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APPLYING GUIDED DESIGN TO THE PRODUCTION/OPERATIONS MANAGEMENT COURSE: A PROGRESS REPORT AND EVALUATION

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ABSTRACT

In this paper we describe the application of the Guided Design teaching method to a course in Production/Operations Management. The Guided Design technique is designed to combine students' learning of content material with the acquisition of decision-making skills through unstructured, open-ended projects. Students are guided through these projects by a series of instructions and feedback. The development of Guided Design materials for a course in Production/Operations Management is described and an evaluation of their effectiveness is presented.

INTRODUCTION

This paper describes the guided design technique and reports the success of the technique when applied to a beginning level production/operations management course.

GUIDED DESIGN

Guided design is a technique developed by Wales and Stager [1] to improve the comprehension of students in mastering knowledge, skills, and attitude elements of a course. Its objective is to teach Subject matter as well as decision-making skills. The basic unit of Guided Design is a "project" which utilizes the concept of programmed instruction to lead students through a decision-making experience. As part of this experience, the students must use their knowledge of appropriate content material as well as their own attitudes to solve a problem.

The usual structure of a Guided Design project Consists of the following Steps.

1. Define the problem to be solved and state the specific objective of your work.
2. List any constraints which will limit possible solutions, assumptions which must be made about unknown data, as well as facts which are known.
3. Develop a list of possible solutions to solve the problem.
4. Evaluate the possible solutions and select the best.
5. Perform whatever calculations are necessary to develop the solution.
6. Present your decision-making work and the details of your solution.

In general, each of these steps is given to the Students, who work together in groups of 3-5, as an instruction. After a group has completed an instruction, they check with their instructor who evaluates their work. If a group's performance on the instruction is satisfactory, they will be given written feedback describing how an experienced problem-solver might have performed that instruction. They may then proceed to the next step. Groups whose performance on a given instruction is not satisfactory will be given additional guidance and told to perform that instruction again. The conclusion of the project is usually a written or oral report.

Since this project is the basic element of Guided Design, the majority of class time is spent working on it. Thus, the instructor becomes a director and coach in the process who is available when needed and ready to offer suggestions about the decision-making project.

Because class time is used for project work, students are expected to learn the content material on their own outside of class. To facilitate this self-study, programmed instruction materials may be provided or a standard text may be used with study notes. In either case, each project is carefully designed to require the use of a specific set of content material which the students have studied outside of class before undertaking the project. The instructor also acts as a consultant in the application of this content material to a specific open-ended project problem and, at the same time, is in a position to evaluate the level of learning achieved by the students.

APPLICATION TO PRODUCTION/OPERATIONS MANAGEMENT

In production/operations management, students learn to apply certain concepts and techniques, mostly mathematical, to the problems of planning, scheduling, and controlling the production of goods or services. Some of the topics which are covered include demand forecasting, aggregate planning, material requirements planning, and inventory control.

Like many quantitative techniques, the content material in production/operations management is relatively simple to apply to single answer, homework-type problems; but difficult to use properly in unstructured, open-ended problem-solving situations. In the latter instance students must decide which technique to use, whether its underlying assumptions are satisfied, and what data are relevant. Since these are the types of problems which students will usually face after graduation, it is important that they learn how to approach them. Therefore, in teaching production/operations management there are three objectives. First, students must learn to apply the content material to single answer, homework- type problems. Second, they must be able to apply these techniques to the solution of unstructured, open-ended problems. Finally, it is also important that students be aware of their own value systems and be able to apply them to a realistic production problem.

Because of the three objectives in production/operations management, it was decided that Guided Design should be used. Students could learn the content material on their own through self-instruction. Outside of class they could also practice using the techniques on single- answer homework problems. In class, they could use Guided Design projects to practice applying the content techniques so realistic, open-ended production/operations management problems which would also require the use of their individual value systems.

<u>Task Analysis and Production/Operations Management</u>

In a Guided Design course the sequencing of instruction- at material is very important. For one thing it is necessary that the content material be closely coordinated with the projects. That is, each project should require the use of a particular unit of content material.
In addition, it is important that each project not require the use of techniques which have not previously been learned.

Secondly, the self-instruction must be carefully sequenced. Since students will be learning material on their own, there should be a progression from the underlying concepts and techniques to the more advanced ideas: students should not be required to use content material which has not been previously mastered.

Because of the above requirements, task analysis was applied to the production/operations management course before any projects or self-instruction materials were written. In task analysis, a learning objective is broken down into its components and the relationships among these components are examined. For example, if the objective is for students to be able to develop an inventory control plan, one component is that they should be able to calculate the economic order quantity. However, in order to do that, they must be able to identify the variables in the formula for economic order quantity.

For the production/operations management course, the overall objective is that students should be able to develop a production plan. The components of this include forecasting demand. preparing a production plan, and controlling inventory. Subsequently, each of these components may be further subdivided. For an entire production/operations management course, part of the task analysis is shown in Figure 1 below.

DESCRIPTION OF MATERIALS NEEDED

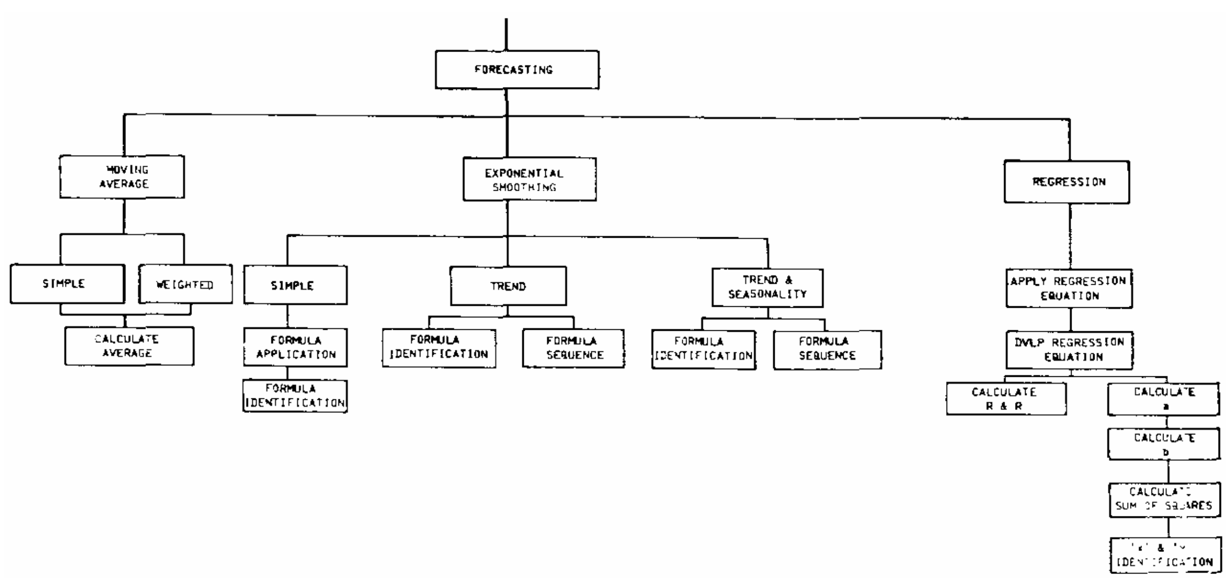
A programmed instruction manual was developed containing the most important concepts of the production/operations management course, including specific learning objectives for each section, and a pre-test and post- test for the use of the students to assist them in evaluating their progress in mastering the material.

Projects or case situations were also developed which would incorporate the desired concepts and skills based on the task analysis and these were organized so that students were given specific directions at each step. Feedback material was prepared and supplied to the groups after they accomplished the assigned task to give them information concerning their progress and guidance for the next steps in the process. Rather than lecture notes, the instructor needed a reasonable understanding of the projects so that he could provide the necessary guidance and direction but remain a consultant to the group rather than the leader. Thus, the students assumed a more active role in the learning process while the instructor “observed and counseled” from the “sidelines.”

OPERATION OF THE COURSE

To ensure the proper coordination of course material, students were given a detailed schedule describing when they should start and finish each self-instruction unit and when Guided Design projects should be started. In general, students started a particular self-instruction unit before they began the project related to that unit. In addition, the first few instructions of each project were general enough that students could perform these without having completed the self-instruction. Consequently, by the time they reached a point in the

FIGURE 1
TASK ANALYSIS FOR PRODUCTION/OPERATIONS MANAGEMENT



Project which required the use of certain content material, the students had at least a basic understanding of that material.

The conclusion of each project was a written report submitted by each group. This report was graded on the basis of completeness and correctness of work, rationale behind the solution presented, and whether any additional work related to the project had been performed. Since some students in each group worked more on the projects than others, a peer evaluation scheme was used to determine Individual grades based on the group report grade. Thus, a group could get an 85 on its report while one person in the group would receive an 80 on the project and another 90 on the same project.

During the semester there were four projects and three tests as well as a comprehensive final exam. Projects were weighed about half of the test grades.

For a class of 60, the instructor was kept extremely busy providing feedback and counseling. Consequently, in subsequent semesters, two graduate assistants have been used to help the instructor. For future classes it is anticipated that undergraduates who have previously taken the course will be used as assistants in exchange for course credit.

Evaluation

While only preliminary evaluation has taken place to date, several facts appear to indicate the effectiveness of the Guided Design technique. In general, the students approached the course with apprehension but seemed supportive of the overall method and arrangement of the course. While frustration appeared at times throughout the course, their attitude toward the course and the topic appeared more positive than in a conventional course, particularly in the mathematical and formula aspects.

More quantitative data have been collected by comparing student performance on identical test questions between the Guided Design class and a standard lecture class. These test questions were based on the following objectives which the student was expected to perform:

1. calculate a moving average.
2. use regression to develop a forecast.
3. develop a forecast using exponential smoothing.
4. calculate an aggregate production plan using a varying size workforce.
5. calculate an aggregate plan with varying inventory.
6. develop an aggregate plan using Overtime.
7. identify variables of the EOQ formula.
8. calculate an EOQ.
9. calculate economic run length.
10. calculate EOQ with price breaks.
11. use MRP to determine planned orders.

On the same multiple choice questions, the percentage of students in Guided Design and lecture classes who selected the correct answer is given below in Table 1.

This data suggests that the students were somewhat better in their mastery of the concepts and skills and this was reflected in higher grades. No attempt has been made to evaluate differences In retention at this time.

TABLE 1
COMPARISON OF GUIDED DESIGN CLASS TO LECTURE CLASS

Objective #	Guided Design	Lecture
1	99.5%	94.1%
2	92.5%	81.2%
3	92 %	81.7%
4	97 %	90.1%
5	95 %	83.5%
6	93 %	69.9%
7	96 %	84.1%
8	100 %	89.8%
9	98 %	73.9%
10	91 %	47.7%
11	99.9%	92.8%

Conclusions and Recommendations

In essence, the guided design technique reverses the normal course processes. While a more traditional course devoted class lectures and discussion to the mastery of concepts and knowledge elements of the course with homework devoted to the application of these concepts to typical situations, this technique relies upon the student to master the concepts on his own and then devotes class time to project or case situations. Thus, as the student faces uncertain situations and enters into areas where his mastery of the concepts is tested, the instructor is available to question, probe, suggest, direct, and guide the student through his problem by referring him back to the appropriate section of the text material or through discussion with the other members of his group. The process appears to provide greater satisfaction for the students and thereby provides a more positive learning atmosphere.

While the technique is not difficult to apply, it does require considerable preparation and planning time to develop the necessary materials. Experience to date suggests that this technique is probably effective with the production/operations management course and that further effort should be devoted to perfecting and fine- tuning the basic technique. Incidentally, a nice side benefit that appears to be present is that, by working with groups rather than individuals, the instructor is able to handle larger classes and achieve a slight increase in productivity.

REFERENCES

[1] Wales, C. E. and R. Stager, Educational Systems Design, (West Virginia University, 1974).