# AN INTEGRATING PEDAGOGICAL TOOL BASED ON WRITING ARTICLES

Vianney Côté and Guy Custeau

Département de mathématiques et d'informatique
Université de Sherbrooke
Sherbrooke (Québec, Canada), J1K 2R1
Tel: (819) 821-7017 Fax: (819) 821-7921 e-mail: vianney.cote@dmi.usherb.ca

**ABSTRACT:** This article describes a teaching method based on the writing of review or vulgarization articles by the students in their fields of study. The best articles are published in a magazine distributed to data processing managers and practitioners. The advantages of this method and a list of evaluation criteria are presented.

**KEY WORDS:** Writing Across Curriculum, Communication skills, Cognitive objectives.

## INTRODUCTION

Professionals generally work in a problem-solving environment in which defining the problem at hand, selecting a general approach for solving it, devising the solution, presenting and gaining acceptance of the solution, and controlling its implementation are necessities. According to Janet Hartman of Illinois State University, "One can write to communicate and one can write to learn. In a business environment, writing to communicate is the focus. In an educational environment, students should be expected to do both" [1].

Despite the specific objectives relating to communications, students have few tools to help them develop and practice their communication skills. This paper describes an integrating concept that promotes the achievement of learning goals and of other educational objectives such as responsibility, motivation, cultural development, ongoing independent learning, communication skills, and the desire to carry out research. This concept consists of publishing vulgarized scientific articles written by students as part of their course work.

The integrating aspect of this concept is demonstrated in three ways:

* It forces the student authors to synthesize the topics treated since this type of writing requires the author to understand the context, and to have an overall understanding of the field and a good grasp of the subject matter.
* It integrates interpersonal communication techniques through multidisciplinary teamwork in gathering information, structuring the message, and revising the article.
* Readers can find review articles treating a variety of subjects not dealt with in class, in one magazine. The most pertinent articles can be used in appropriate courses.



After having positioned the idea of learning by writing in a specific course, this article discusses the learning objectives of the approach in relation with Bloom's taxonomy. It then looks at some other educational goals and gives some pointers to any instructor interested in implementing the tool in a university curriculum. Finally, it concludes with an evaluation and some comments by students and readers.

## COURSE CONTEXT

A "Computer Systems Management" course is taught in the last year of a three year computer science curriculum. Topics such as risk analysis, business systems and project planning, quality and complexity metrics, cost estimation, request for proposal, software contracts and software reliability models are treated in the course. A special emphasis is put on oral communications; teamwork as well as interview and presentation techniques are thoroughly covered. The importance of written communications is also stressed in the course. Management summaries, memos, technical reports and user manuals are some of the documents that computer professionals may be called on to write. Moreover, the fact that technology transfer is a growing concern in software engineering [2] still increases the pressure on computer professionals to master written communications.

Students are asked to write a short paper on a subject related to the management of a data processing department or on one of general interest for software development managers. They have to select their own subject and they can write alone or in teams of two or three persons. Here are some of the titles that have been submitted over the last few years:

What is reverse engineering?
Computers and the law.
Software ergonomics.
Portable computers.
Computer systems at Air Canada.
Groupware: an introduction.
The human mind and the computer.
Farm management systems.
Change management.
The evolution of CASE tools.

The best papers are edited and published in a magazine of professional quality that has a circulation of 1,000 copies and that is financed by external sponsors.

| Evaluation of a Vulgarized Article |
|---|
| **Topic**<br>• The topic is pertinent, original, and interesting. |
| **Rigour**<br>• Pertinent definitions are provided.<br>• Ideas are clearly and precisely expressed.<br>• A bibliography is included.<br>• The development is supported by the litterature.<br>• Redundancy adds to clarity.<br>• The information presented is complete and usefull. |
| **Organization**<br>• The introduction draws attention and is interesting to read.<br>• The introduction defines the contents, objectives, and target audience.<br>• The development is logical and clear.<br>• Each paragraph discusses a specific idea.<br>• Transitions between sentences and paragraph are natural.<br>• The discussion bears only on the aspects indicated in the introduction.<br>• Titles are clear and easy to understand.<br>• The conclusion is short and dynamic, presents a clear synthesis and stimulates reflection. |
| **Language**<br>• No spelling mistakes.<br>• Sound sentence structure.<br>• Dynamic, fluid style.<br>• Clear, concise and rigorous style.<br>• Style adapted to audience. |
| **Illustrations**<br>• Tables and figures strengthen the text.<br>• Illustrations and tables are clear and easy to read.<br>• References are made in the text to illustrations. |

Figure 1 – Evaluation criteria for a vulgarized article

In addition to writing a paper, the students are invited, on a voluntary basis, to give a talk in front of their fellow classmates on the subject they have chosen. Helpful hints for preparing the presentation are given in class and interacting with the audience is encouraged. This exercise is rewarding to the students; they go through a steep learning curve, gain self-assurance, broaden their knowledge and usually have fun preparing and delivering their speech. Mostly because of the large number of students, it is not possible to have every one of them give a talk. However they often learn almost as much by looking at others and by evaluating them as they would by delivering their own speech.

## LEARNING OBJECTIVES

From Bloom's taxonomy [3], one can see that writing articles for general audiences lets students practice activities at the three higher levels of cognitive objectives: analysis, synthesis, and evaluation.

Analysis
In writing a popularized article, the student must perform research, detect hypotheses and formulate pertinent conclusions, analyse and compare points of view that are often quite dissimilar, if not contradictory, and organize the collected information into a clear, assimilated format.

Synthesis
Producing an article starts with analyzing the target audience and developing a coherent outline in which a set of ideas and relations that are relatively abstract must be brought out and ordered. The ability to synthesize information develops with practice, which can be admirably provided through writing articles as part of course work. Standards and stimuli, such as those given by a journal, play important roles in motivating students.

Evaluation
Choosing a topic is not easy. While the instructor may make suggestions or impose constraints, the process of selecting and preparing a topic generally brings the student to read several articles, to evaluate them, and to exercise judgment and a critical spirit. In addition to evaluating articles by several other authors, the student himself is graded by his instructor or a reading committee. The student also is aware of the evaluation criteria, and so he can judge his own work. The list of criteria (see figure 1), once calibrated, can be used for evaluation or self-evaluation.

Writing a popularized article allows students to also attain the lower levels of Bloom's taxonomy: knowledge acquisition, comprehension, and application.

Acquiring Knowledge
Depending on the topic selected by him or assigned by the instructor, the student acquires knowledge on terminology, principles, theory, or practical implementation problems. The knowledge is acquired while doing the research, reading related articles from the library and drafting the article. This knowledge is shared when the students read collections of articles of the current or previous years. Once students have prepared and submitted their own article, they better appreciate the work of others, understand and retain their main message.

Comprehension
Perhaps the best way to understand a new concept is to try to explain it to someone else. Students can discover why writing down what they understand in their own words is so important. They will also come to understand that it increases retention. One can hope that this experience can teach students, not only about their particular topic, but also about an excellent learning method.

Application
Seeking examples and counter-examples to explain a concept or convey a message demonstrates to students how this concept applies to different situations. At the very least, it increases their awareness and leads them to question the usefulness or value of the concept. This is particularly important in a coop environment, as we have in Sherbrooke, where students alternate between work terms in the industry and learning sessions at the university.

Student-authors are required to apply writing, research, interviewing, and teamwork techniques. While very important for all professionals, these techniques are usually learned on the job. Publishing articles provides a richer context and allows for better control. Students know that they might get high visibility and that they are not working only to please the instructor or to get good marks.

## OTHER EDUCATIONAL GOALS

Responsibility and Motivation
It is generally recognized that the degree of control that students exercise over their own education has a significant impact on its final quality. With this integrating tool, the students assume the major responsibility for their learning, which tends to foster deeper motivation and make the learning process more meaningful, more lasting, and more easily transferrable. The publication of their article motivates them even more. Giving more responsibility to the students does not detract from student-instructor interaction; to the contrary, it allows more personalized control and supervision.

Cultural Development
This refers to the technological culture in the field of study. The topics selected by the students often focus on state-of-the-art technology or information. Thus the collected articles soon constitute a good source of general information.

Ongoing Independent Learning
Popularizing articles allows students to acquire and develop certain work skills:

* planning a learning task and evaluating its achievement;
* classifying information and identifying important points;
* organizing time and effort; and
* controlling the quality of one's own work.

By fostering independent study, this method helps inculcate greater adaptability.

Communication Aptitudes
While the proposed method deals mainly with written communication, teamwork is another important aspect of interpersonal communication that can be explored by allowing students to collaborate on coauthored articles. This can be taken a step further by offering them the opportunity to present their articles in class, simulating similar activities at conferences and the like.

Interest in Research
Given the freedom, students will choose topics that interest them, providing impetus to use the library and consult other articles on the same topic area as theirs. Looking for good articles familiarizes students with scientific/professional literature, exposes them to a wider scope of new concepts, and generates a sense of belonging to the profession.

This idea has been supported by a number of authors, such as W. Taffe: "Computer science can be learned better by writing about it, and in the process students become better technical writers, more adept at communicating knowledge through written communication" [4]. Professor R. Cannon from the University of North Carolina is convinced that "students are learning more about science, because they are spending more time thinking about the discipline through their writing", a premise supported by a Harvard University study [5]. In computer science, a number of recent references [6,7] have demonstrated the existence of a strong trend in pedagogy towards the writing of articles as a learning tool. The trend is apparent in other areas as well in the United States, where the practice is termed "Writing Across Curriculum" or WAC. Some universities have even organized WAC workshops for professors.

## IMPLEMENTATION OF THE TOOL

Writing popularized articles has received the sanction of the Department of Mathematics and Computer Science of the University of Sherbrooke. Over the last three years, the students taking Computer Systems Management (about 120 annually) have been asked to develop a particular topic of their choice into a synthesized or popularized article.

At the beginning of the course, students are made aware of the project, including its objectives, length of the assignment, how it will be evaluated, and the deadlines. Students are given the option of working alone or in small groups of two or three; stress is placed on interpersonal communication.

Students are allowed to choose their own topics, which tends to increase motivation. The actual selection should be based on the student's interest in the topic, personal experience (which lends credence while reducing the research required), and originality (which should increase the chances of the article being accepted for publication). Efforts are made to control the length of the articles. The students are also given feedback so that they are forced to keep their work well-structured and concise. Concrete examples, tables, and figures can be included to liven up the presentation and give it a more professional look.

Students are expected to hand in a written outline and proposed title three weeks after the start of class (15-week course). A first draft is submitted to the instructor for comment (but not grading) a month before the end of the course. The purpose of this revision is to keep the author(s) on-track and usually results in significantly improved final drafts. The final version is handed in at the end of the semester, both in hard copy and on diskette (PC or Macintosh systems are both accepted).

The instructor assumes the role of editor, evaluating some 60 articles against a grid (see figure 1). The project counts for 40% of the student's course mark: the assignment is not taken seriously enough by many if it accounts for a significantly lower portion of the student's final grade. A reading committee, comprised of other professors or volunteers from industry, review 12 articles, 9 of which are selected for publication. Experience has shown that even those authors not selected for publication remain very enthusiastic about the learning method.

PageMaker by Aldus is used to lay out the journal for publishing. The actual typesetting can be defrayed by sponsors (normally 8 sponsors contributing $500 each), who are normally easy to find if the document looks professional. The run of 1000 copies is distributed to computer scientists and systems managers across Quebec as well as to 200 department faculty and students who will take the same course the following year. Having employers as a target audience is quite important for the department's cooperative program, in which students alternate semesters in class and on-the-job, getting practical training in industry. To date, the comments have been quite positive and the department hopes to extend the project to other courses. In addition, the journal can accept other items, such as book/article reviews and computer project reports.

For the instructor, an average of 3 weeks of full-time work, in addition to the normal course work load, is required. This is largely compensated for by the feeling of accomplishment in seeing the final product, and by the appreciation shown by the students.

## CONCLUSION

This article describes a teaching method based on the writing of review or vulgarization articles by undergraduate students in the context of a final year course on "Computer Systems Management". The best articles are published in a magazine of professional quality (Gestinfo) edited by the instructor.

This teaching method is shown to be an integrating concept that promotes the achievement of learning objectives defined according to Bloom's taxonomy, and of other educational goals such as responsibility, motivation, cultural development, ongoing independent learning, communication aptitudes and interest in research.

The main difficulty in implementing this method is to find an instructor who will edit the material, given that it requires the equivalent of three weeks of full-time work. However, this is largely compensated for by a feeling of accomplishment and by the appreciation shown by the students and the readers. A sample of their comments follows.

"Writing an article for Gestinfo magazine remains one of the most rewarding experiences of my undergraduate studies. (...) I was not studying only to pass exams; I had to master the subject matter well enough to be able to explain it. I have become so interested in the topic I chose that I now read whatever article I come across on the subject." Nathalie Laroche, Student

"Although my article was not published in Gestinfo, I consider the teaching method to be highly motivating and an excellent way to learn. It should be adopted in all courses."
Christian Lajoie, Student

"Gestinfo is a useful source of information and furthermore it is enjoyable to read from cover to cover."
Michel Gagné, Bell Canada

"I am impressed by the quality of the articles."
Martine Linteau, National Bank of Canada

"Gestinfo is an excellent source of information for all computer professionals and managers."
Marcel Richard, Québec Commission on Construction

"Computer professionals are not the only ones to find interest in the articles of Gestinfo. (...) They are well organized, clear, complete with a useful bibliography; something to invite reflection while giving information."
Jean-Marcel Léard, Professor of linguistics, U. of Sherbrooke

"Gestinfo is an original initiative to develop in future graduates the communication skills that are increasingly sought after in organizations."
Lawrence Cannon, Québec Minister of Communications

Clearly, writing an article is an excellent way to learn that is well received by the students. The publication of the best articles in a magazine is highly appreciated by the student-authors and by the readers. This teaching method can be extended to other computer science courses and to other fields.

## REFERENCES


[1] "Writing to Learn and Communicate in a Data Structures Course", J.D. Hartman, Twentieth SIGCSE Symposium on Comp. Science Education, Louisville, Feb. 1989.

[2] "Diffusing Software-Engineering Methods", S. A. Raghavan and D. R. Chand, IEEE Software, July 1989, pp. 81-90.

[3] "Taxonomy of Educational Objectives: Handbook 1: Cognitive Domain", B.S., Bloom et al., New York, N.Y., McKay.

[4] "Teaching Computer Science Through Writing", W. J. Taffe, SIGCSE Bulletin, Vol. 18 No. 2 (June 1986).

[5] "Trends in Microbiology Education", T. Herring, ASM News, Vol. 56 No. 10 (Oct. 1990).

[6] "Teaching Computer Networks as a Writing Intensive Course", J.R.F. Quirk, SIGCSE Bulletin, Vol. 20 No. 2 (June 1988).

[7] "Teaching Writing and Research Skills in the Computer Science Curriculum", P.M. Jackowitz, R.M. Plishka, J.R. Sidbury, Twenty-first SIGCSE Symposium on Computer Science Education, Washington DC, Feb. 1990.