Doing Methods, Learning Methods: Report on a Pilot Project using Portfolio-type Assignments in Advanced Statistics Courses in Sociology

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ABSTRACT

This report evaluates the opportunities for activating MSc sociology students in advanced statistics courses using a portfolio-type assignment that spans most of the semester and runs concurrently with regular course activities. The project's key aim is to engage students in such a way that they appropriate the criteria of evaluation implied by the course aims and become aware that they have the responsibility to apply these criteria to promote their own learning. The project's aims should be viewed in relation to the nature of advanced statistics classes in sociology, which involve a strong "barrier of authority" between students and teachers. To break this barrier and build authenticity, I design the assignment to mimic the steps of a real research project. The assignment should consequently foster independence and promote a deep learning approach among students. I critically evaluate the outcomes of the pilot project using observations from my supervisors, student interviews, and personal observations. I conclude the report by making recommendations for future adaptations of portfolio assignments in advanced methods courses in sociology programs.

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INTRODUCTION

This study examines the potential benefits of using portfolio-type assignments in an advanced statistics course in the Department of Sociology, University of Copenhagen. To meet this goal, I describe and critically evaluate the process through which I implemented a portfolio-type assignment in a MSc-level course on advanced regression models in the Fall of 2014. The overall purpose of this teaching-learning activity (TLA) is to facilitate students' learning in accordance with the intended learning outcomes (ILO) of the course. These ILOs stress both the interpretation of statistical parameters and the logic of social inquiry implied by the use of the models in sociological research. To promote students' development in these areas and develop their independence as learners, I constructed an authentic assignment that paralleled the phases of a real research project using the statistical models in the course. The assignment consisted of several steps that involved basic data coding, identifying questions to be answered using the statistical models, drafting preliminary analyses, and receiving and giving feedback on the analyses.

My overall evaluation of the pilot project is positive. Students engaged actively in the project, reported that they improved their mastering of the subject matter, experienced a transformation of their understanding of sociological problematics in terms of quantitative methodology, and found the assignment to prepare them well for the final exam. Nevertheless, there is still room for improvements. Most importantly, students expressed the need for (even) more independence with respect to actively setting evaluation criteria for giving and receiving feedback.

This report is structured as follows. First, I provide reasons for adopting the portfolio assignment as a TLA in my course. These reasons are both theoretical, reflecting my assumption about human learning, and practical, reflecting the learning culture in stats courses in the Department. Second, I describe how I designed the project process and give arguments for why I adopted the particular design. Third, I evaluate the outcomes of the TLA, using my own observations, observations by my teaching supervisors, and student feedback from a student group interview. Fourth, I conclude my study by giving inputs to how to develop future portfolio assignments in my department.

BACKGROUND

Activating students is a core concern in university teaching today—and for good reasons. Providing students the means to become self-regulating learners goes beyond conventional lecturing that emphasizes one-directional communication from teacher to student (Trigwell, Prosser, and Waterhouse 1999). As the Kentucky Department of Education concluded in

their study of effective learning, creating supportive learning environments in which students are active participants who take on the responsibility to learn is key to improving learning.[1] However, because teaching always involves tacit assumptions about the nature of the teacher-student relationship (Ulriksen 2009; Entwistle, undated), I first explain my epistemological approach to the project. I view MSc students in our Sociology program as independent learners who actively construct and reconstruct knowledge in light of their existing stock of knowledge and modes of understanding. From this social-cognitive perspective, I view my role as a teacher in advanced stats classes as a person facilitating students' *appropriation* of the methods taught in the course. By "appropriation," I refer to MSc students' integration of advanced methods into their existing understandings of statistical models and their use in sociological analyses (Rogoff 1995). By this token, facilitating students' appropriation amounts to facilitating and aiding a deep learning approach among students (Biggs and Tang 2011; Entwistle 1988; Ramsden 2003).

Teachers can support students' appropriation by various TLAs. Nevertheless, my belief, which grows out of five years' experience with teaching advanced statistical methods in higher education, is that building an understanding of the underlying logic of any statistical method is key to students' learning. It supports deep learning by developing the capacity of students to view sociological problems and problematics in ways that were inaccessible prior to the course (Meyer and Land 2006). Moreover, building such capacity takes practice—a lot of practice. Therefore, I argue that *doing methods* is a prerequisite for *learning methods*. By "doing methods," I refer in this context to a set of related TLAs that all promote learning by allowing students to analyze real data using the statistical methods. In my previous teaching over the years, I have implemented "doing methods" via an extensive set of practical exercises that involve estimating and interpreting the parameters of statistical models. Because the estimation and interpretation of these parameters are a core ILO of the course and part of the criteria used for assessing the students at the exam, this TLA is constructively aligned (Biggs and Tang 2011:95ff).

Despite the advantages of using practical and constructively aligned exercises in my teaching, these exercises have their limitations. Most significantly, students may view practical exercises that asks students to run statistical programs and report on the output as artificial, potentially causing not only a disjuncture between the TLA and the ILOs but also incentives for adopting surface learning approaches. Furthermore, these exercises may conform to a learning culture that involves a strong barrier of authority between students and teachers; that is, a relationship in which the teacher often is the expert with the "final say" in terms of contents and understanding. In my department, this learning culture is particularly strong in statistics courses, and it is so for at least two reasons. First, being based on

[1] See Kentucky Department of Education, 2015, Web (visited June 1, 2015): http://education.ky.gov/curriculum/standards/teachtools/Pages/Characteristics-of-Highly-Effective-Teaching-and-Learning-%28CHETL%29.aspx.

mathematics, statistics have a series of well-defined rules and procedures that leave little room for interpretation. This feature of statistics stands in a strong contrast to most other sociology courses in which negotiating interpretation is a usual practice, and it may thus perpetuate the expert role of the teacher. Second, in the introductory courses to statistics at the BSc level, students are generously supported in their learning by additional supportive classes and a solid network of skilled teaching assistants. While such support is laudable and important in many respects, it runs the risk of habituating students to a high level of support. This institutional setup therefore reinforces a learning environment that delegates little responsibility to students, thereby helping to maintain a barrier of authority.[2]

To deal with these challenges and break the barrier of authority, I developed a portfolio-type assignment that ran parallel with my course on multilevel models, a class of advanced statistical models, in the Fall of 2014. The assignment mimics a real research process that involves several steps in which students are activated in terms of making independent choices and seeing those choices through. Moreover, the assignment not only engages students in an authentic activity but also give them the opportunity to continually reflect on their own performance and learning using both peer and teacher feedback. Therefore, my overall expectation for this pilot project is that, being an authentic research-based inquiry, it would benefit student learning (Healey 2005). In what follows, I describe the design and provide arguments for adopting this particular design. I later return to a critical evaluation of the pilot project.

ASSIGNMENT DESIGN

A portfolio usually refers to a selection of a student's documents compiled over time and used for assessing performance and progress. In my implementation, I use the portfolio in a more restricted sense: The portfolio assignment involves going through a number of steps that mimic an actual research process. As students go through these steps, they must not only draw on course readings, lectures, and the standard practical exercises (that all are part of the course), but also make independent choices and see these choices through by continually reflecting on their performance. The written product of the portfolio assignment is a four-page research paper that applies the statistical models of the course. To make a proper evaluation of the portfolio-type assignment, I set up four criteria that should be met in order for the pilot project to be a success. As a TLA, the assignment should

a) facilitate student activation and independence,
b) improve data management skills,
c) help students achieve the ILOs by improving learning and understanding, and
d) be aligned with the assessment criteria at the final exam.

[2] Because many students adapt their expectations to a high level of support, many also experience the transition to advanced stats courses at the MSc level as unpleasant. Indeed, in seeking to minimize their insecurity, students may come to rely even more strongly on the teacher as an expert.

To meet these goals, the portfolio-type assignment I implemented mirrors in large parts the steps in a real research project using the statistical methods taught in the course. Table 1 gives an overview of the implementation, including the overall learning goals of each step. In what follows, I explain these steps and their rationale in detail.

Table 1. Seven-step implementation of portfolio assignment.

Step	Week	Task	Potential learning outcome
1	1	Choose a raw dataset among pool of real-world datasets (or bring your own dataset)	Student activation and independence (a); indirectly raise awareness of ILOs and exam criteria (c,d).
2	1-6	Prepare dataset for analysis	Data management skills (b)
3	4	Upload three questions that you find relevant for making a sober analysis using the statistical method of the course (using course readings, lectures, and practical exercises as inspiration)	Student independence (a); appropriation of criteria of evaluation implied by the statistical models (what's a good analysis using the models, and why) (c).
4	6	In-class activity: Choose 5-6 questions among the uploaded questions + discuss reasons for asking these questions.	Understanding basic structure of analyses using the statistical models in sociology (c); raising awareness of ILOs (c); reflecting on how self-chosen questions align with exam criteria (d).
5	7-8	Write 4-page paper that answers the 5-6 questions chosen in step 4.	Improve understanding of the statistical models and how to use them in a substantive analysis (c); direct exam preparation (d).
6	9	In-class activity: Peer feedback on papers, evaluating whether the 5-6 questions have been satisfactorily answered.	Facilitate independence by reflecting on own and others' performance (a); improve learning by giving and receiving feedback (c); raise awareness of exam assessment criteria (d).
7	11	Teacher feedback on revised papers (revised after peer feedback) with a focus on precision.	Improve learning by receiving formative feedback from teacher (c); raising awareness of exam criteria (d).

Step 1: Pick a dataset. At the onset of the course, I ask students to pick a raw (unformatted) dataset from a pool of eight datasets. I collected these datasets before the course and placed them in a central database that students could access. The datasets are all renowned datasets used in either national or international research. I also encourage students to use other datasets, if they for some reason had access to such data (e.g., from a student assistant job). I tell them that the dataset is to be used for a small project that runs parallel with the course. I also tell them that participating in the activity is voluntary, but that the payoff of

participating is significant in terms of exam preparation. My intention behind this initial activity was to activate students early in the course, softly making them aware of how the portfolio-type assignment would be aligned with both the ILOs and the assessment criteria at the final exam.

Step 2: Prepare dataset. After students have chosen their dataset, I ask them to prepare the dataset for analysis. Because the datasets were unformatted, recoding the data requires quite a lot of work. This is particularly so for my course, because the statistical models taught in the course requires very specific coding of the data. To aid students in their recoding, I gave them six weeks to prepare the dataset. In this period, I gave several examples on the coding of data in my lectures and practical exercises. After five weeks, I held a two-hour coding workshop (with voluntary participation), that allowed students to be assisted by me with whatever coding issues they had encountered. My intention behind this activity was to not only improve the students' data coding skills, but also make them aware of the many choices that coding data entails.

Step 3: Come up with three questions individually. In the initial phase of the course, I ask students to complete an additional task that runs concurrently with the coding of their data. In this task, they are asked to upload to our online platform by week four three questions that they, in the light of the course readings and lectures, would find relevant if they were to make a "good" analysis using the statistical models of the course. The online platform worked as a chatroom, meaning that everybody could see everybody's proposed questions. My intention behind this exercise was to compel students to critically engage with the course readings and lectures in an independent way, so to come up with their opinion on criteria of evaluation for the analyses using the statistical models taught in the course.

Step 4. Pick 5-6 questions collectively. I organize an one-hour in-class activity with students in week six in which we pick 5-6 questions from the pool of questions uploaded to our online platform (see step 3). In preparation for the activity, I had organized the students' questions in four overall steps that make up a typical research process using the statistical models. The activity consisted of students voting on which questions they found most relevant (within each of the four research steps), followed by an oral discussion about why these questions were relevant. Because I could identify the authors of the questions, I asked the authors to give arguments for why they came up with the question. At the end of the activity, I presented a rough overview over the assessment criteria that I would use for the exam. My motivation behind this activity was to promote learning, particularly showing students how sociological analyses involving the statistical models normally would unfold. Moreover, the activity was intended to promote awareness of how the criteria that the students had established via them asking questions were aligned with both the learning outcomes and the assessment criteria at the exam.

Step 5. Write a short paper. After students have prepared their dataset, and we have picked 5-6 questions (in step 4), in weeks 7 through 8, students are asked to write a four-page research paper in which they answer the 5-6 questions using their dataset. The overall

motivation for this activity was for students to apply their acquired skills; that is, "doing methods" to learn the methods. This key step in the portfolio assignment was also intended for raising students' awareness of both the criteria used to judge the use of the models in sociological research and the assessment criteria of the exam. Because the final exam is a written exam, this activity should also function as exam preparation in which students get first-hand experience with analyzing and reporting on the models. Finally, given the overall setup of the assignment, this part of the activity should also promote learning, because of the authenticity of project (mirroring a real research project).

Step 6. Peer feedback on papers. In week 9, I organized a feedback session on the written four-page papers (turned in by week 8). This session made use of peer feedback. Students were paired two and two to be each other's opponents. Before class, they were asked to prepare a five-minute feedback on their opponent's paper. In preparing this feedback, students were asked to evaluate whether their opponent's paper satisfactorily answered the 5-6 questions that the paper should be answering. Students were moreover asked to prepare an additional question to their opponent's paper that had come up during their reading of the paper. Finally, they were asked to prepare a question for their own paper. From this preparation, the peer feedback session was organized as follows:

(i) Student A gives five minutes prepared feedback to Student B, and Student B then has five minutes to respond to the feedback. Roles are switched.
(ii) Student A asks and Student B answers the additional question that Student A has prepared. Five minutes allocated. Roles are switched.
(iii) Student A presents his or her question to his or her own paper and discusses this question with Student B. Five minutes allocated. Roles are switched.

The feedback session takes about 45 minutes in total. My motivation for adopting this peer feedback exercise is that formative assessment allows students to take control over their own learning (Nicol and Macfarlane-Dick 2006). Moreover, face-to-face feedback is known to yield high learning payoffs (Race, undated). Thus, I used the feedback activity in this stage in the project to not only help students clarify basic misunderstandings, but also aid students' reflections on their own appropriation of the methods taught in the course in relation to the evaluation criteria implied by the course ILOs. Because I asked the students to use explicit evaluation criteria that were collectively agreed on (in step 4), my hope was that the feedback session would also raise awareness of how the ILOs align with the assessment criteria at the final exam. A final motive behind using peer feedback is that it is very time-efficient. It yields the payoff of detailed face-to-face feedback at little cost for the teacher.

Step 7. Teacher feedback on revised papers. After the peer feedback session, I gave the students two weeks to revise their papers in response to the feedback from their peers and subsequently "resubmit" the revised paper to me for personalized, written feedback (by week 11). I told the students that I would give specific comments on their use of statistical terminology and their interpretation of the parameters of the statistical models. I furthermore told them that I gave feedback using the commentary function in MS Word. My motivation behind this feedback is threefold. First, complementing the peer feedback, my feedback

enforces formative assessment by providing a second round of feedback on the same paper. This should further stimulate self-regulated learning, particularly because it supports the students' agency in terms of continually improving and reflecting on their work. Second, giving very specific comments on the writing of students, my feedback should raise awareness among students of the assessment criteria at the final exam (these criteria, which are in accordance with the ILOs, stress the interpretation of the parameters of the statistical models taught in the course). Giving specific comments also made the feedback manageable for me as a teacher. Finally, because students ask for teacher feedback and rate it as being more reliable than peer feedback, my feedback allowed students to triangulate their own perception and the input from peers in light of my input.

PROJECT EVALUATION

I evaluate my pilot project using the four criteria that I set out in the background section. As a TLA, the assignment should

a) facilitate student activation and independence,
b) improve data management skills,
c) help students achieve the ILOs by improving learning and understanding, and
d) be aligned with the assessment criteria at the final exam.

To evaluate the pilot project, I rely on three data sources: supervision of my teaching by my pedagogical supervisors and my peer group in the teacher-training program; a 90-minute group interview with four of my students after course, which explicitly evaluated the pilot project; and my own observations, including the informal feedback from students during the course. These data sources provide valuable insights into both strengths and weaknesses of the project. I structure my evaluation in accordance with the four criteria.

Facilitating student activation and independence

The major aim of the portfolio assignment was to activate students. By this token, the project was a success. Although participation was voluntary, about 95 percent of the students participated in the project and about four in five turned in the paper in Step 5. Moreover, by design, the project supported students' discretion in terms of developing their own project and ideas. My casual observations during the course were that students enjoyed having the freedom to build a project from scratch, including formatting a raw data set. It gave them an authentic experience, allowing them to activate many of their skills acquired throughout their education. In the group interview, my students expressed the same opinion. The students did however also express some anxiety in terms of the inherent insecurity that arises in projects that do not have a final, correct result. This anxiety can be productive in that it forces students to think about the choices they make and evaluate possible scenarios (a learning goal of the assignment). However, it may also impede students' progression, because the task can become insurmountable (from the student's perspective). In these situations, the students made clear that the teacher has an obligation to help steering the student in the right direction.

As an example, students found the coding workshop in Step 2 very helpful, because it gave them the opportunity to evaluate their progress and move on in their preparations.

The feedback I received from both my students and the supervisions by my supervisors and peers pointed to a further concern that merits attention. Although the portfolio assignment promoted student independence, more could be done to promote independence! More specifically, students could be more active in helping defining the steps in the assignment. For example, in the in-class session in Step 4, I organized the questions that students had posed into four overall categories that reflected a typical analysis disposition using the statistical models taught in the course. My teaching supervisors suggested that students could have done this work. Moreover, in Step 4, I took much of the leadership in terms of structuring the session and asking students for arguments for the questions they had posed. Again, my teaching supervisors noted that the students could have done this work. For example, I could have asked select students to organize and carry out the activity (with my support). Nonetheless, in the group interview, students expressed in very clear terms that they appreciated me taking the leadership of the activity in Step 4. They said that at this point in the course, they benefited enormously from comparing their understanding of the process of analysis to my understanding. These contrasting reports point to the delicate balance that the teacher must strike between setting the stage and letting students take charge in these activities. Put differently, although delegating responsibility is well-received by students, delegation has its limits. Students clearly expressed the need for overall guidance and showing them what the best standards of analysis are. I return to this point in the conclusion, because it nuances what it means to break the "barrier of authority" in advanced stats classes.

Another illustration of this difficult balance is found in Step 6. I had tightly organized the peer feedback session in terms of timing and contents. My peers from the teacher-training program, who supervised this class, observed that too tightly structured sessions may impede the momentum that follows naturally from focused discussions with peers. A strictly enforced timetable may even confuse some students, distracting them from the real purpose. Put differently, the students appear well-equipped for taking over the activity once it is started. Thus, in the future, I should consider giving students something to kick off their feedback (e.g., the five-minute prepared feedback) and then leave the remaining organization of the peer feedback to the students. This would support student independence. Similarly, in the interview with my students, the students highlighted another, important point that relates to the issue of student independence. In preparing for the peer feedback in Step 6, I had asked students to evaluate their opponent's paper in relation to the five-six questions that we picked collectively in Step 4. My motivation for this was raising awareness of criteria of evaluation (and the implied alignment to ILOs and assessment criteria at the exam). However, in the group interview, students expressed dissatisfaction with being forced to use fixed evaluation criteria. Rather they would prefer defining their own criteria, thus asking for *more* independence to set criteria for feedback. The reason for this, the students argued, was that after writing the paper in Step 5, they had quite a clear idea about what their difficulties had been and, consequently, what they wanted to discuss with their opponent. Thus future

sessions using peer feedback may benefit enormously from leaving the criteria setting activity to students.

In sum, by design the portfolio-type assignment activates students and supports them as self-regulated learners. Judging by objective criteria, the pilot is success. Nevertheless, in future adaptations of the portfolio assignment to advanced courses in statistics, students are more than able (and willing) to take on more responsibility to structure the activities embedded in the multistep process.

Improve data management skills

Managing the complicated data used in the course is an important learning outcome that paves the way for meeting the overall course ILOs. In the terminology of this report, managing data is a core part of "doing methods," which facilitates understanding of the underlying logics of the statistical models. In Step 2 of the assignment, I asked students to prepare the raw dataset they had chosen for the project, and I held a data-coding workshop that allowed students to resolve coding issues with my assistance. Informal feedback from my students and the formal group interview suggested that students found this part of the activity very helpful. They expressed that having the opportunity to code a dataset from scratch gave them a much better understanding of the nature of the data that the course requires them to master. Moreover, they noted that coding raw data stood in stark contrast to the prepared and trimmed datasets that are usually used in the practical exercises in not only my course but in all courses in quantitative methods in the Sociology program. As one student noticed in the group interview, students in the Sociology program rarely meet real, "messy" quantitative data. Coding such data yields a high learning payoff in terms of not only basic coding skills, but also in terms of understand just how difficult it is to come up with a relevant analysis from scratch. This latter experience, the student interview indicated, helps students see the consequences of the (initial) choices they make and help them reflect on them to improve their understanding. By this token, letting students code raw data from scratch has a potential learning payoff that is worth reaping.

Meeting course ILOs

A major aim of the portfolio assignment is to support students' mastering of the course ILOs. The course ILOs say that students should be able to estimate and interpret the parameters of the statistical models taught in the course (by "estimate" I refer to carrying out the statistical operations that yield the parameters of the models). As previously stated, I hypothesize that learning to estimate and interpret these parameters takes practice, and the portfolio assignment is therefore arguably a strong tool for promoting student learning. I recognize that evaluating the success of the pilot project in terms of students meeting the course ILOs is difficult (since I do not have a baseline comparison). However, in the group interview, students expressed satisfaction with the overall project and found that it, in conjunction with the other course activities (lectures and practical exercises), benefited their appropriation of the advanced statistical methods. They thus agreed that learning methods requires "doing

methods," and would not have been without the portfolio assignment. Moreover, they noted that in the peer feedback session in Step 6, *giving* feedback to their opponent significantly increased their understanding of subject matter. At a general level, my casual observations support the feedback from my students. The portfolio assignment not only fosters learning in the many stages of doing a quantitative analysis using the statistical models of the course, it also promotes a stronger understanding of the course ILOs and their rationale. This finding points to the importance of constructing portfolio assignments that are strongly aligned with course ILOs and which operates in conjunction with the other TLAs of the course (lectures and practical exercises) to promote mastering of the ILOs.

Alignment with exam assessment criteria

In addition to aligning the portfolio assignment with the course ILOs, another major aim of the assignment was to raise students' awareness of the assessment criteria of the exam. In the in-class session in Step 4, I actively pursued this goal by comparing the questions that students had suggested to the criteria that would be used to evaluate to their final exams. Because these final exam criteria are directly aligned with the course ILOs, students should experience a sense of unity in terms of how the TLA supported both the ILOs and the assessment criteria at the exam. In the group interview, students expressed that this form of activity is helpful for them to acquire a better idea of what is required of them to the exam. Being strategic in their learning behavior, students are quite focused on learning about these criteria. Thus, taking them seriously by offering my view appears to be well received among students. However, alignment not only facilitated a strategic (achievement-oriented) learning approach students, but also a deep learning approach in that students benefitted from comparing their subjectively perceived evaluation criteria (formed in Step 4) to the evaluation criteria set by the teacher. Students appear to interpret this type activity as a form of feedback from the teacher on their current understanding. It therefore stimulates awareness by asking students to reflect on their own understanding in relation to the teacher's understanding.

In the group interview, the students also identified another benefit of the portfolio assignment. They experienced the portfolio assignment as a strong form of preparation for the exam: The many experiences they reaped from the multi-step process could be directly applied in answering the exam question. In particular, the students found my feedback on their revised papers in Step 7 to have a high payoff at the exam. The reason was, the students suggested, that direct feedback on their writing and interpretation of the model's parameters gave them very good ideas about how to express themselves in the exam. Moreover, given that the interpretation of parameters is a core ILO and a core assessment criteria at the exam, Step 7 appears to have strengthened the constructive alignment of these components.

CONCLUSION

My overall evaluation of the pilot project using a portfolio-type assignment in an advanced statistics course in Sociology is positive. Students engaged actively in the project, adopted a deep learning approach, reported that they improved their mastering of the subject matter, experienced a transformation of their understanding of sociological problematics in terms of quantitative methodology, and found the assignment to prepare them well for the final exam. Nevertheless, there is considerable room for improvements. Most importantly, students expressed the need for (even) more independence with respect to actively setting evaluation criteria for giving and receiving feedback. I view this an important lesson for future developments of course.

While the portfolio assignment clearly benefited student learning, the question remains whether it helps to break the "barrier of authority" I have alluded to earlier. I believe so. The portfolio-type assignment I have implemented delegates a great deal of responsibility to students. My evaluation is that students are more than capable to take on this responsibility. My students appeared strongly motivated by going through the steps of authentic research process. However, this does not mean that the teacher should step back and leave all responsibility to students. In contrast, my students demanded that I, as a teacher, operate as the authority in terms making clear what my criteria of evaluation are. Students actively compare these criteria to their own, thus facilitating their appropriation of the methods (and their implied logic) taught in the course. In this sense, my view is that teacher should play a facilitating role in terms of letting students *do methods to learn methods*.

To conclude this report, I give five, overall recommendations that future adaptations of the portfolio assignment may use:

- *Be authentic*: Construct a multi-step assignment that mimic real research projects that start from scratch. This is a strong motivator for students.
- *Support independence*: Give students as many opportunities as possible to define both criteria of evaluation (implied by the statistical models) and criteria for giving and receiving feedback.
- *Use peer feedback*: To make feedback manageable, use peer feedback. Students take peer feedback seriously, if you take it seriously, and the learning payoff of giving feedback can be high.
- *Align*: Let all activities in the portfolio support students' mastering of the course ILOs and their awareness of the exam assessment criteria.
- *Facilitate:* As a teacher, take leadership of the process, be explicit about your criteria of evaluation, and allow students to reflect on their own learning. Students critically compare their understanding to that of the teacher, so being clear and allowing room for reflection ultimately promote a deep learning approach and students' capacities as self-regulated learners.

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