Successful Pedagogy With Web Assignment Checking

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Introduction

In recent years many exercises and evaluation methods that rely on an interaction of questions, assignments, classroom study and student achievements were developed. Two years ago the Ort Braude College has decided to test the integration of WAC into academic learning, with the goal to improve learning procedures. The computer- checked assignments program chosen was WebAssign (Bonham et al, 2000 and 2001) from the University of North Carolina. Assignments contain a series of questions on topics that were taught in the previous lesson or are preparatory questions for the next lesson and are relatively easy for faculty to build. The system allows students to tackle assignments given weekly through the semester, over the Internet. Examination of the assignments is performed automatically. The student receives feedback immediately upon submission, and in many cases has an opportunity to correct mistakes. An example of a question on the topic of circular motion appears in Figure 1.

The system allows the teacher to read the students' answers and see their grades for each of the questions in the assignment. With the help of the system, the teacher is able to identify the degree of success for each of the students in coping with the homework. The system contains statistical tools that permit the teacher to receive an overall picture of the class. The information makes it possible for the teacher to prepare the next lesson taking into account the students' difficulties with their homework. They are then able to adjust the teaching to the feedback via the system. The system is consistent with the JiTT[1] pedagogy approach (Novak et al., 2000) that was adopted by the College during the planning stage.

The decision to work with this system was based on a number of assumptions:

1. Student's exercise and especially checking the homework needs to be improved. Following the increase of students, the College faces difficulty in providing a solution for routine weekly checking of homework, and this system is designed to provide the solution.
2. Feedback to students—lacking the feedback, many students found it difficult to assess their achievement during the length of the course. This system is designed to keep the student aware of his grades during the course, and thus allowing him to improve his performance while submitting assignments.
3. Feedback for the lecturer—the lecturers found it troublesome to tune the pace of teaching to students' learning difficulties, because they didn't have the tools to identify these difficulties.
4. Improving student involvement in the courses. The students had a propensity to exhibit passive behavior in many courses and "come alive" with the approach of mid-semester exams and then once again at final exams.

Working with WAC enhances the students' involvement in the course because it forces them to solve homework problems in a methodical way on a weekly basis.

[1] Just in Time Teaching - JiTT

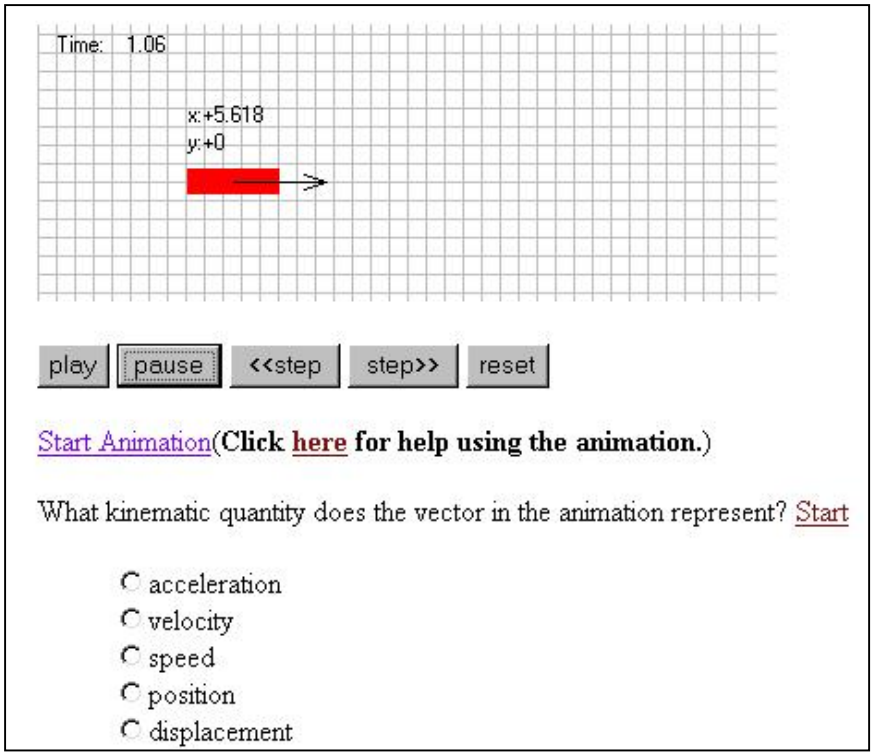


Figure 1. Example of a question from a WAC dealing with circular motion. The question demonstrates the motion utilizing animation that is controlled by the student.

This paper deals with the difference in attitudes held by students and staff members regarding Internet WAC in basic science courses in the College Engineering School. In order to identify these attitudes a questionnaire was drawn up that contains 26 items according to the Likert scale (5 levels of agreement). The questionnaire is intended to examine student attitudes at both the beginning and end of the course. In the first phase the device was applied in five courses with a population of 187 students for the semester. In this paper we will report on the process of building this tool and initial research results.

Since there is so little known relating to students' attitudes from the courses in which the WAC checking is done, a large number of questions could be asked about the students' attitudes and the effect that the WAC have on them. We decided to focus on the two following questions:

1. In what ways are students' attitudes different from those of the staff in relation to the WAC at the beginning of the course and its end?
2. What is the teaching style that would allow closing the gap between students' and staff members' attitudes where WAC is integrated?

Constructing an Opinions Survey

We decided to develop a survey in the Spring semester of 2001 in the Ort Braude College. Students in introductory courses were given a list of statements dealing with their attitudes of integrating WAC into the study process, their backgrounds in computers and computerization, and their estimation of the importance of the tool. They were asked to rank the statements on a scale of 1 to 5 using the Likert method. Full agreement receives a rating of 5 and total disagreement receives a rating of 1. The statements in the questionnaire were assembled following a survey of professional literature, discussions with staff members and consultations with experts in the field of teaching sciences. Validation of the statements was performed in several ways that included: conversations with experts in the teaching of sciences and computers, interviews with students, examination by a number of "experts" and administration of a second survey to a number of study groups.

In relating to the term "students' attitudes," we are dealing with a complex concept that has many aspects to it. We decided to concentrate on six aspects or dimensions by which we can classify student inclinations in relation to the desirable way to integrate the WAC into teaching engineering sciences.

1. **Engagement—**opinions about the course are expressed by preparations for the course lesson, class participation, curiosity that the course stimulates and the willingness to delve into associated topics that are not part of the required material (Hake, 1998).
2. The student's belief in the structure of the **Understanding** which they are about to learn and how the WAC influences their understanding of the material during the course.
3. **Interactive Teaching—**to what degree do the staff members exploit the new technology of the WAC in order to improve the quality of their teaching.
4. **Importance of the course—**Just how important is the course in the student's professional development, and just how much of his or her familiarity with the system is likely to make a contribution to his or her success in the course and understanding of professional problems (Van Heubelen, 2001).
5. **Exercise Style—**Traditional exercise versus exercise over the Net– the students' evaluation of the benefits derived from the traditional exercise based on submitting homework several times during the course and partial feedback, versus submitting homework over the Internet on a weekly basis and receiving feedback for each of the answers.
6. **Studies load—**The students' attitudes to the added workload using WAC versus the benefits derived from it.

The Research Population

We delivered the survey in five courses, as described in Table 1. There was also a sixth reference group consisting of 14 faculty members, who have many years of experience in teaching academic courses. We requested that these teachers also answer the research questions in the way that they would want their students to answer them. We conjectured that the research groups' answers would show, during the semester, an increasing agreement with the answers that were preferred in our opinion.

Table 1. Research groups

Group No.	Course	Department	Year	N
1	Biochemistry	Biotechnology	1	33
2	Materials strength	Mechanical	1	14
3	Kinematics	Mechanical	2	24
4	Network Communication	Software	3	32
5	Cryptology	Software	3	84
				187

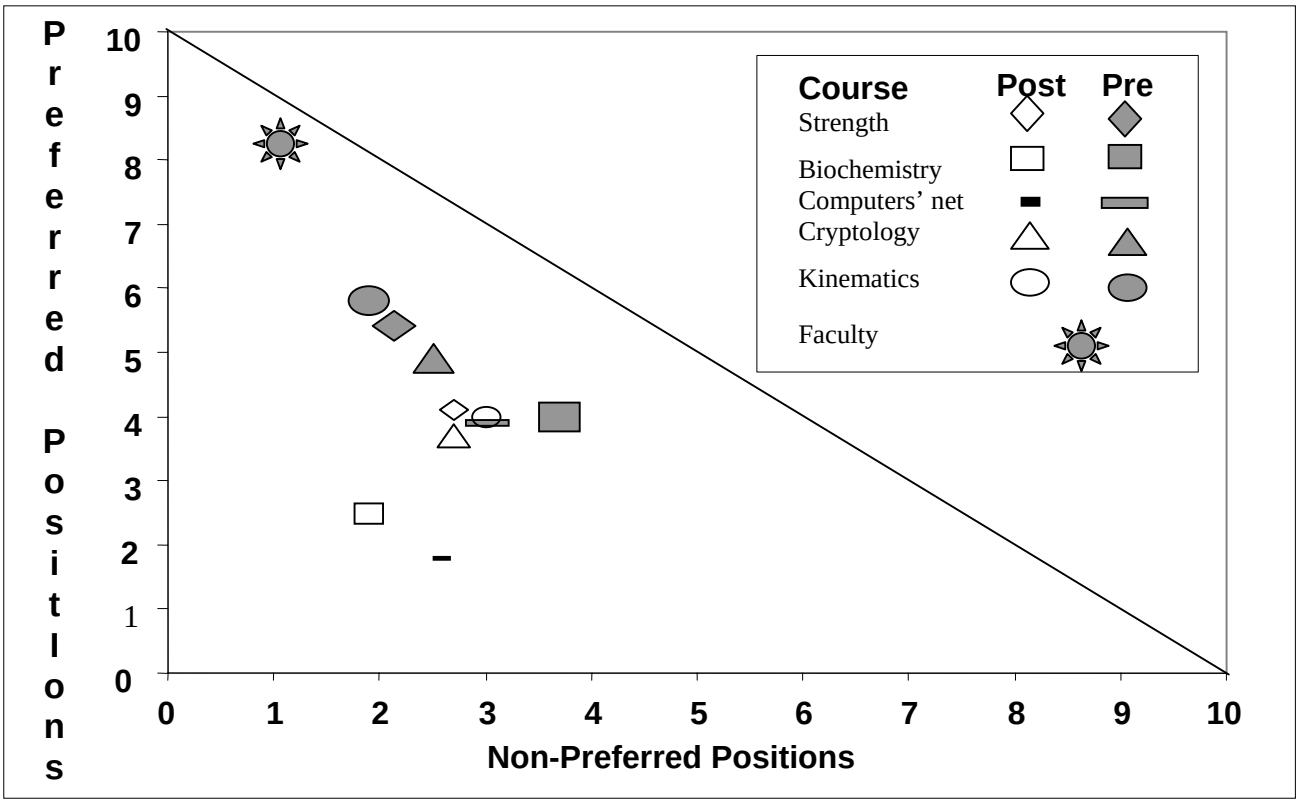
Results of the Research

We expected that the teachers' group would exhibit a high degree of preference for a constructivist science teaching that uses the results of WAC during the course delivery. As such, we estimated that there would be a high concordance between staff members when they were asked to select the answers that they would want the students to choose. We regarded the answers given in consent by the teachers with experience as the favorable responses, and to the responses that don't agree with them to be the undesirable responses. In our analysis the answers *Agree* and *Strongly agree* (4 and 5) were unified, and the answers *Strongly disagree* and *Disagree* (1 and 2) were also unified.

In order to demonstrate the research test results in a methodical and simple way we used a (A-B) graph – *Preferred – Non-preferred*. In the graph the group's placement was determined based on its preferred positions in relationship to the non-preferred positions. Whereas the total of students has to be 100% or less, the placement of all the points must be triangular whereby the points of the triangle are at (0,0), (0,100) and (100,0). The distance from the others in the triangle indicates the percentage of respondents who took neutral stands or preferred not to answer. The closer the placement of the group is to the left upper corner of the triangle, the group's position is in higher agreement with that of the experienced teachers.

The results of the research are in Graph No. 1. In this graph the percentage is the average of all the items in the survey.

Graph 1. Graph A-B that compares between attitudes of research groups, to attitudes of the faculty.



From the graph we could see three facts.

a) At the beginning of the semester the students in all the courses didn't express an opinion for 45% of the items that appeared in the questionnaire. The majority of them at this stage submitted only one or two assignments using the WAC. The effect of the WAC on the teaching and the learning in the course still wasn't clear to them.

b) At the beginning of the semester there was a difference in preferred attitudes to non-preferred attitudes of 9% (32% and 23% respectively), and at the end of the semester the students' opinions changed and the differences grew to 20% (47% and 27% respectively).

c) It is possible to differentiate between two different trends in the two researched populations. The first population was comprised of two groups (biochemistry and computer networks) in which the students at the beginning of the course did not take a position regarding most of the statements. The change in taking a stand was because of strengthened preferred positions and the strengthening of the non-preferences in relation to the integration of the WAC in the learning process. The second population included three other groups (materials strength, cryptology, kinetics) made great improvement along the semester. The common denominator of all three

groups was the growth in the preferred positions by 14% in comparison to the drop in non-preferred positions of 6%.

Conclusions

Characteristics of Successful Pedagogy

The results of the research indicate that in three courses the gap between students' opinions and those of the staff was shortened between the beginning and the end of the course. In light of the survey results and the discussions we conducted with the students in these courses it is possible to assume that the lecturers in these courses succeeded in adopting a pedagogy that more effectively integrates the WAC element in the course. In interviews that we conducted with the lecturers we attempted to find out how these lecturers worked with the WAC and how they utilized the information that was made available to them through it. During the interviews with these lecturers, we identified four central areas in which the integration of the WAC was successfully used during the course, also accommodating the increased workload and the requirements of the subject matter.

- **Assignments construction** – The lecturers tried to give small assignments at least once a week. This is contrary to the current trend, according to which only a few assignments should be given, but each one should have a large number of questions. These lecturers were aware of the student's increased workload and planned it accordingly. The assignments that were designed to prepare the students for the next lesson contained an open question, allowing students to demonstrate their ideas and solving strategies. (Novak, et. al. 2000).
- **Friendliness:** the lecturers were consistent to direct the students to the chapters in the course textbook to which the assignment belonged. Some of them even made a habit of planting clues, for the benefit of the students who failed to correctly answer the exercise the first time. This allowed students to correct their previous approach of solving the problem. In assignments where most of the answers were numerical, the lecturers allowed three or four submits.
- **Feedback** from the WAC during class time: Before the lesson, the lecturers reviewed the students' answers and marked for themselves the common errors or alternative solutions. The beginning of the lesson was devoted to a discussion of the difficulties that arose in the homework or for the encouragement of students who managed to solve the problems in an interesting way. A lesson in which the students' difficulties get priority certainly enhances attitudes (Hestenes, 1998; Salomon & Perkins, 1998).
- **Evaluation:** lecturers who succeeded in improving students' attitudes regarding the assignments were diligent in rewarding the students in the final grade for the efforts they made in doing the WAC. The average weight that the WAC contributed was 10% of the final grade. These lecturers integrated into the final exam similar components from questions that appeared in the computerized assignments as suggested by Mazur (Mazur, 1997) who views the final exam as the impetus for the course. This attitude led to a decrease in the copying of assignments between students working with WAC.

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