OER authorship as a project-based graduate course

OER authorship as a project-based graduate course

Kim Cuddington1 (kcudding@uwaterloo.ca), Debora Andrade-Pereira1 (d4andradepereira@uwaterloo.ca), Eddie Wu1(jiayi.wu@uwaterloo.ca) and Zitao He2 (zitao.he@uwaterloo.ca)

1 Department of Biology, University of Waterloo 2 Department of Applied Math, University of Waterloo

· Proposed length of the session: 15 min pre-recorded presentation (~15 slides)

OER creation as a course-based project for graduate classes

Course-based OER projects for undergraduate and graduate classes

Trust, T., Maloy, R. W., & Edwards, S. (2022). College student engagement in OER design projects: Impacts on attitudes, motivation, and learning. *Active Learning in Higher Education*, 14697874221081454.

- ▶ this approach seems to be a variant of course-based research

Course-based research

- whole classes of students address a research question that is of interest to other scientists or community members (Auchincloss et al. 2014).

- engage students in active learning through real-world meaningful outcomes.

- examples of course-based research at undergraduate (item) and graduate level
https://taylorinstitute.ucalgary.ca/sites/default/files/Resources/Course Design/CURE-Examples-2019.pdf
https://serc.carleton.edu/curenet/collection.html

Key features of course-based research

- **offer opportunities for students to make discoveries that are of interest to stakeholders outside the classroom (e.g., the broader scientific community).**
- students' work is iterative, meaning that students must trouble-shoot, problem-solve, and repeat aspects of their work for the research to progress.
- offers opportunities for students to communicate their research results to those stakeholders.
- new research questions and directions are generated each term and the course is unlikely to look the same from year to year.
- students may engage in a range of science practices such as collecting and analyzing data, building and defending arguments, and collaborating with one another and more experienced scientists.

Advantages of course-based research (see Dolan 2016)

- ▶ were developed at an undergraduate level to allow scaling of the usual mentor-based research experiences to the large enrollments typical in some STEM programs such as biology
- ▶ increased self-efficacy in scientific work
- ▶ increased motivation because of the involvement with a real research problem,
- ▶ iteration and productive failure: students learn by trying, failing, and trying again

Course-based research or projects for graduate classes

- ▶ not much documentation at the graduate level, more examples of OER course projects
- ▶ e.g.

Jacobsen, M., McDermott, M., Brown, B., Eaton, S. E., & Simmons, M. (2018). Graduate students' research-based learning experiences in an online Master of Education program. *Journal of University Teaching & Learning Practice*, *15*(4), 4.

Zapata, G. C. (2020). Sprinting to the finish line: The benefits and challenges of book sprints in OER faculty-graduate student collaborations. *International Review of Research in Open and Distributed Learning*, *21*(2), 1-17.

How does a project-based course differ from a typical graduate course in biology

- typically two types of courses: 1. reading or literature review 2. techniques (e.g., stats)
- reception of content
- application of skills
- project-based course will require both 1 and 2 , but in addition will require other skills not specific to the course (e.g., data collection and cleaning)

Using OER creation as a course-project

- Shifting students' roles from consumers to curators and creators of OERs (Trust et al. 2022)
    - increased motivation,
    - improved attitudes about learning,
    - aided the achievement of course learning objectives, and
    - supported the development of other valuable skills

BIOL 652 project: Create an OER resource on structured population modelling

- ▶ the first author (instructor) proposed a course project of creating an OER resource
- ▶ could benefit other biology graduate students and early career professionals anywhere on the globe,
- ▶ would be a permanent record of scholarship,
- ▶ might provide incentive for students to more thoroughly engage with the material.

BIOL 652 Course design

Relevance - the OER nature of the product means that the students are producing educational products rather than simply receiving information - public nature of the material, and its potential use by others may serve as incentive to produce high quality work

Iteration - opportunity for formative comments from instructor and peers - present outline of topic area in slide presentation - incorporate input in revision to online text version of content - final round of revision following review of text materials by instructor and "lead" on that content section

Ownership - one student acts as project lead on each major content section, provides outline, divides material among other students, and provides feedback on written sections

Specific output

- ▶ an online e-text (see draft at https://www.ecotheory.ca/teach/BIOL652.html)
- ▶ with embedded R code and examples

Connecting Theory, Research, and Application

Snapshot of study

Picture of organism

How to model population dynamics

Model projections

In our educational material, we are developing sections dedicated to illustrating how a recent publication has applied population ecology theory to tackle ecological problems such as biological invasions or extinction risk

These sections are composed by a short description of the publication, an illustration of the concerned organism, codes using published population data and equations to create models, and plots providing model projections for that given population

Applying Theory to Understand Big Problems

Illustration of current application

Ecosystem effects of the world's largest invasive animal (Shurin et al., 2020). This research paper discusses population dynamics of invasive hippos in Colombia.

Snapshot of the study

- An invasive population of hippopotamus (*Hippopotamus amphibus*) is showing an exponential growth in Colombia
- These three mammals were brought from Africa to the famous drug trafficker Carlos Scobar's private zoo ab...

```
# To predict population sizes, we first set our initial population size
initial<-hippopop_size[1]

# And we create an empty vector in which we will later include population sizes for the
# next 50 years
pred.pop.expon<-vector("numeric", 50)

# Our modelling starts with initially observed population sizes
pred.pop.expon[1]<-initial

# And we add a function to calculate population sizes according to our previously
# estimated growth rates
for(i in 2:50){
pred.pop.expon[i]<-pred.pop.expon[i-1]*lambda
}
```

Exponential growth model of invasive hippos in Colombia
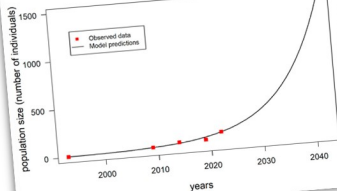
One of our examples describes how an exponential growth of invasive hippo populations in South America is threatening aquatic systems due to the overload of organic matter they bring.

Improving Learning Through Case Studies

Illustration of current application

Density-dependent condition and growth of invasive lionfish in the northern Gulf of Mexico (Dahl et al., 2019). This research paper discusses how increasing population density can affect the condition and size-at-age (growth) of invasive lionfish.

© Bernard Dupont Red lionfish

Snapshot of the study

- Indo-Pacific red lionfish (*Pterois volitans*) have invaded the Gulf of Mexico over the past 30 years. Their invasion success is likely due to a release of predation pressure in the novel environment.
- Their invasion poses long-term threats to the native communities by altering trophic structure through direct predation, and reducing species richness.

```
Calculate the population growth of invasive lionfish
# First, let's create a data frame containing population counts as in Dahl et al. (2019):
lionfish <- data.frame(year = c(2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017),
        density_natural = c(0, 0.02, 0.15, 0.49, 0.57, 0.34, 0.43, 0.56),
        density_artificial = c(0, 2, 6, 14.7, 32.98, 30.5, 20.45, 32.98))
# We can plot the population trajectories for both populations inhabiting natural and
artificial reefs:
par(mfrow=c(1,2))

plot(lionfish$year, lionfish$density_natural, type="o",
    pch=16, lwd=1.5, bty="l", cex.lab=1.2, cex.main=0.8,
    main="(a)",
    xlab="years", ylab="population size")
plot(lionfish$year, lionfish$density_artificial, type="o",
    pch=16, lwd=1.5, bty="l", cex.lab=1.2, cex.mai...
    main="(b)",
    xlab="years", ylab="...
```
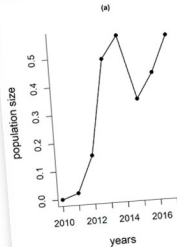
Another example focused on invasive lion fish, which threatens the biodiversity of invaded areas, shows that the number of lion fish living at the same time controls the population sizes for this species, which has implications for management actions

Perceived difficulties: Jan 2023 - Now

- ▶ Overwhelmed by multiple skills/requirements
  - ▶ the course topic, population modelling, requires programming, mathematical and statistical skills in addition to conceptual and quantitative content
  - ▶ combining all this with an additional task of formatting materials for OER presentation
- ▶ completing assignments which involve teaching others requires reading and summarizing far more literature than an ordinary course with curated materials.

Perceived benefits: Jan 2023 - Now

- ▶ the curation of the OER materials on github using markdown format seems an important additional training component that directly relates to needed skills in open science and file versioning
- ▶ the development of additional teaching skills, such as the need to identify with learners that are less familiar with the topics in order to simplify and organize the materials

Brown, B., Jacobsen, M., Roberts, V., Hurrell, C., Neutzling, N., & Travers-Hayward, M. Open Educational Practices Create Conditions for Developing Research Skills in Graduate Education. *Online learning and teaching from kindergarten to graduate school*, 457.

Coding skills developed from the OER experience
Graphic skills

- ▶ Graphs and figures are provided in many section for demonstrating some important concepts.
- ▶ The process of re-creating the graphs through code deepens the understanding of the material.
- ▶ Better formatting and visualization for the audience.
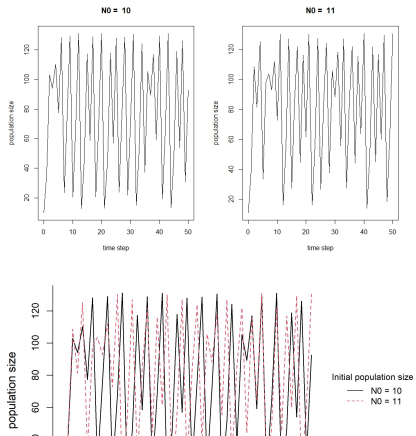
Summary

- this OER project course may have added benefits in developing professional skills related to teaching, literature review, and open science practices, beyond the stated learning objective of developing mastery in population modelling
- however, there is a workload cost associated with these benefits

Would I do this again? Instructor

Would I do this again? Students