HOW TO HAVE THE WEB PLAYING ON YOUR SIDE

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Abstract *- We describe the results of our experience in the way students are using the Internet. We also found a lot of cheating attitudes, some of them we believe involuntary. We developed some ways of incorporating the Internet to our courses, in order to change the cheating attitude in a healthier research attitude. We address two types of use of the Web: programming assignments and report written assignments, presenting our experience in both areas. After some experience of using the Web with the courses where we detected cheating, students attitude changed. In this paper we present our experiences with both types of courses discussing our findings and suggesting some approaches.*

Index Terms - Ethics, programming, web in the classroom, writing activities.

INTRODUCTION

There are plenty of things in the Internet, and these things can help students and educators in their journey. But not all sources are equally valuable or reliable and not all students make a fair use of them.

For some students breaking the rules seems to be an irresistible challenge. And the Internet seems to be on their side. They continually look for (and find) new ways to cheat, and teachers have to manage themselves to detect purloined paragraphs, pages, entire papers, or computer programs. There are specific sites devoted to cheating where the asked work may be readily available, or where the work is sold with some sort of quality statement [1]. Of course, these students know what they are doing and educators have no other choice but to prevent this sort of things to happen at best, or to act enforcing the anti-plagiarism practices of the institution.

Some students, having accessed the Internet for information and music regularly, fail to understand that without proper credit attribution, they are appropriating the work of another individual. In an extreme situation, they claim that Engineering is also combining known developments in a new one, a premise with which we may agree, and that this is what they have done. Here borders become somewhat fuzzy if the possibility of plagiarism was not considered in advance. Teaching the appropriate way of using some other work is a must when using the Internet resources, in addition we must teach how to evaluate and criticize the material they access.

One way of beginning with the task of integrating the Internet in the courses is to know first how students are using it. Of course, one can teach how to use the Internet from the basis, but by knowing the way the tool is used, professors are in a better starting point to obtain the best of it. Aside, letting the students know that one *knows* how to cheat dissuades a number of students to attempt it from the beginning.

In this paper we present the results of a three year experience in using the Internet, from the shy beginning as a consulting tool until the true integration in several central issues of our subjects. The experience is made in three successive courses of programming and in three subjects on Operating Systems and Data Networks, covering different kind of assignments such as programming, writing activities and true new projects [2] [3]. We will focus on programming and report assignments, drawing similarities and presenting some ideas in how to have the Web playing on our side.

THE INTERNET AND PROGRAMMING ASSIGNMENTS

Students are supposed to program some "classic" algorithms during their first two programming courses, to develop hands-on expertise and to understand the foundations of some programming techniques such as recursion, greedy algorithms, dynamic programming, divide and conquer, etc. The programming language used can be different and these "mandatory" problems can be part of a more general approach such as "Object First," "Imperative First," "Functional First" or "Breadth First" [4]. But some variations of these problems are asked and there are a lot of solved examples in the Internet.

We found three main attitudes in using the Internet as a help to solve programming assignments. The survey covered 176 students in three courses with 80% male population.

- 5% of the students hired someone to write the program or used the full text as found in the Internet.
- 0% of the students used parts of the code found in the Internet in their assignments, without gaining proper understanding on how the "borrowed " code worked
- 30% of the students "caught ideas" or revamped Internet code, showing enough knowledge of the way it worked.
- 25% of the students did not use the Internet.

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Figures are rounded and not very trustworthy. These are a three years' average obtained by inspection, questioning, searching the Internet and asking to fill in anonymous surveys, but the surveys had to be very unofficial and we know for sure that true plagiarism is underreported. Martin Dick et alter [5] publish more data. In our survey we focused on Internet and printed material and left classmate cooperation outside, which was allowed in some cases.

Students of the first group were true cheaters. They knew what they were doing and they knew what kind of game they were playing. It is very important for the University to have explicit rules on the matter and for the students to be aware of them. There are tools and also services that scan a given corpus of material or the Internet itself looking for similar works [6]. Personal interviews with the students showed that they did not understand (or even know) the assignment they handed in. One way to prevent this practice is to ensure that the homework is not readily available in the Internet. This has to be followed with a face to face review. Of course, this is not a rewarding task for most of us and the best thing to do seems to be building a learning environment where these kinds of attitudes are ruled out in a more "natural" way.

The third group was what we can consider "fair use" of the Internet, if this use is allowed. Our opinion is that not only must this use be allowed but also encouraged, as we will develop some paragraphs ahead. There is a concern about proper attribution of the work and critic evaluation of the source. Students must be taught that they must give proper credit and how to do it [7] and that they must evaluate their source of information [8].

The fourth group did not use the Internet. Perhaps following their Students Manual they decided to "do their own work." Not a bad thing, but it must be seen in the context of the subject we are teaching. In science we are used to building our knowledge using someone else's work and in engineering we mix different approaches to build something that was not there before, at least in a ready to use form. Unless we want to train students to acquire some habits, we must encourage the fair use of previous work. First, we must carefully explore our subject to make out which items require "training," as basic programming does; and which items require a critical understanding, such as is the case with algorithmics. Later we will develop some examples about it.

The second group seemed to be the more challenging from the teacher's perspective. Focusing on them, and with some interviews made by us as their professors and by some teaching assistants from other subjects, who are their classmates, and using some anonymous surveys, we can state for sure that most of them failed to acknowledge they had done something "out of the law." Students are used to accessing music and software in the same fashion. They are used to seeing in video clips and TV news such kind of "stapled" material with little or no connection between pieces, and they never see (and frequently they are not allowed to see) the final credits. They reported they had a hard work writing the program and we believe them, it is really difficult to make something you don't understand work. Interestingly students seemed to find the way of proper coupling unknown pieces of code by playing with them enough time.

There are some tools to automatic detection of this type of plagiarism [9] [10], but we want to focus ourselves on how to prevent the "involuntary plagiarism" described in the last paragraph.

THE INTERNET AND REPORTS

In the courses of Data Structures, Operating Systems and Computer Networks we asked students for reports on different issues. They were supposed to use the Internet to find information and to write a summary of their findings. We wanted to use the material they found in our lectures. Again we found the Internet playing against us. We tried to classify their attitudes in a scheme related to the one used in the previous section. Drawn from an survey on 233 cases of three courses, also with a 80% male population, our findings were that

- 15% of the students hired someone to write the report or copied it in full from some of the cheating or repository websites.
- 60% of the students used parts of reports in their assignment with various degrees of "un-understanding" and different techniques of "pasting" and "cosmetics"
- 25% of the students made a "fair use" of the Internet material.
- None reported not having used the Internet (using it was strongly encouraged).

There is a lot more bibliography covering that kind of use of the Internet, the taxonomy of cheating is also richer than this classification. There are also tools to detect plagiarism [10] [11] and we are not considering the "intra corpus" plagiarism, such as using a classmate (or a previous course classmate) work as the base document [12].

WHICH IS THE GAP?

There seems to be a gap between what some students consider proper work and what we consider satisfactory. We seem to expect from students a maturity and commitment to our subjects they do not have. And we think we have to teach students what we consider the proper use of the Internet resources. After all, they have a lot of counterexamples that teach them how to misuse the material.

We want everyone to do his/her own work. Though teaming is highly encouraged, and we make extensive use of it, a team results from the synergy of individuals. If some member meets with the team without being prepared for the

work, this member is wasting time. Worse than it, she/he is slowing down the whole team pace and teammates will feel that the whole teaming idea is a waste of time. After all, they alone can go faster, and without proper discussion they lose the enriching part of teaming.

We want our students to use some other ideas, but after proper understanding of them and of their application range. We want them to gain knowledge by reviewing other people's work, but some work must be redone in order to understand the underlying limits and choices the original author faced. Each individual is different and has a different learning style, so the piece of work to be redone depends on each student. In a programming example, some students have to program parts of it before understanding, other have to play with some subroutines and a third group may only have to read the code carefully and draw some decision trees. We have to teach each one how to develop his/her own style. The same applies when studying new and difficult material.

We want our students to develop critical thinking. We must teach them how to evaluate Internet resources and that they cannot blindly trust what they read. More than teaching we must "train" them in systematically questioning everything, and they must understand when they can feel confident with what they read. This means also integrating different subjects to their way of reasoning, against the more "popular" way of separating their knowledge according to the subject they are studying.

Finally we have to develop in our student the habit of proper referencing some other's work. For their own sake, in order to let the reader know which are their sources and giving the necessary clues on meanings, environment and other peculiarities present in the original author.

When we looked into the four attitudes we want our student to have, good team work with individual accountability, meaningful understanding, critical thinking and credit acknowledgment, we could state for sure that these attitudes were neither taught nor encouraged in the secondary school, at least in our country. And gazing the surrounding environment our student share with their mates, these are not highly rewarded social values. In the decision of giving our students a hint on how to develop these attitudes, we changed the way we asked for homework, adding writing activities [13] and guiding their Internet search.

TEACHING HOW TO USE THE WEB

Actually, this paragraph could have the title "... how to use bibliography", but with the Internet the ease of copy/pasting the material and the impossibility of knowing beforehand what can be found, as in the University's library, poses new problems that were not present in the old days.

In both types of assignments, programming and technical reports, we decided to have a step by step approach. First, we handed out some guidelines on how to search in the Internet and how to evaluate resources. After checking that everyone understood what they found, we directed the task of mixing their different findings. We handed out more guidelines explaining the difference among citing, paraphrasing and using someone else ideas, and proper referencing techniques. Teams were formed with students who searched for the same topics in order to elaborate the best of their material, using different criteria. The next step was to join different issues in one report or program, and finally to draw some conclusions or to apply the new knowledge to some "real" case.

Depending on the subject, the mentioned approach has some differences. The key point is to survey each stage of the work to help students to find inconsistencies developing a critical view on what they read and write. Working in class allows for a richer exchange of opinions and raises a lot of questions. Students learn to listen to each other, and our role as teachers changes becoming the task of a mediator or expert.

An important add-on is a "folder activity" [14]. A folder is a set of the findings and exercises the student made during the course. This folder is handed out to teaching assistants and lecturers in order to provide adequate feedback of the student's understanding. The folder is checked for correctness, but not graded. Students are allowed to be creative and to use the style of their preference. Written feedback flags incoherence, internal contradictions or the need of a deeper development on some items. Students do not get the "correct" answer unless some general misunderstanding is detected. They know they are not being graded for their folder activity, but that the folder must be done. In the final reports, they are allowed to reference to their folder in the same way authors use to reference previous work. Students did not perform well in referencing and they made it worst in self-referencing, but this practice raises their self image and the image they have of their work.

USING THE WEB IN PROGRAMMING ASSIGNMENTS

The "classic" way of teaching programming using hands-on experience was to have each student write some set of programs chosen in order to expose him or her to some experiences. This approach was used in the first two courses of programming: basic programming and general algorithmics. In the Internet there is a wealth of material that can support this approach. Animation, paced execution of programs and basic understanding of the compilation process are some examples. But there are also several versions of the classic problems solved using several languages, and, what is worse, using different and contradictory approaches regarding some key practices such as the use of global variables, cohesion and coupling. This fact not only enables a cheating approach, but can also be confusing for the student and forbidding its use only promotes it.

We decided to split the programming in three different approaches. Basic algorithms are developed in class with active student participation. Uses against the desired programming practice are explained, stating the consequences of breaking the practices during other stages of the software life cycle. Students are asked to do some "end of chapter" programming as a folder activity. In the written guidelines, some Internet addresses are given but they are encouraged to use the searching guidelines they have previously got to find and report new addresses. For some key problems they have to do the coding and some form of execution tracing, using tables of variables or drawings. This tracing is also used during lectures as a way of introducing state diagrams and other techniques. Finally they have to search the Internet for some theory or for some classical problems such as the knapsack problem or the knight's tour.

In the following lecture, a block of time is set for student to meet in teams to discuss and summarize some problems, writing their conclusions in their folders. The lecture is supposed to address some of the items students discussed, and the active participation or even presentation of the teams is a key point of it. After some lecture, new teams are formed and students are asked to draw some general conclusions in a "vertical" approach, for example, discussing different problems solved using the same technique. The lecture concludes with the group elaboration of this work and the preparing issues for the next topics. In average we divide the three-hour lecture in 1.5-hour group work and 1.5-hour lecture. Students also have 3-hour laboratory they can use to do the programming or to search the Internet.

When some topic seemed to be over, we asked for the folders and reviewed them. We asked for completeness of the work and we marked the corrections not by stating the "right" answer but leading students to use some different approach in solving or to do a bit more research. Sometimes we found some general misconceptions or lack of understanding and we used some time, lecture or lab, whichever is best suited, to clear it. Folders are not graded, but students know that completeness of work helps them in "critical" situations.

We also ask for some programming assignments they have to handle. This assignment can also be found in the Internet, though we try very hard to find some that are not. The key in this assignment is that students must make some sort of presentation to classmates, parents and the institution authorities in a way resembling a Conference or a demo. In [15] the authors reported a big motivation with paper submitting for a Conference and we are trying to persuade our authorities to give Students Conferences an opportunity. In the presentation, they have to present not only the working program using projectors and TV screens connected to computers, but also to explain in easy words how the program works. If they hunted the program from the Internet, they have to gain enough knowledge of it to explain it. The assignments vary from individual ones in the first stage to a full-blown project with some market research made by four member teams in the last stages.

A key aspect of this practice was that students had to properly state the sources of their findings. It worked in two ways, taught students how to cite and how to give proper credit and "protected" them against "undesired" effects of the code they are using, such as poor programming practices. From our exchange of ideas during FIE 2001 [16] we decided to add a new practice. Students will have to send an e-mail to the web site authors letting them know that they are using the material and how they are using it.

USING THE WEB IN TECHNICAL REPORTS.

In the courses of Data Structures, Operating Systems and Computer Networks, we develop several non-programming topics. To involve students actively and to "keep the class with us" during the lectures, we asked them to prepare handwritten reports as a folder activity searching for the material in the Internet. We asked the reports to be handwritten to foster writing habits preventing the cut-and-paste approach, but they were allowed to reorganise the material in their own way, with their preferred examples, graphs, diagrams, tables as summaries of the different concepts and their relationships. The reports addressed information:

- covering the essential points discussed in the last lecture
- preparing for the next lecture
- related to the current project.

We addressed students' interest in writing based on their expectations on how engineers work. Although the primary training and interests of engineers lie in technical areas, in many software-engineering activities, the ultimate product of their work is a written document. The report is evaluated by the individual effort he/she does. Consequently, mistakes and errors are part of the learning process of writing reports. Adequate feedback with recommendations is given by flagging but not correcting mistakes. The reports were used during the in-class assignments using the following outline:

A homework report on some topic is asked individually. Students are able to choose one of a list of related topics (e.g., different sort methods or different aspects of and Operating System task) as long as the entire list is chosen.

During the next class we worked on the reports in four steps. First, we presented a real case and asked students with the same topic to solve the case in small groups at their seats using their reports. They had to write a short guide on how to solve the case. Second, a lecture using the different topics was held, allowing enough time for active participation asking and replying questions. Third, students were asked to form mixed groups, each member with a different topic. They were asked to compare their approaches and write the conclusions. Last overall conclusions were drawn and the

next topic was introduced in order to repeat the outline in the next class. The in-class reports and the individual reports were handed in.

When the topic was over, we reviewed the folders following the general folder's guidelines with special care in citations and source evaluation. Technical style is also corrected but different ordering of the material, related to different learning styles is allowed.

As part of each out of class assignment that varies depending on the subject and the course general interest, a professional report, well structured and referenced had to be presented. We helped students with outlines and different proposed layouts, but they had to follow one of them. As an important part of the assignment, the bibliography must be commented. This requirement enforces the guidelines on source evaluation and critical thinking handed and discussed. In this way we integrated writing abilities, the use of the Internet, proper citation techniques and information source evaluation in a "natural" way in the projects we develop during the course.

CONCLUDING REMARKS.

A second survey on the same group. But a year after beginning with the Internet folder activity showed the following results.

With the programming assignment

- 5% of true cheating remained at the same level. The cases were easily detected, and they are "problematic" in other subjects too. We think they were testing our abilities to detect cheating.
- 20% used parts of the code without proper understanding. These students asked us for help or more time, when we asked them to hand in whatever they had done, their work showed these characteristics. We think they were working out the assignment by having first a program that works and after modifying it (sometimes students exhibit "engineering" attitudes that are truly amazing).
- 75% enjoyed the experience making really good jobs, comparing and criticizing approaches they found in the net.
- In the report assignments we found.
- 10% continues with the cheating being easily detected.
- 35% did an outstanding work, even citing more than one author in the final examinations, months after the end of the course.
- Quality of the remaining 55% varies a lot, but they showed more than usual textual transcripts, proper citation and some critiques were always present.

Modifications were introduced in the realm of other innovations such as writing activities, case-based studies, multidisciplinary teaming and an effort of learning style self awareness. It is difficult to measure their effect separately

Proper attribution of credits is seen frequently after our courses, as some kind of interaction with Web sites authors is seen, such as exchanging ideas, code, animation, figures and tracing material. It has a great effect on our students who begin to fell themselves part of the International Community. Also it is important to Web site publishers who acknowledge some lack of internationalization of their sites as the use of spoken explanation tracks. With the feedback of our students, authors get also some sort of recognition of their work. Finally we, teachers, can address better the origin of some misused or different defined concepts.

The use of the bibliography in general, not only the Internet resources, improved a lot. We began to see written summaries with books, journals and magazines references. And some scale of credibility is developed and shared by students studying in group.

A critical attitude was developed regarding advertisement claims, sometimes written as technical papers. Claiming about product features began to be seen as something that is better to confirm on the field. We see this as a preparation to cope with the overwhelming propaganda usual in computing.

We do not know if this practice changed their attitude on using some other work, but they are at least aware that we know how they do it. And we are making some efforts to spread the information. The attitude of not banning but integrating their tricks in our class development acted as a high motivator and made our relation with the students closer. In some aspects we moved from our teacher position to an expert counseling position.

REFERENCES

[1] Young, J, "The Cat-and-Mouse Game of Plagiarism Detection", *The Chronicle of Higher Education*, July 6, 2001 available at http://chronicle.com/free/v47/i43/43a02601.htm, last accessed Feb 2002.

[2] Feldgen , M., Clúa ,O. "Hardware Dissection as a Tool to improve Teamwork " FIE2000 (*Frontiers in Education)*, Oct 18-21 2000. Kansas City, MO.

[3] Feldgen , M., Clúa ,O. "Fostering Writing Habits in Computer Science: a Road to Meaningful Learning", ICEE 2001 *(International Conference on Engineering Education)*, Aug 6-10 2001, Oslo, Norway.

[4] IEEE, ACM. *Computing Curricula 2001 Section 7*.6

[5] Dick, M., Sheard, J,. Markham, S. "Is It Okay to Cheat? - The views of Postgraduate Students" ITiCSE 2001 *(SIGCSE ACM Conference on Innovation and Technology in CS Education)* June 25-27, 2001, Canterbury, England, P61.

[6] Viguen, J. "Educators Fighting a Web of Deceit" available at http://computernewsdaily.com/147_052797_130001_8138.html last accessed Feb 2002.

[7] Tong, J. "Citation Style Guides for Internet and Electronic Sources" available at http://www.library.ualberta.ca/guides/citation/index.cfm last accessed March 2002. Herbert T. Coutts Education and Physical Education Library, University of Alberta. CA.

[8] Grassian, E. "Thinking Critically about World Wide Web Resources" available at http://www.library.ucla.edu/libraries/college/help/critical/ last accessed March 2002. UCLA College Library, 6/95. USA

[9] Bowyer, K. "Experience Using MOSS to detect Cheating on Porgramming Assignments" FIE1999 (*Frontiers in Education)*, Nov 10-14 1999. San Juan, PR.

[10] Ryan, J. C: H. "Student Plagiarism in an Online World" ASEE Prism online at http://www.asee.org/prism/december

[11] Cunningham, p. "Using CBR techniques to detect plagiarism in computing Assignments" Proceedings of the First European Workshop on Case-Based Reasoning, Kaiserslauten, Germany, 1993

[12] Lancaster, T.; Culwin, F. "Towards an Error Free plagiarism Detection Process" ITiCSE 2001 *(SIGCSE ACM Conference on Innovation and Technology in CS Education)* June 25-27, 2001, Canterbury, England, P57.

[13] Hein,T. "Using writing to confront students missconceptions in physics", *Eur J of Physics*, 10 (1999), 137-141, UK.

[14] Hein, T., Budny, D. "Teaching to Student's Learning Styles: Approaches that Work" FIE 1999 (*Frontiers in Education)*, Nov 10-14 1999. San Juan, PR.

[15] Hein, T., Budny, D. "Learning the Write Way in Science and Engineering. FIE 2001 (*Frontiers in Education), Oct 10-13 2001. Reno NV* Paper nr 1130.

[16] McMartin, Bayard, Muramatsu, Tront: "Introduction to Evaluating, Selecting and Using Computer Enhanced Learning Technologies and Courseware in Engineering Education", Workshop held at the FIE 2001 *Frontiers in Education), Oct 10-13 2001. Reno NV* related to the NEEDS and SMETE project http://www.needs.org and http://www.smete.org