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THE ALGEBRAN INDUSTRY: A TUTORIAL FRAMEWORK

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ABSTRACT

This paper describes how a tutorial for students of basic algebra was organized as an experiential exercise. An industrial company paradigm was adopted, with solved algebra problems as the company's product. Work teams were organized around specified job assignments with corporate coordination and planning being provided by a management committee. The method could be adapted to a variety of other subject matter.

INTRODUCTION

ABSEL seems to be divided into two membership "camps" that, while not being in opposition, largely ignore one another. In the first camp are those who use simulation and gaming to teach business administration. This group can be further sub-divided into those whose primary interest is business economics versus those whose interest is business policy and organizational behavior. In the second camp are those whose primary interest is in simulation and gaming as a group-centered pedagogical technique. The first camp focuses its research on developing more "realistic", usually computer-based, models of production and market environments. The second camp emphasizes the development of experiential approaches to class-room organization that are largely independent of course content.

After teaching an undergraduate course in business policy for two years, in which I made extensive use of management games, I took a year off to pursue doctoral studies in management, during which time I accepted an assignment to run a basic algebra tutorial for academically disadvantaged students. This experience gave me an opportunity to see experiential learning from the non-business camp and to test in a very modest way the potential of management simulation as a general pedagogy.

This paper describes only the mechanics of how the tutorial participants were organized as a simulated industrial bureaucracy and how the subject matter was made to "fit" an industrial paradigm. I beg forgiveness for the lack of numerical validation data and hope this will not deter others from experimenting with the technique, as others may have already done, in other contexts.

Some of the factors which favored a group experiential approach to my algebra tutorial were as follows:

1. Primary teaching of the course subject matter was responsibility of other instructors, so the tutorial had more freedom to use a non-traditional technique for remedial purposes.

2. Students enrolled in the course were those who had scored poorly on a math proficiency examination taken on matriculation to the college. Many lacked motivation and self-study discipline necessary to master the subject matter on an individual basis.

3. The number of tutorial participants was expected to be initially small and then grow to more than 20 over the course of the semester as students came to appreciate their need for academic support. This meant there would be an on-going need to accommodate new participants and those attending intermittently.

TUTORIAL DESIGN

The organizational paradigm adopted was that of a modern industrial company manufacturing a standard product, called an algebran, for economic gain.

Product Specification:

Algebrans are solved algebra problems. The unsolved algebrans were obtained by random sampling from the algebra course textbook exercises. This gave us a "raw material" source of 2000 unsolved problems.

To be "marketable" an algebran had to conform to certain industry standards;

1. Drafted in ink to a high standard of penmanship

2. Include a full re-statement of problem taken from textbook

3. Intermediate solution steps to be numbered and follow logically from the previous step by application of a specified algebraic operation

4. Solution to be stated separately and be in agreement with textbook solution.

An example of a finished algebran is shown in Exhibit 1.

Plant Facilities:

"Plant" facilities available for algebran production were a 20 x classroom with ten 2 x 4' tables, 30 chairs and 6 blackboard spaces.

The company was in session for four 1-1/2 hour "shifts" per week. Participants were encouraged to report for at least two shifts per week. All company work was to be performed during the scheduled sessions.

Company Organization:

A. Basic work units

The basic unit of company organization was a four- person work unit consisting of a manager, an engineer, a technician and a clerk. Each function would normally be performed by a single person, but by consolidating two or more functions it was possible to have units of any size up to four persons. The specific duties of each function were as follows:

1. Manager: responsible for overall performance of unit, procures raw algebrans (problem numbers only) at beginning of session and delivers finished algebran at end, represents unit on management committee

2. Clerk: retrieves problem statement from textbook and checks engineer's solution against textbook solution.

3. Engineer: obtains problem statement from clerk and works out steps to solution on the blackboard

4. Technician: drafts problem statement, engineer's analysis and solution onto Algebran Product Sheet (Form A)

Each unit was assigned a table and blackboard space. Participants could freely interact with members of the same unit but not with members of other units. Members were encouraged to rotate work assignments within their unit.

A manager could dismiss any unit member. He could himself be dismissed by all the other members acting in concert. A dismissed member would be re-assigned to another unit by the management committee.

B. Management Committee

A committee composed of the team managers plus any functional managers that had been appointed was responsible for planning and coordinating overall company activity. The management committee would meet for a limited time during each session.

Some specific functions which were coordinated on a company-wide basis were:

1. purchasing and distributing raw algebrans

2. quality control of finished algebrans

3. technical support activity

4. recording and evaluating team and individual performance

5. personnel matters such as integration of new participants and job reassignments.

Up to a company size of 20 members with 5 work teams the management committee consisted of the 5 team managers, and there was no formal assignment of functional duties to particular managers. As the company size exceeded 20 while the number of work teams remained at 5, additional managers were appointed with functional duties (e.g. quality control, personnel, etc.)

Company Economics:

A. Algebran earnings

The company was charged $1 (1 point) for each raw algebran purchased and received a credit of up to $3 for each finished algebran delivered depending on its quality. Raw algebrans could be purchased just once at the beginning of each session, and any that were not finished and delivered by the end of that session had to be discarded at a loss to the company.

B. Wages and profit-sharing

Company earnings were distributed twice during the semester to individual members as a base wage plus profit-sharing bonus. Each member received a base wage of $1 for each shift worked, or proportionate share of any lesser company earnings. Company earnings in excess of the amount needed to cover base wages were distributed according to a peer evaluation survey conducted among the members.

C. Company Report

At the beginning of each session the tutor supplied the company with a written report of its performance for the preceding period and cumulative performance to date showing:

1. number of raw algebrans purchased

2. number of finished algebrans delivered

3. algebran dollar earnings

The finished and graded algebrans were stored in a central file to which the company had access during each session.

COMMENTS

After the algebran production cycle became routine for the teams, the technical difficulty of the raw algebrans was increased to maintain the intellectual challenge of the team's work.

A competitive spirit developed among the work teams, which had a regenerative effect on the company's performance.

The group process gives participants a chance to compare the strengths and weaknesses of their own approaches to problem-solving with those of others.

Peer pressure and company performance goals encourage the better students to assist the slower ones, who in turn are encouraged to bring their performance up to the group norm.

The need to communicate concepts and methods to others stimulates clarity of thought and precision in symbolic representation.

With changes primarily in the design of the "product" this technique could be applied to problem-solving tutorials in a variety of academic subjects (e.g. physics, computer science, language).

EXHIBIT 1

FORM A ALGEBRAN PRODUCT SHEET

COMPANY: Alpha

SESSION PURCHASED: 4-23-03 SESSION DELIVERED: 4-23-03

PROBLEM NUMBER: 15.10

STATEMENT:

Solve $\begin{cases} 2x-y=10 & (a) \\ 4x-3y=16 & (b) \end{cases}$ by substitution

ANALYSIS:

1. $y=2x-10$	add $-2x$, multiply by -1 in (a)
2. $4x-3(2x-10)=16$	substitute for y in (b)
3. $4x-6x+30=16$	distribute -3
4. $-2x=-14$	add -30, simplify
5. $x=7$	divide by -2
6. $y=2(7)-10$	substitute for x in step 1
7. $y=4$	simplify

SOLUTION:

$x=7, y=4$

QUALITY POINTS:

EARNED POINTS: