Final Report for NV faculty "Innovative Undervisningsprosjekt" Integrating Statistics Teaching into the Biology Curriculum

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Results the project has achieved

The aim of this project was: **To improve student abilities to correctly assess and apply statistical methods as an integral part of their biological work.** With the funding from the NV faculty, we have begun this process.

Since Autumn 2019, we have focussed on a resource building phase of the project. Here we have been developing webpages in collaboration with the SFU – bioCEED at the University of Bergen. Alongside the resource development, we have also been working to restructure the teaching of a key statistics course for biologists and biotechnologists (ST2304). We have moved the focus of this course away from long classical lectures to a more flipped-classroom design focussing on group work and exercises supported by modules containing background theory. This sets up a good foundation to be able to move the content of this course to sit alongside different biological courses as each self-contained module can act as background theory for each statistical analysis. Eventually, the content from these modules will be added to the resource website so students can navigate it for themselves.

<u>During this phase we have completed:</u>

- 10 completed or nearly completed web pages. 5 from NTNU, 5 from Bergen. (see Figs 1 & 2 and attached example – simple-linear-regression.html).
- ST2304 moved completely into modules and mini-lectures (videos). Ready to be flipped classroom/on the web. In the future we can then take each module and link to one or more biology course practical exercises (example – https://www.math.ntnu.no/emner/ST2304/2020v/Week12/Binomial_GLM_module.html).
- Problem-based exercises with student reflection to develop evaluative judgement. This format that can thus be used as basis for write ups of biology practical classes. (example – https://www.math.ntnu.no/emner/ST2304/2020v/Week08/Exercise6_2020v.html).

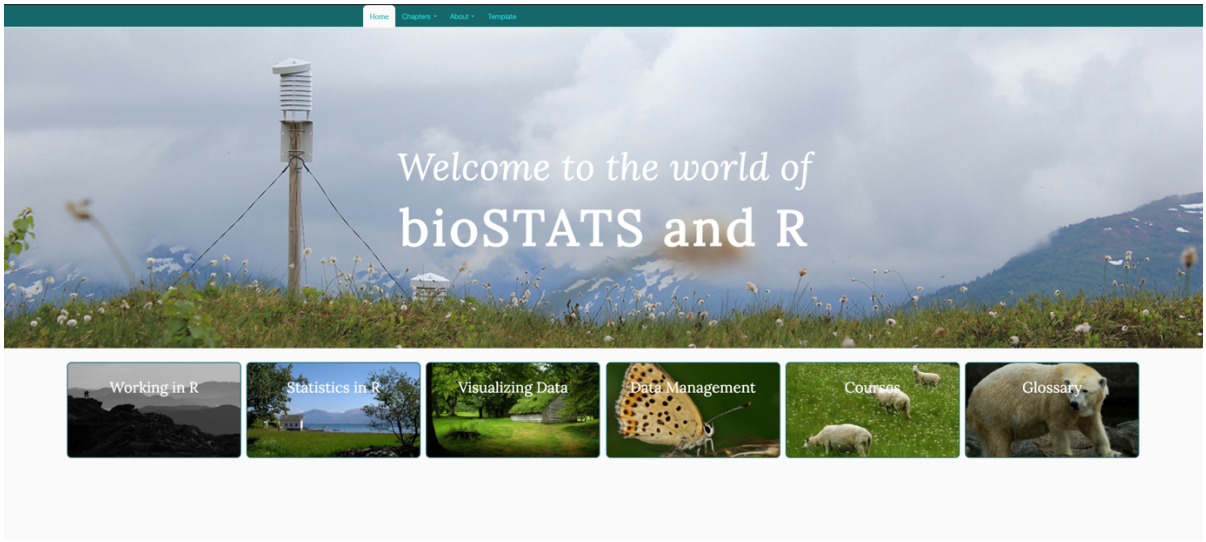

Figure 1: Example of the webpage home screen

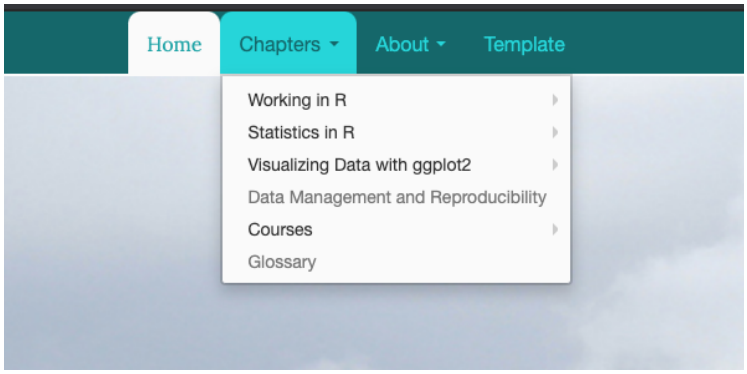

Figure 2: Example of the chapter menu for the website

What has been learned from the project

What has been learned	How would we address this in future work?
Webpages can take some time to refine and finalise, and this is especially the case when in collaboration with many people involved that need to agree on style and content. However, working in collaboration also helps to create more pages more quickly due to combined effort.	Agreeing on styles and modes of working ahead of time is essential. Clear and repeatable instructions for all involved. Focussing effort early to get as much content produced as possible and then having a smaller team work on refining pages could be most efficient.
Having dedicated person to cover the technical side of things (e.g. manage the website) is really important. While postdocs and PhDs can create content for the pages, linking them altogether as a single page takes extra expertise.	We have had access to such a person through the collaboration with bioCEED. But specific funding for a technical role in future NTNU work would be beneficial.

Involving the biology core subjects in this initiative requires dedicated effort and dialogue.	Budgeting specific time and a role to start communication with a broad group of biology teachers would be a great next step for this project. This role should identify their needs, doubts, worries, and come up with a constructive way to use our resources to best meet these.
Students seem to very much like the modules and active way of learning. All the active methods were by far most popular last year and we can see them learning better (see Figures 3 & 4).	In order to link these quantitative modules to biology classes, it is essential to still create the time and space needed for students to work together on the problems with assistance of teachers and assistants.
Some theory elements still need support, but this can be student directed - i.e. the students can always request an extra lecture on certain issues and aspects of statistical theory.	Some lectures and videos were still very popular, especially for difficult core conceptual theory. Therefore, space should also be given for these types of sessions to support the independent student group learning.

How can this pre-project help to develop further ideas that can contribute to increased learning outcomes among students

- The work forms a basis to extend quantitative methods teaching across the whole of the biology curriculum, with a standardised way of covering all such topics from within strong biological contexts.
- It should thus cement the learning for students, improve retention and relevance of these quantitative skills.
- This approach can also be used for masters and PhD courses, etc.

Figures 3 and 4 (below) highlight the popularity among our students for this move to using class time for group exercise work (exercise modules) and mini-lectures. This outcome was a key use of our funding from NV faculty.

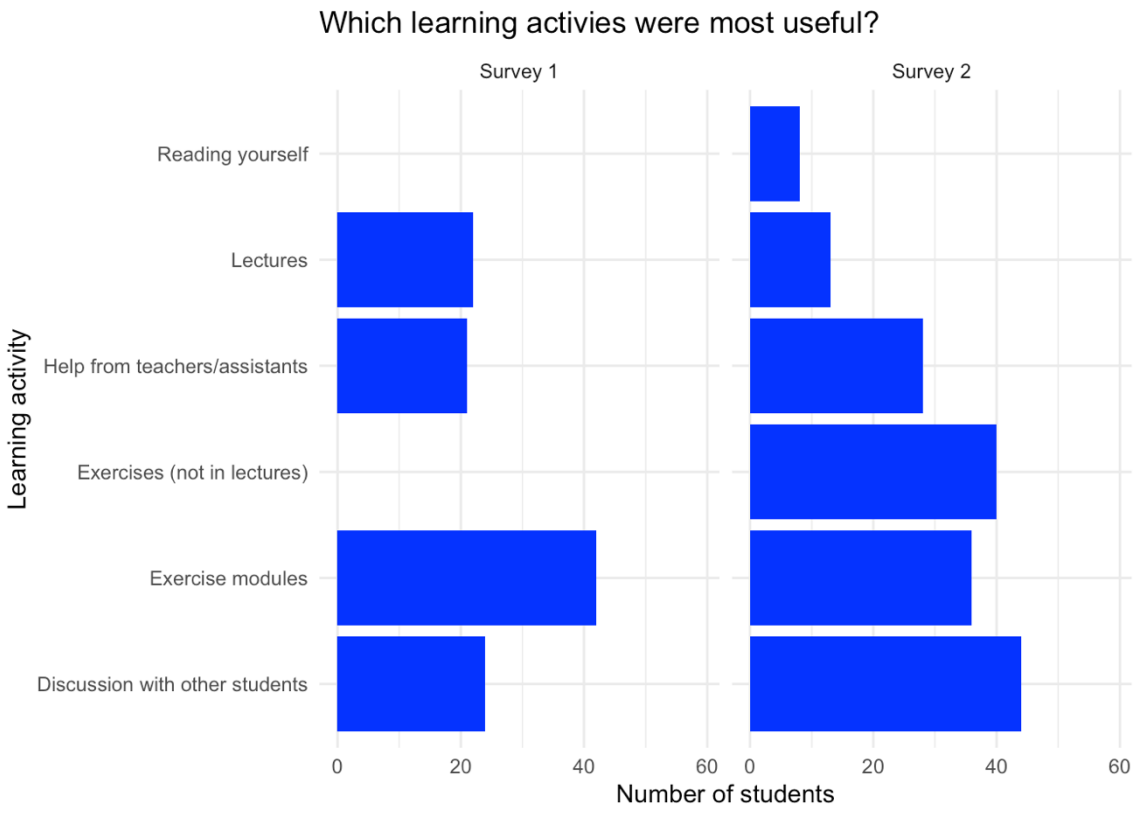

Figure 3: Results of two surveys of students' preferred learning activities (49 and 59 respondents respectively). All active learning elements (exercise modules during class time, exercises outside of class time, discussion with students) were substantially more popular than classic styles of lecturing or reading alone.

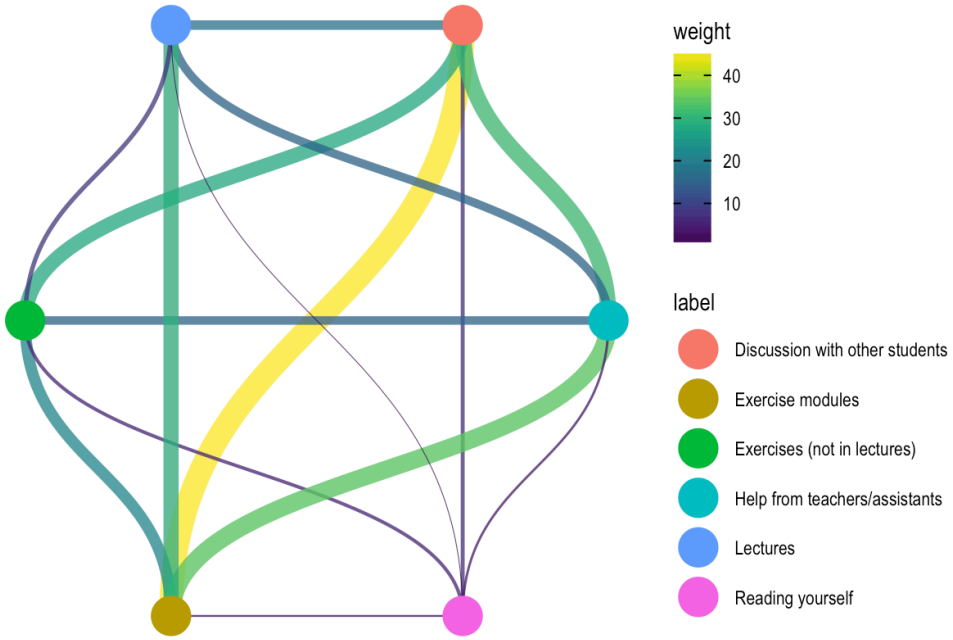

Figure 4: Network map of connections between different preferred learning activities. The selection of preferred learning activities was not mutually exclusive. This figure shows the strongest connection (greatest number of students that selected both activities) were 'discussion with students' and 'exercise modules'.

Financial status – project number 70442809

Funds were spent exclusively on hours for the coordinator (Emily) and PhD candidates (Kwaku and Safa). Most of the money was spent in this way on producing content.

Time	Task	Person	Cost	Total (nok)
Nov 2019	Hours for content creation	PhD student Kwaku Peprah Adjei	350 NOK/hour	19 167.72
2020	Hours for coordination of project, content creation and content moderation	Førstelektor Emily Simmonds	1.5 months salary	95 234.12
Feb 2020	Hours for content creation	PhD student Kwaku Peprah Adjei	350 NOK/hour	28 083.00
Nov 2020	Hours for content creation	PhD student Safa Chaabani	350 NOK/hour	28 700.00
Nov 2020	Hours for content creation	PhD student Kwaku Peprah Adjei	350 NOK/hour	28 700.00
			Total	**199884.8 NOK**