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Enhancing an Engineering Learning Environment

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PELLET ANALYSIS OF WINTER-ROOSTING LONG-EARED OWLS *(ASIO OTUS)* IN ARKANSAS

The Long-eared Owl *(Asio otus)* is rather rare in Arkansas, with only about two dozen individuals recorded in the state in the past 30 years (James and Neal, Arkansas birds: their distribution and abundance, 1985, p. 210); (Muth, Am. Birds 39:177, 1985; Am. Birds 40:291, 1986; Am. Birds 42:277, 1988). Herein I report on the contents of owl pellets from 2 Long-eared Owls found in northeast Arkansas. On 6 December 1988 I discovered a dead Long-eared Owl on railroad tracks at the NE corner of the Jonesboro municipal airport, Craighead County. Subsequently 2 live individuals roosting close to the trunk of a small oak tree at a height of 3 meters, in a wet scrubby area along the railroad tracks were observed. They could be found each day in the identical spot until 19 January 1989, after which they were not seen. Sixty-two pellets were picked up under their perch and analyzed for the animal remains they contained as an index of the owls' feeding. Pellet contents and percent occurrence in total pellets were as follows: house mouse *(Mus musculus)* 41.3; unidentified bird species (Passerines) 14.9; unidentified rodent remains 11.5; marsh rice rat *(Oryzomys palustris)* 6.9; *Microtus* spp. 5.7; southern short-tailed shrew *(Blarina carolinensis)* 4.6; least shrew *(Cryptotis parva)* 3.5; prairie vole *(Microtus ochrogaster)* 3.5; Norway rat *(Rattus norvegicus)* 3.5; hispid cotton rat *(Sigmodon hispidus)* 2.3; and southern bog lemming *(Synaptomys cooperi)* 2.3. The species taken, and the percentages of each, conformed closely to the types and numbers of small vertebrates likely to be encountered at that time and place (Van Rick McDaniel, pers. comm.), and indicated that the Long-earned Owl, during the winter in Arkansas, is an opportunistic nocturnal predator. This agrees with the results of other studies of feeding habits of this species (e.g. in Bent, Life histories of North American birds of prey, part two. U.S. Natl. Mus., Bull. No. 170, 1938).

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ENHANCING AN ENGINEERING LEARNING ENVIRONMENT

As part of a Title III grant from the Department of Education, Christian Brothers University initiated a focused effort to incorporate critical thinking and enhanced communication abilities into the freshman engineering sequence. One of the first courses targeted for this incorporation was the introductory FORTRAN course which is required of all engineering and engineering physics majors. This course is an elective for computer science and science majors.

The modification to the course consisted of 4 major components. The first component was the introduction and use of a problem solving paradigm. Research by Charles Wales of West Virginia University (Wales, ASEE Volume 78, Number 7, p. 687, 1988) and Donald Woods of McMaster University (Woods, Strategies, p. 4-1, 1985) determined that student performance improved with the use of a problem solving paradigm. The paradigm that was used consists of seven steps:

1. I want to and I can — Students were encouraged to motivate themselves and prepare before starting a problem.
2. Define the situation — Students were prompted to try to understand the words of the problem, to analyze the statements concerning the problem, to identify constraints, to identify criteria, and, where applicable, draw diagrams and sketches.
3. State the objective — Students were required to write down exactly what they wanted to accomplish.
4. Explore the options — Students were expected to play around with ideas, make connections, collect information, and postulate possible solutions.
5. Plan — Students selected and developed a plan for solving the problem.
6. Do It — Students worked the problem in this step.
7. Look back — Students were asked to evaluate their performance. They were asked to check and double check, identify experience factors, extend to similar problems encountered, and determine what they learned about problem solving.

This same problem solving paradigm has been used in chemistry and physics courses. The student response to the problem solving paradigm was generally positive. Hesitation about the paradigm centered around the concern that following the 7 steps made the problem solving process longer. A typical student comment about the problem solving paradigm was, "Using the paradigm makes me stop and really think about what I am doing. It requires me to organize my thoughts, but this sometimes takes too long." A typical student misconception concerning the paradigm was that the problem solving paradigm is serial. Some students believed that once they completed the "define the situation step" that they should never return to that step! The majority of students expressed the opinion that the problem solving paradigm had been helpful in solving problems.

The second modification introduced was the use of guided design and discovery techniques. Prior to the modification, students were given lectures explaining programming theory before writing or seeing programs which exhibited those techniques. The student interest in the theory was low and little concerning the theory was retained. Kobl (Kolb, The Modern American College, Chapter 10, 1981) has suggested that students learn better when they start with a concrete experience. Now students are given a structured and well documented program which exhibits the desired programming theory before the theory is discussed. For example, on the first day of class, students are taken to the computer lab and asked to create a simple program. The program prompted the student to enter 3 numbers and then the program displayed the average of the 3 numbers on the screen. The students were first asked to compile, link, and run the program with a few sample cases. Next the students are asked to change the declaration of variables in the program from type real to type integer. They are asked to edit, compile, link, and run the program again and observe the differences. Finally, they were asked to read the program and hypothesize what each statement accomplishes. When the program was discussed in class, some students had already figured out what most of the program did. Those students who were not sure about the program had many questions and were motivated to learn about programming. The shift to self-discovery has increased students' participation and given them a sense of "ownership" concerning the course. There were a few students who were uncomfortable with self-discovery and wanted to know the "answers" before working on any program. These students performed well and their sense of discomfort seemed to be with the shift of responsibility. Usually, by the fourth week of class, students adjusted to the shift and expressions of anxiety decreased.

The third modification introduced in the course was the use of journal keeping as a learning and communication tool. (Knoblauch and Brannon, College English 45:5, pp. 465-474, 1983) Prior to the introduction of writing as learning, engineering students had been required to keep design journals. The focus of these journals was primarily on documentation. The focus has now been expanded to include not only the students' observations but also their feelings, guesses, and reflections concerning their own learning process. Students were given assignments to write in their journals in the classroom and outside of the classroom. As an example, on the first day of class, students were given a syllabus which outlined course goals. They were then asked to write down their initial reaction to the syllabus and select the course goal which was most important to them. In the process of thinking about the course goals, some students changed their perception of FORTRAN. The course was transformed from a dreadful required course to a possibly useful course.

The journals were also useful to the instructors. By reading students' thoughts and feelings concerning the material, it was possible to find and correct misconceptions concerning FORTRAN. In addition, it was readily apparent when a student understood a concept and it was possible to monitor a student's progress in the class. The journal also added a personal communication link between the student and instructor. When students realized that the journals were confidential, they began to vent concerns and frustrations that they did not feel free to express in class. As the last journal assignment in the course, students were asked to re-read their journals and reflect on the usefulness of the journals. The majority of students found the journal keeping helpful. Those who did not find the journal helpful made comments such as, "I do not believe that the journal actually helped me in my learning. It may have pointed out any problems I have to the instructor, so that I could receive help."

There were some students who were exhuberent about the use of the journal. It was gratifying to read entries such as the one below:

> Can I see any evidence of growth???? When I came to this class, I knew nothing at all about FORTRAN. This seems like such a short time ago. I can't believe all of the things I know now. My growth in this class can be compared to the size I was at one day old as compared to my size at 18 and one day....I would recommend using journals in FORTRAN next semester. I will admit that I thought it was dumb at first, but after looking back on it, I think it was a very good idea. The fact that I can now look back and see just how far I have come in so little time justifies using the journals tenfold.

The fourth modification introduced was the concept of assessment as learning. (Mentkowski and Loaher, Assessing Educational Outcomes, p. 47, 1985) Specific criteria were developed for each assignment. These criteria were not exact instructions but rather the rules for evaluating a student's performance on each assignment. Each student was asked to evaluate his/her performance on each assignment. In addition, the instructor gave timely feedback to each student concerning the student's performance. Initially, students tended to rank their performance on assignments much higher than the instructor. Through the feedback process, many students began to develop the ability to self-assess their work. As an example, to introduce control structures students were asked to input and test a simple program. The requirements and criteria for the assignment were as follows:

I. REQUIREMENTS

1. Enter the program. Compile, link, and run the program with various inputs. Try to select inputs which represent normal operating conditions and others which test the limits of the program. Create a table of these results for inclusion in your submission. Justify all values which you select to test.
2. Explain in your own words what the program is doing. If you had been the programmer, how would you have changed the way that this program is written?
3. Propose a structure to handle the case in which there were 3 possible alternatives for the calculation....
4. In the program that you entered into the machine, what error do you receive if the END IF statement is not entered?
5. Submit at least one page detailing what you have learned fromthis assignment.
6. Submit a self evaluation of your performance on this assignment. Assign yourself an evaluation of Excellent, Good, Acceptable, or or Unacceptable. Support yourself in terms of the criteria shown below.

II. CRITERIA

1. Completeness of the submission as detailed in the requirements. Failure to submit any of the above components of the assignment will result in an evaluation of Unacceptable.
2. Thoughtfulness and completeness of the testing as outlined in requirement 1.
3. Depth of explanation of what the program is doing. This is to be an ENGLISH explanation of what the structures in the program are doing. Unknown structures should be solved based on how they behave in program operation.
4. Accuracy of the alternate control structure in requirement 3.
5. Accuracy of the results in requirement 4.
6. Length and depth of "what you have learned" and "self evaluation" sections. This should be an HONEST evaluation and should be given careful consideration. It is not an add on to be completed at the last minute.

To help students understand the expectations for excellent work, examples of excellent work were shared with the class. By the end of the semester, students reacted positively to criteria based learning.

In conclusion, the modifications made to the introductory FORTRAN course have been received favorably. Student participation and performance have increased.

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