OPERATIONALIZING A TEST OF A MODEL OF THE USE OF SIMULATION GAMES AND EXPERIENTIAL EXERCISES

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ABSTRACT

The authors propose an addition of two important dependent variables: Student Learning and Student Attitudes, to a previously-reported model of the use of simulation games and experiential exercises. Additionally, a research design proposal is tendered for ABSM members’ inspection and criticisms. The authors specify the anticipated operationalizations of variables, tests for reliability and validity, and the general analysis of the model’s postulated relationships. The paper is couched as a necessary step intermediate to theorizing and empirical hypothesis tests.

INTRODUCTION

Burns and Gentry (1977, 1980) have attempted to specify a number of variables assumed critical to the success of simulation games and experiential exercises and placed these variables in a causal framework. Their conclusion, arrived at through causal modeling, was that “user involvement” is the most crucial variable of the twenty-five specified, as it is hypothesized to relate, either directly or indirectly, to all others. However, the model proposed by Burns and Gentry (1980a) considers only independent variables and fails to explicitly relate the independent variables to salient dependent variables; namely, student learning and student attitudes. Recently, Burns and Gentry (1980b) have restructured the hypothesized linkages between the independent variables and postulated impacts on the dependent variables. Given that the model has been hypothesized, the logical next step is to test the hypothesized relationships empirically.

This paper will focus on a necessary intermediate step between theorizing and hypothesis testing that of developing the research design. Admittedly, it is tempting to go ahead and acquire data from users and participants; however, the intent of this paper is to propose a comprehensive research design that would preclude a “quick and dirty” data collection effort. Given the care taken in the development of this topic thus far, it would be inconsistent to ignore the tenets of proper research. Moreover, an earlier attempt (Gentry, McCain, and Burns, 1979) to operationalize the Bloom taxonomy (Bloom et al., 1956) showed vividly that the operationalization stage is critical in educational research, for the results indicated a high level of confusion as to the nature of the underlying concepts. Consequently, rather than to rush the data collection process and obtain data of questionable value, our intent is to use this paper to introduce our proposed methodology with the objective of eliciting constructive feedback from ABSM members.

DEPENDENT VARIABLES IN THE MODEL

Burns and Gentry (1977) described the independent variables hypothesized to be related to the effectiveness of simulation games and experiential exercises. These brief descriptions are provided in Figure 1. The two dependent variables, Learning and Attitude, are discussed below.

OPERATIONALIZATIONS OF THE VARIABLES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>How long the exercise lasts; number of decision phases, number of days, or weeks it takes the exercise to run</td>
</tr>
<tr>
<td>Decision Variables</td>
<td>Absolute number of decisions or phases over the duration</td>
</tr>
<tr>
<td>Results Sharing</td>
<td>Degree to which participants formally share the results of their game or exercises with one another</td>
</tr>
<tr>
<td>Participant Grouping</td>
<td>Number of participants in a group</td>
</tr>
<tr>
<td>Course Interaction</td>
<td>Amount of time devoted to the exercise, administration, and teaching related concepts</td>
</tr>
<tr>
<td>Accountability</td>
<td>Ability to relate individual results/learning to exercise decisions/performance</td>
</tr>
<tr>
<td>Autonomy</td>
<td>Individual responsibility for performance versus group consensus decisions</td>
</tr>
<tr>
<td>Participant Involvement</td>
<td>Amount of time required (per week or semester) for the average participant</td>
</tr>
<tr>
<td>User Involvement</td>
<td>Amount of time required (per week or semester) in teaching and administering the game and evaluation of participants</td>
</tr>
</tbody>
</table>

CONCEPT VARIABLES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity</td>
<td>Simplicity of the concept versus the complexity; the ease with which the concept(s) is understood</td>
</tr>
<tr>
<td>Theoretical Nature</td>
<td>Degree of abstraction in the concept; pragmatic (operational) versus theoretical concepts</td>
</tr>
<tr>
<td>Functional Environmental Impact</td>
<td>Number of business factors and outside considerations involved</td>
</tr>
<tr>
<td>Precision</td>
<td>Precision (implicit) versus precision (explicit) relationship of concepts to business decisions in the exercises</td>
</tr>
<tr>
<td>Stochasticity</td>
<td>Degree of random variation in the concept(s) versus degree of determination in the concept(s)</td>
</tr>
<tr>
<td>Number</td>
<td>Number of concepts or subconcepts to be taught or used</td>
</tr>
</tbody>
</table>

STUDENT ATTITUDES VARIABLES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to Learn</td>
<td>Capability of participants to learn due to intellectual level and situational factors</td>
</tr>
<tr>
<td>Willingness to Learn</td>
<td>Ability to learn</td>
</tr>
<tr>
<td>Willingness to Participate</td>
<td>Willingness to Participate: willingness to participate, positive attitude</td>
</tr>
<tr>
<td>Ability to Participate</td>
<td>Ability to participate in exercises</td>
</tr>
<tr>
<td>Number</td>
<td>Number of students in the class</td>
</tr>
</tbody>
</table>

SELF ATTITUDES VARIABLES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Self-serving versus self-serving motive</td>
</tr>
<tr>
<td>Familiarity with Topic</td>
<td>Number of years user has studied, taught, or worked with the topic</td>
</tr>
<tr>
<td>Teaching Philosophy</td>
<td>Number of hours or in-service training received during the course</td>
</tr>
<tr>
<td>Choice Sets</td>
<td>Awareness of other exercises which could accompany the same or similar ends</td>
</tr>
<tr>
<td>Resource Base</td>
<td>Number of resources available for running the exercise</td>
</tr>
</tbody>
</table>
Learning - One must assume that the educational system exists to develop the student. As such, learning is critical variable of concern when measuring the effectiveness of a particular teaching methodology. The operationalization of "learning" poses difficult measurement problems, however, many different measures have been used to represent "learning," including: simulation game or exercise performance, objective test performance, course grade, and self-reports. In fact, the definition and measurement of learning proves to be an elusive goal. Confounding occurs in most instances. For example, simulation or exercise performance measures both knowledge of the concepts and understanding of the game itself. The use of standardized tests dealing with the general course topic removes this problem, but introduces others. One such problem occurs when the teaching methodology is used with one objective in mind, and the test measures performance not directly related to it.

Bloom et al. (1956) developed a classification system of six different levels of learning. The Bloom hierarchy structures learning in progressive strata: Basic Knowledge, Comprehension, Application, Analysis, Objective Synthesis, and Objective Evaluation. Figure 2 summarizes each level. It is not uncommon to find an objective test emphasizing Basic Knowledge being used to measure learning in a course in which simulation game was employed. As the objective of simulation game would be Application or possibly Analysis, it follows that Basic Knowledge measures are inappropriate.

<table>
<thead>
<tr>
<th>Learning Objectives</th>
<th>Description of the Learning</th>
<th>Student is Assessed by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Basic Knowledge</td>
<td>Student recalls or recognizes information</td>
<td>Answers to direct questions and multiple choice tests.</td>
</tr>
<tr>
<td>2. Comprehension</td>
<td>Student changes information into a different symbolic form</td>
<td>Ability to act upon or process information by relating material to another context.</td>
</tr>
<tr>
<td>3. Application</td>
<td>Student discovers relationships, generalizations and skills</td>
<td>Application of knowledge to simulated problems.</td>
</tr>
<tr>
<td>4. Analysis</td>
<td>Student solves problems in light of concrete knowledge of the relationships among components and the principle that organizes the system</td>
<td>Identification of critical assumptions, alternatives and constraints in a problem situation.</td>
</tr>
<tr>
<td>5. Objective Synthesis</td>
<td>Student goes beyond what is known, providing new insights</td>
<td>Solution of a problem that requires original, creative thinking.</td>
</tr>
<tr>
<td>6. Objective Production</td>
<td>Student develops the ability to communicate the decision, to weigh, and to analyze logical consistency and attention to details.</td>
<td>Logical consistency and attention to details.</td>
</tr>
</tbody>
</table>

Clearly, the level of learning sought should be determined very early. If, in fact, the purpose of the course is to provide an awareness of the general topic area, then methodologies aimed at higher levels of learning may be counter-productive. On the other, if the objective is to improve the student's ability to apply the concepts, the use of multiple choice questions from the typical instructor's manual is also inappropriate. Consequently, one must be extremely careful in how he/she defines the dependent variable "learning." In short, the chosen pedagogy must be attuned to learning objectives and results measured by proper tests.

Attitude - "Attitude" refers primarily to the student's affective reaction to the teaching methodology, although the term is often used to encompass the affective reactions to the instructor or to the course. Student attitudes have also received a great deal of attention for several reasons. One reason is that student attitudes are often postulated as an intervening variable between the pedagogy and learning; highly motivated students are likely to learn more. A second reason is that student attitudes can have an influence in the measurement of performance (in the form of teacher evaluations) in administrative reviews of faculty. Student attitudes, then, represent another variable of concern when measuring the effectiveness of a particular teaching methodology. The operationalization of "attitude" has been a difficult measure, however, many different measures have been used to represent "attitude," including: student perceptions of the effectiveness of teaching ability, affective reaction to the teaching methodology, student perceptions of the teacher attributes, and course context. Seemingly inexorable interactions undoubtedly exist.

A relevant consideration is the temporal aspect of the measurement. Most measures are taken either after the termination of a particular exercise or at the termination of the course. It has been argued that the proper time to measure the perceived effectiveness of teaching methodology is after the student has been in the business world for a few years. While the authors agree that perceptions are more valid after some period of time has elapsed, we will concentrate on a measure of attitude taken in the short run due to:

1. the greater feasibility of measurement and
2. the necessity of short-term feedback in most pedagogy decisions.

PROPOSED RESEARCH DESIGN

The study will consist generally of surveying (1) faculty and (2) students, using the questionnaire shown in general for in Appendix A (Faculty version). The questionnaire represents our proposed operationalization of the Several variables under study.

Faculty Population. Many of the independent variables are, in fact, the 1980 version of the model (Burns and Gentry, 1980) have an instructor-orientation; that is, the effectiveness of the particular teaching methodology is evaluated by the instructor. Consequently, a survey of faculty using simulation games and experiential exercises will be made. While the model of the use of the methodologies is proposed as a general one, we hypothesize that the strength of the relationships will vary according to the following variables:

Methodology Used: Simulation Games vs. Experiential Exercise
Duration of the Exercise: Short vs. Long Scope of the Exercise: Operational vs. Strategic Nature of the Exercise: Stochastic vs. Deterministic

Student Population: While faculty have their own perceptions of the effectiveness of their teaching approaches, students must be studied insomuch as the dependent variables consider their learning and their attitudes. Moreover, it is highly likely that there will be discrepancies between faculty and student perceptions of the various variables (even the ones that can be measured objectively, such as the number of decision variables, the duration, the number of students, the resource base, etc.) due to the different frames of reference.

Also, nature of the relationships found among the variables are hypothesized to vary with the following student-related factors (as well as those specified for the faculty population):

Background: Business vs. Non-Business Major
Level: Freshman-Sophomore vs. Junior vs. Senior vs. Graduate Student
Sex: Male vs. Female
Time Status: Part-time vs. Full-time

Sample Design. We propose to use the ABSEL membership as a first source of faculty responses (and student responses, as we will ask certain ABSEL members to survey their students). Unless sufficient responses are obtained for all of the various cells, we will sample using adoption lists for simulation games and experiential exercises from cells needing more response.

Proposed Analysis. Proper instrument development procedures dictate that the measuring device be assessed for reliability and validity. A customary approach to these concerns is the multitrait-multimethod matrix method advocated by Campbell and Fiske (1959). Essentially, this approach requires that reliability be ascertained through test-retest procedures. Validity is apparent when high, positive correlations are determined for the same variable as measured by maximally different methods. The issue at hand, then, becomes the determination of methods which are sufficiently dissimilar yet comparable.

Were it not for the previously stated belief in the differences in the perceptions of faculty users and students, it would have been acceptable to consider the two populations as dissimilar methods. However, the contention requires that reliability and validity be determined within populations. We propose to draw subsamples in addition to the primary sample from each population and to administer instruments with different wording and different response scales. Thus, convergent validity will be assessed with test-retest measures.

Upon satisfactory results from the reliability and validity measurement phase (We realize that this phase may require a number of iterations.), attention will turn to tests of the various postulates and hypotheses within the general model. The model, one will recall, is a set of expected causal interactions among the several variables. Unfortunately, the huge aggregation of variables and relationships renders experimentation impractical; consequently, it is necessary to look to some other device for aid. It would seem that the most likely candidate in this regard is path analysis, which has been used unsuccessfully to isolate causal relationships in associative data.

CONCLUDING COMMENTS

The reader may experience frustration with our description of the proposed analysis; however, it is the intent of this paper to focus attention on the operationalizations of variables proposed research design. In this interest, we earnestly solicit the aid of ABSEL members and interested others in the critical evaluation of our instrument and basic procedure. It is our firm intention to incorporate constructive criticisms and useful suggestions in questionnaire revision before field tests commence. At the same time, any observations or shared experiences by ASSEL members with regard to the expected differences in perceptions within and between the two populations under study will be appreciated. We anticipate a comprehensive progress report for ABSEL next year as the next step in our long-term, programmatic effort to isolate the salient variables and relationships in the successful use of simulation games and experiential exercises.

REFERENCES


7. During normal conduct of the exercise or game, approximately how much do competing participants share results from their individual experiences? (Check one)

- Very little
- A limited amount
- A fair amount
- Almost everything
- Everything

8. Please indicate the approximate number of hours that you devote to each of the following tasks in the typical use of the game or exercise.

a. Approximate hours for orientation: ___________ hours
b. Approximate hours for game administration: ___________ hours
c. Approximate hours for decision making: ___________ hours
d. Approximate hours for teaching related concepts: ___________ hours
e. Approximate for "other": ___________ hours

9. On the average, in the conduct of this game or exercise, which of the following items indicates the amount of individual accountability for the typical student participant? (Check one)

- No accountability whatsoever
- Limited accountability
- Fair amount of accountability
- A considerable amount of accountability
- Complete accountability

10. For each individual student participant, approximately how much individual responsibility is there for the performance of the "team"? (Check one)

- No responsibility whatsoever
- Limited responsibility
- Fair amount of responsibility
- A considerable amount of responsibility
- Complete responsibility

11. Approximately how many hours per semester (or, per quarter, if it applies) does the average student spend, both in class and out of class, being involved with the game or exercise? ___________ total hours.

12. Approximately how many hours per semester (or, per quarter, if it applies) do you personally devote to the teaching and administering of the game or exercise? ___________ total hours.

13. Approximately: how many business concepts (e.g., span of control, economic order size, forecasting) are demonstrated, applied, or taught by the game or exercise? ___________ business concepts.

14. On the average, how complex are these business concepts involved in the game or exercise? (Check one)

- Very simple concepts
- Simple concepts
- Somewhat complicated concepts
- Complex concepts
- Very complex concepts

15. Approximately how many separate business functional areas (e.g., accounting and finance) are involved in this game or exercise? ___________ total business function areas.

16. Approximately how many subfunctional areas are involved in this game or exercise? (e.g., personnel and organizational development would be two subfunctional areas) ___________ subfunctional areas.

17. Approximately how many students with experience in this area of study have been involved in this game or exercise? ___________ total students.

18. In the average, how theoretical or business concepts involved in this game or exercise? (Check one)

- No theory whatsoever
- A limited amount of theory
- Some theory
- Considerable theory
- Complete theoretical

19. How closely related are the concepts in the game or exercise related to real-world business decisions? (Check one of the following)

- Almost no close relationship
- Very little close relationship
- Somewhat closely related
- Moderately related
- Very closely related

20. Please use the following scale to indicate the amount of random variation involved in the game or exercise. (Check one of the following)

- Almost no random variation (i.e., deterministic)
- A limited amount of random variation
- Some random variation
- Great deal of random variation
- Very great deal of random variation (i.e., stochastic)
4. What is your normal course and section load?
   _____ courses, _____ total sections per (check one): _____ semester, _____ quarter

5. Is the course in which you primarily use the game or exercise? (Check one)
   _____ required of all business majors
   _____ required of all majors in a particular business function
   _____ an elective course

6. Please indicate the year of your most recent degree.

7. Please indicate the approximate total number of papers or articles you have given or have had accepted in each of the following:
   a. Refereed journals
   b. National proceedings
   c. Regional proceedings
   d. Unrefereed journals

8. Please indicate the approximate emphasis on each of the following types of learning objectives through this game or exercise.

   Learning Objective Description of the Learning Amount of emphasis

   a. Basic knowledge
      Student recalls or reinterprets information
      1 2 3 4 5
   b. Comprehension
      Student changes information into a higher order frame of reference
      1 2 3 4 5
   c. Application
      Student discovers relationships, generalizations and skills
      1 2 3 4 5
   d. Analysis
      Student solves problems in light of conscious knowledge of the relationship between concepts and principles in the system
      1 2 3 4 5
   e. Objective Synthesis
      Student goes beyond what is known, providing new insights
      1 2 3 4 5
   f. Objective Evaluation
      Student develops the ability to make standards of judgment, to weigh and to analyze
      1 2 3 4 5

9. Please indicate your from opinion of the average student's reaction to the game or exercise and the teaching methodology you employ in the use of this game or exercise (check one of the following):
   _____ Enjoy it a lot
   _____ Enjoy it a little
   _____ Enjoy it somewhat
   _____ Enjoy it considerably
   _____ Enjoy it immensely

Thank you very much for helping in this survey. Please place the completed questionnaire in the attached self-addressed, postage-paid envelope and drop it in the mail.