

EXPANDING BIOINFORMATICS SKILLS IN UNDERGRADUATE AND POSTGRADUATE CURRICULA TOWARDS EMPLOYABILITY



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INTRODUCTION

Large biological consortia have generated a huge amount of biological data (i.e DNA and protein sequences) at exponential rate which requires powerful computational resources as local servers or as web interfaces in order to extract and re-use biological information for research applications.

For these reasons, bioinformatics knowledge on how to extract and analyse data is in high demand [1] and gradually becoming part of undergraduate and postgraduate curricula nationally and internationally [2].

Python is on of the most used programming languages in the UK in universities and courses [3] and Biopython is the collection of Python tools specifically designed for biology [4].

I have been involved in enhancing the bioinformatics content at NTU for the UG Bioinformatics module (BIOL33221 and for the PG module Tehcniques in Macromolecular Analysis (BIOL40251).

RESULTS

The curricula of UG modules BIOL33221 and PG module BIOL40251 in the academic years 2020/2021 and 2021/2022 were modified to include respectively 3 hours and 6 hours tutorials of 1 hour each integrating fundamental theory (15 min) followed by interactive in real time usage of the Programme PyMOL.

The PG students were given examples from the on-going SARS-Cov2 pandemic (Fig.1) in order to showcase the capabilities of the program and contextualise to the science being developed during the pandemic.

The UG students were given examples of visualising the cancerogenic protein PINK1 (Fig.2) which was linked to previous genetic analysis in the first part of the module.

The final assessment included: data retrivial from databases and data analysis via web interfaces, to produce publication quality images using the full functionality of PyMOL (Fig.1 and Fig.2).

The changes of the curriculum for the Degree of Biochemidtry have become a permanent componend of the Degree after accreditation in May 2022 from the Royal Society of Biology.

IMPACT

Given the positive feedback from the students, the new material has been permanently included in the curricula of the UG and PG modules and received accreditation from the Royal Society of Biology for the Degree in Biochemistry in May 2022 .

The usage of the program PyMOL will also be extended to produce 3D printed models of biological molecules to allowed interaction in the classroom and convey biological information (i.e. vaccine design strategies).

NTU Teaching grant (15K GBP) was awarded to add another program in the training list (Biorender) and to purchase two 3D printers to take the PyMOL program applications to the next level.

This work was part the project which, was commended for the NTU Vice-Chancellor's Award for Excellence in Teaching.

REFERENCES

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OBJECTIVES

To include more fundamentals in computer skills in the UG curriculum (i.e. working with the terminal and using simple Python language commands).

To expand the bioinfotmatics offer by showcasing its applications to Life Sciences as case studies during module delivery.

To enhance the student experience by learning how to produce independently images of publication quality using novel programming skills via terminal and graphic user interface (GUI) with PyMOL [5].

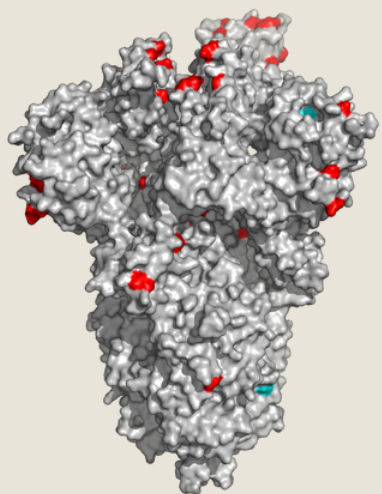
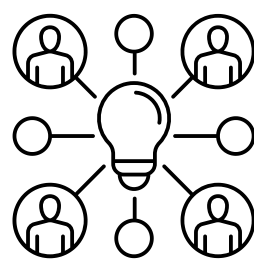
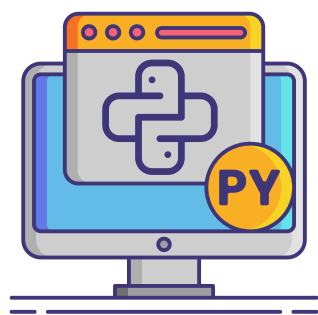


Fig.1 Mapping of Omicron mutations (red) on the SARS-Cov-2 S protein (grey surface) produced by the MSc students using PyMOL.

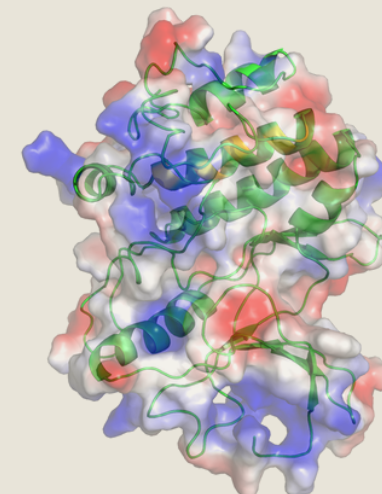


Fig.2 Overall structure of protein PINK1, produced by BSc students using PyMOL.

METHODOLOGY

Coordination with colleagues teaching related topics from year 1 to year 2 to create a IT and bioinformatics skills development plan.

Introduction of basic knowledge of Python 3.0 programming language in the curriculum and monitoring of the real time student engagement with Mentimeter.

Introduction of the usage of the Python-based graphic program PyMOL as a combination of traditional lectures and practical interactive tutorials with in person and remote deliveries.

Assessment of the new learned skills via examination.

ANALYSIS

Student feedback was collected using NTU survey tool MySay and was overall very positive, with the TMA module achieving the highest score since introduced as part of the curriculum in 2010.

PG student satisfaction 96.4%

UG student satisfaction 4.5/5.0



STUDENT FEEDBACK

"I really enjoyed the content and I think the teaching staff made a really engaging online learning space. I found it easy to contact the teaching staff and feedback and additional information for the course was made readily available. I enjoy the mini class tests to help considerate knowledge".

"The assessment types are incredibly useful I personally think they really help to deepen our understanding of the field."

"I like the new content studied, and that it is something we have not covered before"

MY TEACHING PHILOSOPHY IN A NUTSHELL

My teaching philosophy was based on providing essential knowledge to the students to enable them to use a new programming language (Python) and a new graphic software (PyMOL) independently demystifying the need of high level computer literacy to use them. The new concepts were then consolidated with group activities, interactive workshops, lectures and Q&A sessions to enable the students to explore the potential of the learned skills leaving space for their creativity (Fig.3).

Criteria met:

- TS. K.1
- TS. K.2.
- TS. K.3.
- TS. K.4.
- TS. S.3.
- TS. S.4.
- TS. S.5.

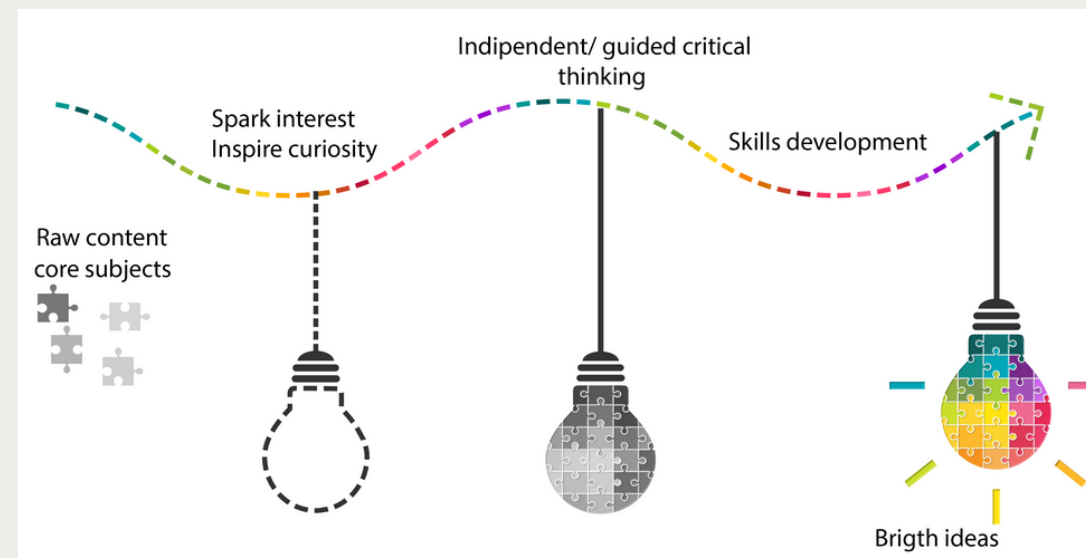


Fig.3 Teaching philosophy overview.

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Dr Ben Dickins (NTU), module leader for BIOL3322 and Dr Philip Bonner (NTU), module leader for BIOL40251. Practice & Scholarship Group at NTU for APA/PGcert training.