Embedding scientific communication and digital capabilities in Biomedical Science curricula

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Introduction

- Central to biomedical science undergraduate degree programmes are final year research projects to promote the development of research skills.
- Professional bodies such as the IBMS which accredit these degree programmes advocate that the development of key transferable skills should be encouraged including, communication of the specialist subject to a variety of audiences, service users[1,2].
- Communication competencies are required by employers, and regulators such as the Health and Care Professions Council[3].
- It is therefore important that students comprehend the various implications of research findings and be taught why and how the significance of research findings are disseminated, to both the scientific community and the general public.

Objectives of this action research project

(i) co-design an on-line scientific communication and digital capabilities resource, constructively aligned to the learning objectives of a final year investigative research project in part fulfilment of an IBMS accredited undergraduate Biomedical Science degree programme and ensuring resource flexibility for future adaptation by others;
(ii) to embed authentic scientific communication learning assessments, i.e., preparation of lay summaries & visual abstracts;
(iii) to promote students' awareness of developed capabilities and transferable skills through written reflection

Methods

- Student experiences and performance were evaluated by a mixed methods approach.
- Qualitative data- focus sessions, free text responses within questionnaires & content analysis of students' written reflections (n=104).
- Quantitative data- 5-point Likert responses within student questionnaires (n=31) & analysis of student lay/scientific writing (n=146) using the readability parameters Flesch-Kincaid Grade Level and Flesch Reading Ease (Readable software readable.com)
- Non-parametric statistical methods (Kolmogorov-Smirnov test , Wilcoxon signed-rank test, Pearson correlation) (p=<0.05).

(This research was reviewed and approved according to Ulster University procedures for research involving human subjects (CHERP-20-002-A).

Results

- A learning resource was co-designed & created involving multiple stakeholders (see right)
- Students prepared aesthetical and informative visual abstracts (Figure 1).
- Students' lay summaries were statistically (p<0.0001) more readable than their paired scientific abstracts and comparable to scientific abstracts and lay summaries in the *Journal of Cystic Fibrosis*[4] and its sister lay journal *CF Research News*[4] (Table 1).
- There was a significant correlation between easier readability of lay summaries and awarded marks for the written elements of the module (Table 2).
- Students reflected on 21st Century[5] & discipline specific skills which they developed (Figure 2).
- Students reported their digital and communication capabilities & confidence increased significantly (p<0.0001) (Figures 3-5).

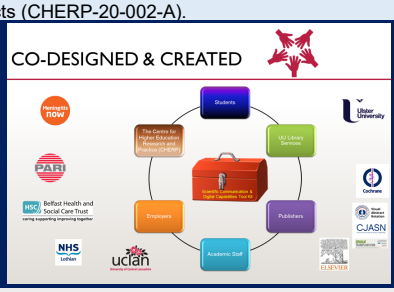


Table 1: Readability analysis of scientific & lay abstracts

Scientific abstract Range 15-18 / Lay summary Target 60	Flesch Reading Ease (FRE) (mean±SEM)	Median	Range
Scientific Abstract (Student) (n=146)	20.3±1.1	20.7	-57.9 – 45.8
Lay summary (Student) (n=146)	47.1±1.0***	47.0	-4.1 – 74.1
Scientific Abstract (Journal paper) (n=104)	25.2±1.1	25.9	-5.0 – 56.2
Lay summary (Journal paper) (n= 104)	43.3±1.0	43.9	11.4–43.9
Scientific abstract Range 12.6- 25.6 / Lay summary Mean 17.3 Target 8	**Flesch-Kincaid Grade Level (FKGL) (mean±SEM)**	**Median**	**Range**
Scientific Abstract (Student) (n=146)	16.4±0. 3	16.1	10.9 – 50.1
Lay summary (Student) (n=146)	10.7±0.2***	10.8	6.2 – 20.6
Scientific Abstract (Journal paper) (n= 104)	14.1±0. 2	14.0	9.2 – 8.4
Lay summary (Journal paper) (n= 104)	11.7±0.1	11.6	8.1 – 16.3

Figure 1 : An example of a student's visual abstract

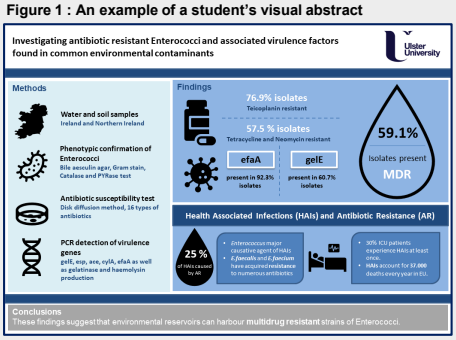


Figure 2 : Students' reflection on skills development

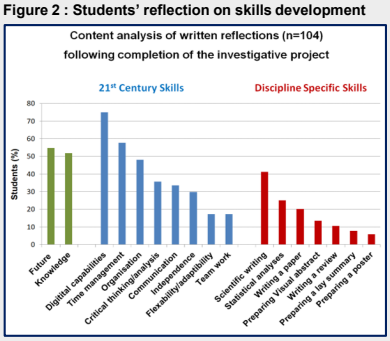


Table 2: Statistical analysis of writing lay and scientific abstracts and marks

Pearson Correlation *Correlation significant at the 0.05 level (2-tailed) **Correlation significant at the 0.01 level (2-tailed).	Flesch Reading Ease (SCI)	Flesch-Kincaid Grade Level (SCI)	Flesch Reading Ease (LAY)	Flesch-Kincaid Grade Level (LAY)	Review	Dissertation	Supervisor Mark	Poster
Flesch Reading Ease (SCI)	1.000	-.832**	.335**	-.270**	-0.100	0.019	-.187*	-0.013
Flesch-Kincaid Grade Level (SCI)	-.832**	1.000	-.170*	.225**	-0.065	-0.152	0.109	-0.097
Flesch Reading Ease (LAY)	.335**	-.170*	1.000	-.881**	-0.005	0.145	0.104	0.062
Flesch-Kincaid Grade Level (LAY)	-.270**	.225**	-.881**	1.000	-.172*	-.263**	-.202*	-.231**
Review	-0.100	-0.065	-0.005	-.172*	1.000	.663**	.442**	.540**
Dissertation	0.019	-0.152	0.145	-.263**	.663**	1.000	.407**	.661**
Supervisor Mark	-.187*	0.109	0.104	-.202*	.442**	.407**	1.000	.435**
Poster	-0.013	-0.097	0.062	-.231**	.540**	.661**	.435**	1.000

Figure 3 : Students' (n=31) confidence in relation to acquired skills

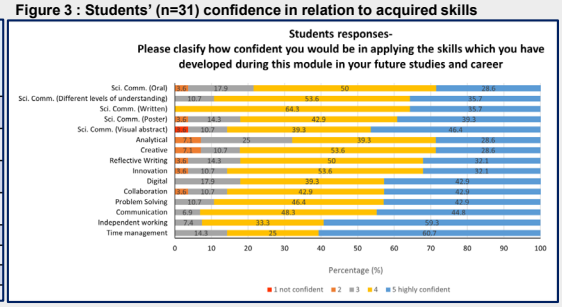


Figure 4: Student reflection-Digital capabilities developed as defined by Jisc[6]

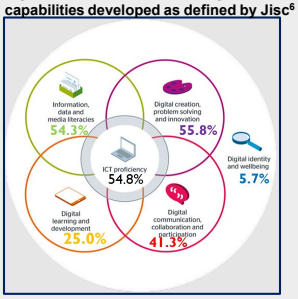
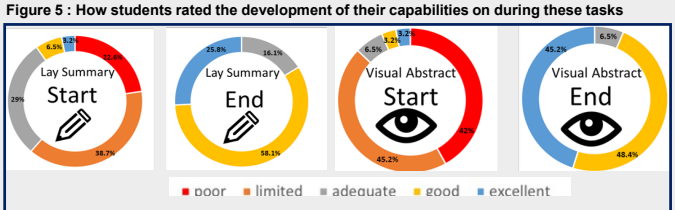


Figure 5 : How students rated the development of their capabilities on during these tasks



Conclusion

This project has enabled students to successfully develop, appreciate and use varied approaches to scientific communication to articulate research findings. Competency in digital skills and other transferable skills were developed. The dissemination of the evaluations of this project has resulted in staff adapting and embedding elements of the on-line resource and learning activities throughout all levels of higher education as well as other institutions delivering undergraduate biomedical science programmes.

[1]Institute of Biomedical Science (2021)https://www.ibms.org/resources/documents/criteria-and-requirements-for-the-accreditation-and-re/ [Accessed 10 Feb 2022]; [2]Quality Assurance Agency for Higher Education (2019) https://www.qaa.ac.uk/docs/qaa/subject-benchmark-statements/subject-benchmark-statement-biomedical-sciences.pdf?sfvrsn=2bf2c881_4 [Accessed 10 Feb 2022] [3]Health and Care Professions Council (2014) https://www.hcpc-uk.org/resources/standards/standards-of-proficiency-biomedical-scientists/ [Accessed 10 Feb 2022]; [4]Anderson HL, et al. (2021) J Cyst Fibros. 2021;S1569-1993(21)01414-4. doi:10.1016/j.jcf.2021.09.009
[5]World Economic Reform (2015) http://www3.weforum.org/docs/WEFUSA_NewVisionforEducation_Report2015.pdf [Accessed 05 Feb 2022]; [6]Jisc (2019) https://repository.jisc.ac.uk/7278/1/BDCP-DC-Framework-Individual-6E-110319.pdf [Accessed 10 Feb 2022]