Generic Skills	Q4: How skills are taught or developed in module as learning process/objectives/outcomes?
1. Analytical Skills	Analysis of Datasets (published and unpublished), Critical Reading of Published Article.
2. Collaboration Skills	Group Projects (Research, Making of Short Documentary), Field/Laboratory Practical, Group Debates.
3. Communication Skills	Lecture/Instruction, Project Presentation (Making of Short Documentary), Report Writing, Essay Writing, Peer-review and Feedback Exercises, Debates.
4. Computer Skills	Analysis of Datasets (published and unpublished), Project Presentation.
5. Creativity	Projects and Presentation (Poster & Oral, Making of Short Documentary, Assignment on Create an Invention).
6. Critical Thinking and Problem Solving Skills	Critical Reading & Questioning of Published Article, Research Project, Peer-review and Feedback Exercises, Debates.
7. Ethical and/or Civic Awareness	Lecture/Instruction, Group Discussion, Case Study.
8. Independence and Resourcefulness	Projects (especially research-based).
9. Quantitative Thinking	Lecture/Instruction, Research Project & Practical with Data Measurements, Quantitative/Statistical Analysis of Dataset (published/unpublished)
10. Scientific Thinking (Scientific Literacy)	Lecture/Instruction, Individual/Group Research Project.

The findings reveal that for most of the survey participants, most generic skills which they required their students to develop/acquire as part of the learning process, objectives and/or outcomes in the modules were embedded in project-based assignments. This is not surprising because project works require a range of skill sets to accomplish them. Field and laboratory practicals would also require students to develop/acquire a range of such skills. Additionally, there are learning activities/assignments such as critical reading and questioning of published articles, analysis of datasets, case studies, essay writing assignments, debates, peer-review and feedback exercises that would necessitate the acquisition and application of some of these skills. It would appear that the survey participants employed a host of approaches to teach and develop these generic skills as part of the learning process, objectives and/or outcomes of their modules. However, with reference to responses to Q2, why did most of the survey participants perceive 6 of the skills/abilities to be "Somewhat Lacking" or "Lacking" in our undergraduates? It is possible that there were mismatches

between the survey participants' expectations, the pedagogical approaches employed to train students in these skills, and the intellectual readiness of our students to learn these skills.

POTENTIAL CHALLENGES

In general, there are two approaches to the teaching and training of generic skills i.e. the "embedded built-in" and the "parallel bolt-on" approaches. In the "embedded built-in" approach, the teaching and development of these skills are completely embedded within the modules together with content learning, while the "parallel bolt-on" approach teaches and develops these skills on standalone modules or platforms, running in parallel but separately from content learning modules. The pros and cons of both approaches have been studied and debated, and the "embedded built-in" approach has been perceived more favourably (Cranmer, 2006; Drummond, Nixon, & Wiltshire, 1998; Wingate, 2006).

As reflected in Table 2, the "embedded built-in" approach has been more frequently employed by survey participants to facilitate the training of these skills. While the "embedded built-in" approach has its advantage where the learning of skills are embedded with the learning of discipline-specific content and there is low impact on the curriculum (i.e. there is no need to make extensive changes to the curriculum to teach these skills), students may not be aware that these skills are to be developed as part of the learning process and outcome of the module itself. Being embedded with content learning, the learning of these skills tends to be invisible, untraceable or even un-assessable; hence they can be easily neglected and seen as less important than the content. Students may not be aware of what these skills are, why they are important, when/where they are required and how they can be developed, and therefore lack the motivation and understanding to learn them. Conversely, teaching staff might have assumed that students know them and might not have explicitly explained and communicated the necessary instructions for learning these skills. Teaching staff may not give students adequate and contextualised opportunities to acquire these skills through practice. Consequently, the training and learning of these essential generic skills may not be as effective and hence students may be perceived as lacking or somewhat lacking of these skills.

POSSIBLE SOLUTIONS AND ACTION PLAN

Upon reflecting on the challenges of the "embedded built-in" approach, the authors propose to employ a combination of "explicit embedding and bolt-on" approach. These solutions are highlighted in Table 3.

Table 3

Potential challenges of the present "embedded built-in" pedagogical approach and possible solutions and action plan using the "explicit embedded and bolt-on" approach

Potential Challenges	Possible Solutions & Action Plan
I. What and Why?	
Teaching staff may not have explained what generic skills will be developed in their modules and why learning them are important.	Provide explicit information on generic skills that are taught, developed and their importance as learning objectives and outcomes in the module profile. Such information should also be reiterated during lectures.
Students may not know what these generic skills are, and why they are important; therefore lack understanding and motivation to learn/develop them.	Provide a student handbook, webpage and/or a student learning workshop explaining what these essential generic skills are and why they are important for students, especially freshman.
II. When/Where?	
Teaching staff may not have communicated effectively when/where specific generic skills are required to be learned in specific tasks, exercises or activities in their module.	Highlight explicitly specific learning activities/exercises when/where specific generic skills are developed as learning objectives/outcomes in modules. Requirements and learning of specific skills are explicitly indicated in the project/assignment instruction.
Students may not know when/where they are supposed to learn these generic skills hence did not consciously learn and practice them effectively when/where required in the module.	Provide examples of when/where (e.g. learning activities/exercises) these generic skills are required to be developed in academic settings in the student handbook and webpage.
III. How?	
Teaching staff may not have provided instruction on how generic skills can be learned in specific exercises/activities in their module.	Provide explicit instructions on how specific skills are learned and developed in specific learning exercises/activities during lectures.
Students may not know how to learn these generic skills effectively.	Provide general instruction and resources on how these essential generic skills could be developed in the student handbook, webpage and teaching workshop session.

By using the "explicit embedding and bolt-on" approach, training and learning of these skills would be made more explicit in terms of motivating learning, communicating requirements and providing instruction on what, why, when/where and how these skills should be taught and developed in specific learning activities embedded within a module. The "parallel bolt-on" approach, which involves providing standalone information and/or instructions on these skills

in a module profile or a student handbook or presenting these skills separately in a webpage, e-handbook or delivered in a student learning workshop, can be integrated as a parallel resource to create awareness and provide instructional support to students as needed. They can help students to be affectively aware, intrinsically motivated and cognitively ready for the experiential learning of these skills embedded within the modules.

In using the proposed combination approach, explicit embedding will make the training of such skills more visible, traceable, and possibly assessable. This would help create greater awareness and motivation for the development of these skills among teaching staff and students in DBS, while the additional information and resources would be "bolted-on" in parallel to provide general instructions that facilitate embedding and learning of these skills. It is here that, as a Department, we are in a pivotal position to augment the existing NUS framework in equipping our students with generic skills because we can systematically and strategically contextualise the learning as well as support the development of these skills within our curriculum (as partially listed in Table 2) throughout their undergraduate training. These skills can be developed progressively from content-based modules, taught within the classroom context, to internship- and research-based modules, which would require students to learn and apply these skills within an immersive real-world environment. This will complement other existing platforms of formalised programmes, courses taught in residential colleges, and extracurricular activities, which can occur in an academic or a social setting, in which students are given a much shorter timeframe (1-2 semesters) to develop these skills.

In terms of providing DBS academic staff support for skills development and to strategically contextualise the learning of these skills within the DBS curricula, the Department Teaching Committee can play the following active roles:

1. Create awareness and an environment which facilitates the explicit embedding of "skills learning activities" in modules amongst DBS academic staff (Table 3).
2. Develop "parallel bolt on" resources to explain what, why, when/where and how these essential generic skills are relevant for our undergraduates (Table 3).
3. Develop a simple mapping scheme that will allow students to trace their personal development of these skills so that they can articulate in their CVs/resumes that they have learned certain generic skills through specific learning activities and "brand" themselves during the employment process. This mapping scheme will also help the Department to monitor the development and training of essential generic skills in its undergraduate curriculum.

Finally, to assess and evaluate the impact of the "explicit embedding and bolt-on" approach, small- or large-scale longitudinal studies can be conducted on both students and teaching staff. For smaller scale studies, students' perceptions and academic performance can be assessed before and after taking a module explicitly embedded with generic skills training. Students who acquired the relevant skills would perform better in learning tasks or assignments that require such skills to excel, compared to those who have not acquired them. The larger scale longitudinal study can be conducted to assess the perceptions and confidence of the generic skills that students possessed themselves upon entry into (as freshmen) and leaving NUS (as graduating students). We can also conduct a survey to find out teaching staff's perceptions of these students in terms of the generic skills the latter might possess. If resources permit, a test assessing selected skills can be conducted to provide triangulation of data. If we are more ambitious and would like to determine the longer term impact of such skills development support on employability, we could also track the employment progression of students, starting from their first jobs. It is possible that students who have acquired these skills explicitly would achieve a better career progression over a shorter duration of time (from graduation) compared to those who have not, although such a longitudinal study would require extensive resources and excellent alumni rapport. These are some possible ways that the authors plan to expand on this current study.

ABOUT THE CORRESPONDING AUTHOR

LAM Siew Hong is a senior lecturer at the Department of Biological Sciences, NUS. He is currently the co-chair of the Department Teaching Committee and is involved in several continuing professional development programmes. H e is also interested in equipping students with transferable, essential generic skills for lifelong learning and employability. He has published in various forms; more information can be found at http://www.dbs.nus.edu.sg/staff/lamsh.html.

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