BIO-ECOLOGY STUDENTS AND RESEARCH: WHEN PASSION BECOMES CONTAGIOUS

Interview conducted by Chantal PROVOST, a research educational advisor at the CÉGEP de Saint-Laurent. The author collaborated on an article entitled "Learning in the Age of Web 2.0: How Wikis Help Develop Clinical Judgment", which appeared in the Vol. 26, No. 2 (Winter 2013) issue of *Pédagogie collégiale*.

Since 2006, students in the CÉGEP de Saint-Laurent's environmental and wildlife management program have been submitting projects to competitions held by the Association pour la recherche au collégial (ARC), and won awards practically every year. They have also distinguished themselves in such other competitions as Pédagogie-Environnement and Expo Science. Marie-Josée GAUVIN, who teaches biology, describes how to provide students involved in the research process with guidance and direction.

CHANTAL PROVOST:

Environmental and wildlife-management students take part in research activities. Could you tell us exactly what this research entails?

MARIE-JOSÉE GAUVIN:

As part of their program, students must take two courses (project introduction and project completion) aimed directly at carrying out research conducted over two sessions. Several program competencies are explored—for example, publishing scientific information, applying the scientific method to problem solving, and planning the technical and logistical aspects associated with a research project.

Students carry out all steps of the scientific method involved: establishing a protocol, evaluating costs, setting a deadline, drafting a conceptual framework (in the field or the lab), analyzing data, and writing up a final report. At the end of each term, students must discuss project information verbally and in writing. The last oral presentation is made in public, with parents, friends, and teachers invited to attend.

Over the sessions, how do you monitor or evaluate student progress?

mjg In the winter session before the project, we have students form teams and think about a research topic. At that time, we explain how the project course will work, the deadlines to be met, and the scope of the project to be completed. We also distribute the final assessment grid (see appendix), which gives them an overview of both courses.

In the fall, students must establish a theoretical framework, develop their research protocol, and provide some data-collection tables. They make an oral presentation, which is filmed on the first three sections of their project. In the winter session, the team and the teacher view the presentation again, discussing the corrections that have been made and the points that require improvement. This step, which was added over the past few years, has proven extremely instructive for students. In the same session, students submit their analysis section in several steps, such as tables and graphs illustrating some of their findings and a description of their statistical analysis. At the end of the term, they submit a final report, some 40 pages in length, that includes the sections written up over the fall and winter (these steps are sometimes done out of order, especially when teams collect their of field data during the summer).

Does that mean that some students will collect their field data without even having taken the two project courses?

mjg Exactly. It's a question of time constraints. Some studies —such as the physicochemical analysis of a lake—have to be conducted in the summer. Teacher supervision thus remains a very important factor in conducting research. Even though the two project courses take place the following year, students still have acquired certain competencies allowing them to do their field work. Teachers meet with these teams more frequently, and discuss such things as protocols and the number of samples to be taken. That way, they ensure that the techniques used and the data collected meet project objectives.

How do you supervise teamwork?

mjg At the end of the fall term, we meet the members of each team individually, and ensure that each student fully grasps the project. Students must also submit a time sheet (once a month, on average) describing their duties on the team. These teamwork "management tools", which have been developed over the years, help us avoid certain problems the following semester.



In tangible terms, what percentage of teachers' duties does this supervision represent?

mjg As regards the time invested, these courses don't really "pay" (*laughter*)! While the assessment grids do make our task much easier—especially because students have clear, written instructions to follow—teachers must still be motivated and passionate about research. However, I'm always impressed to see how sophisticated the projects can be: students understand and incorporate each step of the research process. The teacher's role is primarily to supervise and ensure that the research steps are properly carried out. Students are the real researchers! I should also mention that, even if two teachers usually supervise the teams, several others from the department contribute to project success by providing advice and, more especially, expertise that often differs from ours.

How do you assess such dissimilar projects fairly?

mjg We've developed extremely detailed assessment grids that target very precise project criteria, regardless of the research topic in question. Of course, we have to ratify content, which is project specific. If we're unsure about the information provided, we can consult other teachers from the department. The grid for the final report (see appendix) allows us to properly evaluate all aspects of the research project and determine if the students have mastered the process.

In short, does the degree of student's involvement in their projects and of teachers' supervision contribute to research quality?

mjg Yes. Although it might seem obvious, students still have to put in the effort required to successfully carry out their projects. Moreover, the project courses also have a fairly good reputation. Second- and third-year students are very enthusiastic about them when speaking to their first-year counterparts.

These projects are a major endeavour. How do you ensure that students stay motivated?

mjg The scope of the undertaking really is impressive; students have to conduct all the steps of their research project and carry out several experiments. However, the choice of topics is a major motivating factor. They are told that the topic must be important to them, and that it must be feasible given the material and time constraints involved. Students with the proper structure maintain a good level of motivation. There is also an increase in motivation when students start getting results. The scientific method really starts to make sense; it's as if their painstaking efforts are finally «paying off».

A comment frequently made by the panels of the various competitions in which our students take part is that they truly respect the scientific method. I remember an anecdote I heard during a team presentation at the student ARC awards: someone asked the two students why they had used Gaussian process regression in their analysis. Few people are familiar with this type of statistical regression. The students could have just said that it was the type of statistical processing they had been advised to use, but, without any hesitation and with total conviction, one of them answered that one of the variables was of the absence/presence type, and that Gaussian regression made it possible to target the threshold value at which species occurrence was most noticeable, which is something logistic regression does not do. Not a bad reply for novice researchers! I'm sure it impressed the judges.

For seven years now, students in the program have won ARC student awards. How do your students view this experience?

mjg They know their fellow students submit projects every year. In short, it has become a real tradition, and interest in entering is sort of contagious. This event brings them recognition from their peers; it is also their first contact with a research community. Some students are truly "bitten by the bug". Awards aren't mandatory, but they do represent a considerable reward for the students, and crown their efforts.

What is the motivation for teachers to invest in such an approach?

mjg An approach like this lets teachers get "out of the box". It's also stimulating for them to share their passion for research and explore different topics every year, as well as to see their charges win awards. The teachers feel privileged to have seen their students develop and grow.

In conclusion, what should teachers focus on if they want to encourage their students to get involved in a research project?

mjg Students must be given the reins; as researchers, they have quite an influence on project success and scope. Furthermore, an adequate number of tools must be developed to give students the autonomy required to carry out their projects. Our main role is to provide coaching

and supervision. Teachers must be able to quickly identify overly ambitious projects and dysfunctional teams, and provide students with advice throughout the process. They have to aim at achieving a certain balance between promoting students' autonomy and offering them support. And, last but not least, I'm also convinced they have to love research themselves if they want to successfully "infect" their students!

APPENDIX

In order to properly understand the weighting specified in this assessment grid, it should be noted that a methodology handbook has been drafted to help students write up a scientific text. This guide is distributed the first term, in the course on the scientific method. We keep an electronic copy of all corrected assignments; this shows us if the students have corrected their mistakes, if they have made progress, or if we simply neglected to correct certain aspects of the project-course assignments. Since some work is assessed right from the first term, its weighting is lower than for the final assessment (see sections 2, 3 and 4 of the grid).

EVALUATION CRITERIA FOR PROJECT COURSES

1. Abstract **(5%)**

a. Structure
b. Compliance of required information

2. Introduction **(5%)**

a. Clear, precise introduction of topic and problem
b. Evidence of interest in topic
c. Originality of problem
d. Relevance and compliance with objective (goal to be reached)
e. Relevance and compliance with hypothesis(es)
f. Originality of hypothesis(es)
g. Organization of introduction (inclusion of three topics)

3. Theoretical Framework **(5%)**

a. Knowledge of latest research and facts
b. Relevance of information presented (too much or too little)
c. Compliance, validity, and accuracy of information presented
d. Organization of information
e. Relevance, validity, and diversity of documentary resources (references)
f. Progress and corrections made since project was first submitted

4. Protocol **(5%)**

a. Quality of presentation and of procedural organization
b. Detailed, structured list of materials
c. Relevance and exhaustiveness of major aspects to be considered
d. Relevance and quality of observation and data-collection methods
e. Protocol organization
f. Protocol backed by references (if necessary)
g. Corrections made since project was first submitted
h. Description of data
   i. Type of data
   ii. Processing of data
   iii. Analysis and statistics

5. Results and Results Analysis **(30%)**

a. Data are presented clearly and concisely (organization).
b. Relevance and justification of tables and figures
c. Quality of data presentation (graphs, tables)
d. Important aspects are emphasized.
e. Quality of writing

6. Discussion **(30%)**

a. Quality of interpretation of results (comprehension)
b. Relationships with analyses conducted
c. Relevance of ties with theory
d. Experimental errors are highlighted.
e. Discussion of any problems encountered; quality of solutions suggested (critical judgment)
f. Quality of writing

7. Conclusion **(10%)**

a. Clear, concise project summary
b. Responses to the underlying hypotheses
c. Completion of project, re-examination, new hypotheses

8. Quality and Compliance of Work **(10%)**

a. Compliance with instructions governing form of written material (see methodology handbook)
b. Completeness of report (cover page, abstract, table of contents)
c. Compliance with scientific method
d. Accuracy of scientific terminology, symbols, and conventions
e. Clarity and precision of written work
f. Proper use of the computer and software in drafting the document

9. Compliance with Grammatical and Spelling Rulese

(maximum of -10%)

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