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ABSTRACT

Simulation is the duplication of the essential characteristics of a task or situation. It represents three elements of the teaching-learning process: (1) stimulus situation; (2) response; and (3) feedback. The uses of simulation may fall into one of three general categories: research--the generation of information about an operational or proposed system, process, or environment; development--the generation of new systems, processes, or components; and instruction--the development of knowledge or skills. Simulation is used as an instructional technique in education and in nonacademic atmospheres--the military, business, and industry. The military have used simulation effectively to train individuals as well as teams. Simulation training devices can range from simple trainer type devices to sophisticated facilities and aircraft used for crew training under simulated environmental and operational conditions. Simulations have been used in business and industry training programs as a means for stimulating discussions of management principles and concepts, providing practice and experience in extracting information crucial to decision-making and competitive interaction and also to aid in the integration of theory and practice. Simulation has important implications for formal education as well. It allows teaching problems to be realistically represented, permits teaching behavior to be modified, and relates theory to practice. Simulated problem-solving is an effective mode of learning because it is realistic and allows the student to test and apply his own knowledge of skills and ideas by actively engaging in a situation that is realistic but controlled. (DMT)

SIMULATION: What is it?

Simulation simply means that one thing is much like another, that it reproduces the characteristics of something else in certain important respects but is otherwise somewhat different. "Thus, an ultra-violet light may be thought of as a simulation of sunlight, arylic pile may be a simulation of lamb's wool, and oleo margarine may be a simulation of butter. In such cases, there is not necessarily any intent to deceive: there is simply an attempt to provide a functional substitute for something else." In a similar way, almost anything can be considered a simulation. Consider these items: a typewriter, a book, a picture, an air conditioner. In conclusion, any substitute for or representation of something else may be considered a simulation.

Three Uses of Simulation

The use of simulation may fall into one of three general categories: (1) research, the generation of information about an operational or proposed system, process, or environment; (2) development, the generation of new systems, processes, or components; (3) instruction, the development of knowledge or skills. However, regardless of the use of simulation, a common characteristic is that, ". . . the essence of the real life situation is obtained, but without all of the particular reality." This paper will focus upon

the use of simulation as an instructional technique.

According to Twelker, in the area of instruction there are three elements of the teaching-learning process that may be represented by simulation. They are: (1) simulus situation; (2) response; and, (3) feedback.

Stimulus situation - Stimulus situation refers to the cues that are presented to the learner that serve to elicit a response. These cues represent or simulate real life and can take many forms. The stimulus can be a:

(1) concrete representation, a model that possesses attributes of the object represented such as shape, size, color, or texture.

(2) iconic representation, visual or other sensory stimuli which correspond to the person the specific elements of real life; e.g., motion pictures, still pictures would be visual stimuli. A recording of a bullfrog would be sound stimuli since it would allow a person to objectively classify the sound as a result of the real life elements in the recording (simulated representation).

(3) analogue representation, one property is used to represent another; e.g., the flow of electricity may be represented in an analogue fashion by using water flowing through a pipe.

(4) symbolic representation, refers to numbers or words which symbolize models of real life.

Response - Response refers to the means or activity by which a person responds to stimuli. Responses can take various forms. There can be:

(1) enacted response, doing the task in a non-real-life situation;

(2) iconic response, drawing what would be done in a non-real-life situation;

(3) analogue response, giving an analogous response in a non-real-life setting; and,

(4) symbolic response, saying, writing, or choosing among given alternatives what would be done in a non-real-life setting.

Feedback - Feedback is defined as the stimulus following the learner's response. Feedback possesses the same features discussed under stimulus representation; that is, concrete, iconic, symbolic, and analogue. Figure 1 is provided to help the reader envisage how the aforementioned categories and their features can be used to analyze the representations a simulation exercise may utilize.

Type of Representation
(3 Main Elements of the Teaching-Learning Process)

Simulation	(1) Stimulus	(2) Response	(3) Feedback
Simulated Observation Experience	iconic	symbolic	symbolic
Link Trainer	concrete	enacted	concrete

Figure 1

The first example analyzed is a simulated observation experience. Simulated observation, i.e., using video tape or films to replace a part or all of an active field experience a trainee would normally receive, is a popular simulation technique. For example, simulated observation can be used by business schools to replace part of an actual in-field observation experience or by teacher training programs to replace actual in-school observations. Regardless of its specific function simulated observation is a type of simulation. Let us continue with the analysis of a simulated observation experience.

The stimulus situation is classified as iconic. That is, the trainees in this simulation were presented a stimulus by way of video tape recordings which is a visual representation of reality. The response is classified as symbolic; the trainees responded to the video tape recording in writing. Feedback is symbolic; the trainees received information as to the appropriateness of their response in a verbal "armchair" discussion.

The second example analyzed is the famous Link Trainer. The Link Trainer simulates the cockpit of an aircraft. The simulation is the Link Trainer. The stimulus situation is classified as concrete; the Link

Trainer is a model (shape, controls, and size) of an aircraft cockpit. The response is enacted; the pilot trainees act out their response to a given situation by operating the controls within the cockpit. Feedback is concrete; the pilot trainees receive information as to the appropriateness of their control operations from the movement of the actual model which is a direct result of the trainee's manipulation of the controls.

Other types of simulated activities can be analyzed in the same manner, activities such as micro-teaching, peer-teaching, and role playing. Their stimuli represent some part of the teacher's role, trainees are required to respond in a designated mode by assuming or accepting the role of teacher, and feedback comes either from direct (peer or student) reaction to the trainee's response to the given situation or through one of the other designated modes of feedback.

Simulation presentation (stimulus situation), response, and feedback, therefore, take several forms. Simulation can be video recordings, audio tapes, role playing, case studies, or academic games. (The latter have the characteristic of competition between

players or teams of players which provides the distinction between a simulation and a simulation game.) Participant activity (response) within the simulation can vary from actual acting, to a verbal or written response. Feedback can also range from the trainees directly experiencing the consequences of his decision or actions to an "armchair" discussion as to the appropriateness of the trainee's decision. However, regardless of the mode of presentation of response, and of feedback, the characteristic which is common among all simulations is that ". . . the essence of the real life situation is obtained but without all of the particular reality."

Now that we have sufficient background for analyzing and understanding simulations, let us look at the instructional uses of simulation in the military, in business and industry, and in education. In each section I have attempted to cull from the literature successful uses of simulation which have established simulation as a viable means for instruction. Hopefully the positive attributes presented would provide potential users of simulation, research support for the adoption of simulation.

Non-School Uses of Simulation

The non-school uses of simulation which have influenced educational application are those of the military, business, and industry.

Military Use of Simulation

The military has used simulation chiefly as a means for teaching specific skills required for a particular job. The most famous of such simulation training devices is the Link Trainer. Developed by Edwin Link, a military flight instructor, the Link Trainer simulates the cockpit of an aircraft. Through this simulated model it was possible to teach various aspects of flight control to pilot trainees.

Another example utilizing simulation to teach specific skills can be found in the Radar Navigational Trainer. The Radar Navigational Trainer employed radar motion films as its prime component and provided a means of acquiring skill in interpreting radar scope returns, obtaining fixes, determining wind, plotting courses, and maintaining the navigational log as would be done in actual flight. The effectiveness of the Radar Navigational Trainer was determined by comparison with two other training methods. One method provided navigational training by using only air missions. The second method used half air missions and half Radar Navigational Training films. The third method was only motion pictures, i.e., the Radar Navigational Trainer

method. Results revealed no significant difference in the final performance examination. The Radar Navigational Trainer simplified instruction as well as provided a more economical means for practice than the conventional in-flight method of instruction.

In a similar endeavor, the Rand Corporation developed an air defense direction center. This simulator recreated the entire environment of an air defense direction center: the physical layout, the communication network, and the displays. In reporting the training results of this air defense direction center, it was stated:

> The members of each crew became an integral unit in which many interdependencies and coordinating skills developed. And each crew learned to perform more effectively. This learning showed itself in procedural shortcuts, reassignment of functions, and increased motor skill to do the job faster and more accurately.

These results prompted the Air Defense Command to train all their air defense crews throughout the world by simulator packages.

Another example of simulation effectiveness as an instructional method can be found in helicopter pilot training. Expansion of Army aviation has caused a demand for rotary wing pilots. The Army speculated that since synthetic flight training devices have been successful in fixed wing training programs, similar benefits might accrue from rotary wing applications. From the test results it was concluded that the device lowered student failures, improved their performance and served as a predictor of student flight

proficiency levels.

A somewhat different use of simulation from those already mentioned can be seen in the development and evaluation of a fixed wing simulator as well as its accompanying instructional program. This study had two phases. Phase I was to determine the transfer of training between a new twin engine training device to the device traditionally used. Phase II was concerned with the development and evaluation of a new flight training program which was designed especially for use with the new training device. The results indicated that trainees trained with the new device were evaluated superior during check rides. Phase II resulted in a 40 percent reduction of flight hours required to attain the twin engine transition. The results of the study indicated that transfer of training can be achieved when the training program and its devices are geared toward this criterion.

Summary

In summary, simulation has been used effectively to train individuals as well as teams. Simulation training devices can range from simple trainer-type devices useful for teaching specific tasks, to very sophisticated facilities and aircraft used for crew training under simulated environmental or operational conditions.

Business and Industrial Uses of Simulation

Our expanding economy has increased corporation growth thus causing a shortage of manpower at the management

and executive levels. This expansion has caused large firms to initiate some means for training personnel competently to fill these badly needed staff positions. Business needed training programs which were realistic and rapid as well as effective. Business seems to have adopted simulation as this means, to provide management personnel the decision-making skills necessary to meet the challenges of their job.

Traditionally, business had two methods of training from which to choose. The first emphasized learning of facts and ideas through seminars, courses, or lectures much like a college or university class. The chief disadvantages of such an approach was that this method provided no means for testing the learner's ability in a job-like setting. The second training method was the well-known O.J.T., on-the-job training. Although this method provided practical job experience, it was a slow process and was restrictive in that it confined learning to limited areas. Business thus had methods which provided broad-based theory on one hand counterbalanced by the slow and restricted method of practical experience on the other. As a result, it was necessary for business to find an alternative means which would fuse the positive aspects of both the aforementioned methods.

In 1956 the American Management Association developed the first of such games which was called Top Management Decision Simulation. It was to be the precursor for many

such management training games. The purpose of the Top Management Decision Simulation was to allow management trainees the opportunity to act as executives, make business decisions and experience the effects of their decisions. The game consisted of five teams of executive trainees. Each team respresented a company selling identical products within the same price range. The teams were given forty-five minutes to organize themselves; i.e., to plan strategies and elect officers. They also had to decide on the price they would charge for their product, short and long term budgets, costs of production, marketing, development and expansion. After these decisions were made, each team's decisions were fed into the computer. Within a short period of time, the companies received feedback; i.e., they knew the quantities their companies sold, costs and profits projected over a quarter year.

The second phase of the game provided the company the opportunity to review the facts and figures returned by the computer, make new decisions and try to guess the intentions of their business rivals. The game was carried on in this sequence until a period of years had elapsed. At this time, additional feedback was provided by a group discussion of all participating companies under the guidance of an instructor. This made it possible to discuss and analyze errors of judgment and mismanagement.

The importance of this game was that reality was captured, time was compressed, practice in decision-making

was provided and feedback was immediate. As a result, an effective means for training business managers was achieved.

A benefit from the Top Management Decision Simulation which is also based upon competitive decision-making of teams was the Carnegie Tech Management Game. The purpose of the Carnegie Tech Management Game was to train people to become more effective business managers. In this simulation game, trainees assumed the roles of top executives in the packaged detergent industry. Trainees were divided into three teams which represent competing detergent companies. Trainees in this game were required to make a number of related decisions.

> They must schedule production by product and by warehouse destination, they must purchase raw materials ahead of time, the must insure, through their employment and overtime policies, that enough workers are on hand, and, through maintenance and capital investment expenditures, they must provide adequate equipment and facilities.

Finished goods and excess inventory could be consigned to warehouses. Firms could also generate new products through research and could plan ahead to meet projected financial commitments. Results of the Carnegie Tech Management Game showed:

> Active participation in the Carnegie game has proved to be successful training for future businessmen. Students playing the game are challenged to deal effectively with many of the same types of problems faced by real executives. The game helps students understand that decisions made in different functional areas and on different dates are interrelated, and it helps them realize that their organization and procedures for decision making have consequences for the quality of performance which results.

This type of interaction and decision-making scheme served as the basis for many simulations used in business training programs in higher education. One such example was the Management Decision Making Game. "The basic purpose of the game is to provide students with a knowledge of the importance of proper expense control and accurate profit determination in retail business management." The underlying rationale for the use of this simulation game was identical to those previously mentioned. Traditional methods of education for business never provided the student the opportunity to live with the decisions he has made, to test the effectiveness of these decisions in terms of results, to recognize and rectify mistakes and adjust to changing circumstances in a competitive environment. In this game students were organized into teams to consider such factors as sales forecasts, payroll, advertising, and inventory in making their decisions. The results of these decisions were provided by computer. In evaluating the effectiveness of the game, it was stated that the game seemed particularly useful in motivating students and helping them to understand business concepts. Thus again it can be seen that simulation exercises provide an environment for decision-making, allowing the student to see first hand the meaning and relevance of the knowledge he has gained from his classes.

Simulation games of this type have also been used in secondary schools. Simulated Agribusiness is an example

of such a game. Simulated Agribusiness is a competitive game that can be played by any number of individuals or groups on a hypothetical mid-latitude farm in a capitalistic economic system. The objective of the game is to earn as much money as possible without going bankrupt. The player must make a series of decisions which will determine his success or failure, decisions such as land acquisition, crop selection, optional investments, soil bank, and crop insurance.

Simulated Agribusiness closely follows the decision-making scheme of the other business simulation games presented. It is different only in the sense that it prepares trainees for a personal and somewhat independent business venture.

A somewhat different type of simulation training game is the In-Basket Problem. This simulation technique was usually employed as an individual decision making exercise. Greenlaw explained this technique in the following passage.

> Each member of the training group, working individually, is usually given from an hour to an hour and a half to study over the problem presented and to indicate in writing what action he wishes to take on each of his In-Basket items, together with his reasons for each decision. Once this decision-making period has been completed, the various courses of action taken individually are usually compared and analyzed--either by the total training class, small 'buzz groups,' or both.

Greenlaw stated that the In-Basket technique was an excellent means for stimulating discussion of management principles and concepts.

Another yet somewhat different use of simulation was the Incident Process simulation developed by Pigors.

> The Incident Process begins with each student being given a brief description of an incident of importance in the case under review. The group is then allotted about thirty to forty minutes to ask questions of the instructor (who has at his disposal additional information about the problem) in an effort to find out as much as they can about the situation. After completion of the question period, the major issues at stake are usually summarized, and each student is then asked to submit in writing an outline of the course of action he deems most appropriate to the resolution of the problem.

A group discussion followed the written response. Part of the purpose of the Incident Process simulation was to provide trainees practice in obtaining information upon which to base their decisions.

In summary, simulations have been used in business and industry training programs to serve the following functions:

1. As a means of stimulating discussion of management principles and concepts.
2. Provide practice in extracting information which influences decision-making.
3. Provide experience in group decision-making and competitive interaction.
4. Provide more experience in a shorter interval of time by compressing time.
5. Integrate theory with practice.

The above findings have the following implications for learning:

1. Specific problems can be identified.

2. Problem solving and decision-making situations can be presented through simulation in a realistic manner.
3. Time can be compressed to accelerate the learning process.
4. Participant role playing is an effective means of learning.
5. Simulations can be utilized in training individuals as well as groups or teams.
6. Simulations can be simple or complex, use a great deal of technological hardware or none at all, yet still be an effective method for teaching.

Simulation in Education

The Jefferson Township School District was the first widely publicized simulation in education. This exercise simulated a hypothetical school called the Whitman School in which participants assumed the role of Principal. Hundreds of elementary school principals from varied school districts throughout the country acted as participants and played the role of the new principal of the Whitman School. The participating principals were given background information about their roles through written materials, tape recordings, and films. They were also given information about the Whitman School and the hypothetical town of Jefferson in the same manner. The simulation used was the In-Basket technique; i.e., principals reacted to school problems as they were

placed in his "In-Basket." Examples of problems the principals encountered were writing an article for the school paper, making a tape recorded speech to the PTA, analyzing and evaluating the teaching of a probationary teacher via a film, handling discipline problems and answering various kinds of letters. The simulation exercise lasted about a week and at this time each principal's work was reviewed. At the conclusion of the entire simulation exercise, results had shown that:

> The simulation of a standard job in educational administration through the use of in-baskets has proven to be successful as a method of collecting records of administrative performance which can be scored reliably and yields scores which are useful in providing a better understanding of some of the dimensions of performance in such a situation.

The Jefferson Township simulation package was used by eight universities in the summer of 1961. Participants ranged from elementary principals, secondary principals, teachers, superintendents, counselors, to graduate students. The outcome reported by the staff at the conclusion of the summer session was as follows:

> The simulated situation provided high motivation and interest plus instructional opportunities not usually found in traditional courses. . . .
> Workshops provided an opportunity to apply theory to specific situations in working with students preparing for administrative positions. In the simulated situation the responsibility for problem solving was shifted to the group. The workshop staff was better able to appraise students' effort since each participant's approach to problem solving could be observed.

Far West Laboratory for Educational Research and Development was the company responsible for the development and analysis

of the Jefferson Township School District game just discussed. By further analyzing the data collected, they were able to identify areas of competency for principals as well as eight distinct style factors principals exhibited. However, more importantly they have used this information to develop materials to facilitate principal competency in the area of decision preparation. The materials focus on preparation and consultation behaviors principals should perform in all aspects of instructional planning. Basically, then, the purpose of the materials was to provide basic skills, knowledge, attitudes needed by principals, or other school personnel, who are involved in or preparing for instructional decisions.

The Jefferson Township (Whitman School) simulation has been modeled many times. One such simulation exercise was The Intermediate School Principal. The materials used for this exercise simulated some of the problems that intermediate (junior high, middle and senior elementary) school principals could face under actual working conditions. The materials were developed from real-life problems of some intermediate school principals. The exercise consisted of in-basket items such as letters, memos, phone messages, etc., which required some action on the part of the person assuming the role of intermediate school principal. The purposes of the exercise were to improve skills related to the administrative processes and to provide a better understanding of role theory and role relationships as part of the

interpersonal relationship within a group setting.

Another early attempt to use simulation in teaching was developed by Harold Guetzkow in the area of international relations. The simulation was called Inter-Nation simulation. Its purpose was to provide practice for participants in foreign policy decision-making. The game consisted of five nations operating simultaneously. Each nation contained the following:

> . . . an 'internal decision-maker' (IDM) made the nation's final decisions with regard to overall policies of the nation as they related to both external and internal considerations. Another participant served as 'external decision-maker' (EDM), conducting the relations of his unit with other nations. . . . The two positions attempt to represent decision-making as it encompasses the nation as a whole, especially as the government relates to its resources and society, and as the nation relates to an external environment, consisting of other nations.

At the conclusion of the training exercise the following evaluation was given:

> As the war game has been judged of practical value in providing decision-maker experience to military executives, so the manning of an inter-nation simulation may be helpful in the training of foreign policy makers.

This simulation appears to have paved the way for many high school classroom simulation games. For example, in social studies the Alpha Crisis Game developed, was a simulation about the outbreak of World War I. Playing in teams, students acted as heads of state and ministers of five mythical European countries. Game play consisted of government meetings, press releases and negotiation sessions. Multilateral Trade Game was another classroom simulation

game used to teach basic processes of trade through role playing. The students were divided into teams representing nine different countries. The complexities of multilateral trade were simplified to encompass a few basic decisions in order to provide students with some knowledge of the interdependence of nations engaged in trade and of the disadvantaged position of some third world countries in the world trading system. Men Under Law was a simulation game which consisted of five constitutional case studies. The case studies were presented in order of increasing difficulty for the student. Each case study contained a statement of the pertinent law, narration and question sections, and arguments for the defense and prosecution at each level of appeal. The legal terms used in the excerpts of Supreme Court decisions were listed and defined and a copy of the United States Constitution was included. The entire class participated by forming small groups which were given responsibility for developing the argument for one particular case. Each group then further subdivided into prosecution and defense. Furthermore, all students served in the role of Supreme Court Justice at least once. These are but a few examples of how simulation has been utilized at the secondary classroom level for providing students the opportunity to apply the facts and principles learned in class to the situations to which they apply.

One of the most common uses of simulation in education is in the field of driver education. Zaun and Schroeder

describe a driver simulator training course which is based on a series of films. The films cover a range of driving problems such as turning at intersections, shifting, backing, driving on hills and entering and driving on an expressway. Each student takes his turn in the simulated car. The car is equipped with the usual automobile equipment such as footbrake, hand brake, accelerator pedal, horn, steering wheel, directional signals, ignition switch, clutch, and shift control. A filmed situation is projected and the student driver begins to drive. During the film, the students must react to the traffic and road situations presented in the film. The reactions of the students are recorded as a score sheet moves through a recorder.

The advantage of this simulated approach is that driving skills can be presented in an organized manner which provides for orderly and effective learning of safe driving skills. Driving teachers are also able to bring street and highway conditions into the classroom and to provide solutions to dangerous driving situations. Other advantages are also provided by a driving simulator.

> Not all schools have the many types of driving experiences within the distance which may be reached in dual control instruction. Steep hills, fast traffic, night driving, wet weather--these conditions involve hazards rarely possible for all students. . . . By means of simulation, however, we can provide all of these experiences to all students in all locations.

In this capacity simulation can provide students a range of experiences, especially those not provided because of location or logistical problems.

The most famous simulation used for the training of classroom teachers was developed by B. Y. Kersh as part of an NDEA project at the Teaching Research Laboratory of the Oregon System of Higher Education. The purpose of this project was to: (1) design and develop a simulation model for training prospective elementary teachers to identify, assess, and solve teaching problems in the areas of pupil confusion, inattention, distraction, and fatigue; (2) determine what instructional differences could be obtained through the use of varied image size: i.e., lifelike vs. small; and motion: i.e., still picture vs. motion picture.

Kersh's simulator was a room with a movie screen placed in the front and three motion picture cameras in the back. The participant faced the screen and a classroom episode was projected upon the screen. The participant reacted to the episode projected by actually acting out his response. Immediately following the participant's response, another film was projected portraying the students or classes reaction to the participant's response. The appropriate class reaction was decided upon by an instructor who sat in the back of the room and activated the appropriate response projector electronically.

The simulation episodes were of a hypothetical sixth grade class, the teacher of the class was Mr. Land. Participants acted as Mr. Land's student teacher and were oriented to the school and community through background information. Participants were also familiar with the students in the

class by studying cumulative records. The purpose of the exercise was to train participants to respond to the simulated episodes in a manner judged by expert teachers to be most effective. At the conclusion of each simulated episode, the participant and instructor discussed the appropriateness of the given response. This part of the exercise served as the tutorial aspect.

The results of the project indicated that simulation did increase learning of specific behaviors; and that the least realistic, i.e., the small-still image, was more effective than the life-size motion picture. However, the most important finding was that simulation training allowed teacher trainees to assume full responsibility of their student teaching duties as much as three weeks earlier than student teachers who had had no simulation training.

In 1965 Kersh used his classroom simulator but this time to determine its effectiveness as a method for transferring theory to practice. The results of this study supported those of the first. The study was significant, however, because of its emphasis on transfer of training.

Since its inception, Kersh's simulation model has served as a guide for other experiments in teacher training. A simulation package similar to Kersh's, that is, in mode of presentation, participant application and feedback phases, is Low Cost Instructional Simulation Materials for Teacher Education. Its purpose is to help participants become more effective classroom managers and teachers through a

programmed simulation approach. The simulation is divided into two phases. In Phase I participants use an exercise book which corresponds to a film tape presentation on an Audoscan projector. After viewing two films, participants react to the way the teachers in the films responded to a classroom situation. Participants must choose which teacher behavior is preferable and state why in the exercise book. The participant then compares his written response with the one in the book. After this, additional feedback if provided using Kersh's video method; that is, participant trainees view a film on how the class would respond to the two teaching strategies employed.

In Phase II, participants are given an opportunity to practice the principles learned in Phase I. Participants respond to filmed incidents and compare their responses with those made by expert teachers to the same incident. Similar to Phase I, participants also view the class's reaction to the expert teacher's strategy. However, ultimately the participant receives feedback by comparing his responses to those made by expert teachers.

A simulation model used in teacher education in addition to the Kersh model described in the previous pages is the Cruickshank-Broadbent Model, the difference being: (1) open-ended feedback system, (2) low cost production, (3) use of the "in-basket" approach, and (4) flexibility in use. Using this model, Cruickshank and Broadbent conducted a study to examine the effectiveness of simulation for

presenting teaching problems and to determine whether or not exposure to simulated critical teaching problems has any observable effect on the participant's teaching behavior. The important general objectives of the simulation experience were: (1) to have each participant assume the role of a fifth grade teacher, (2) to expose participants to critical teaching problems through simulation, (3) to provide participants with opportunities to analyze and solve the problem, and (4) to provide opportunities to project and react to each other.

Participant trainees responded to the critical teaching problems by using a response sheet. It included: (1) defining the problem, (2) defining the task, (3) considering alternative solutions and predicting their consequences and selecting one alternative as the "best." The stated conclusions of the study were:

1. . . . that problems of beginning teachers can be identified which are satisfactory for use in developing simulated incidents.
2. Development of a role simulation appears to be feasible for colleges or school districts through the use of materials modeled on an existing situation and video tape recordings.
3. The simulation training proved to be at least as effective as an equal period of student teaching in the areas of attitude change, confidence, teaching behavior, and amount of time needed to assume full responsibility as a student teacher, but the students who underwent simulator training experienced significantly fewer teaching problems as reported by their supervising teachers than did the control group students.
4. Students became highly involved and stimulated by the simulation.

A revision of this simulation exercise was accomplished by Cruickshank, Broadbent, and Bubb. The previously videotaped incidents were refilmed in 16 mm. sound color and changes were made in the printed materials used. This revision is now known as the Teaching Problems Laboratory. However, the simulation still retains the characteristics of the Cruickshank and Broadbent model; that is, the methodology employed makes it flexible and easily modified, participant reaction is captured on a response sheet rather than being acted out. As a training technique it is better since it allows more people to be trained in any given time with less supervision. Concomitantly, feedback is received through small and large group discussions guided by an instructor. In addition to these characteristics, the Cruickshank and Broadbent model is also less costly to produce than the Kersh model. These characteristics distinguish the Cruickshank and Broadbent simulation model from that used by Kersh.

Venditti also conducted a simulation study based on the Cruickshank-Broadbent Model. The purpose of this simulation was to prepare teachers to work in desegregated schools. Participants assumed the role of a fifth grade teacher and were confronted with problem-solving activities pertaining to problems encountered in a racially integrated school. The simulations presented critical problems such as pupil behavior, individualization of instruction, curriculum change, teacher-pupil relations and selection of

instructional materials. At the conclusion it was reported that simulation was an effective instructional device; participants became highly involved in the simulated situations; and they engaged in constructive problem solving. These results support previous research findings on simulation's attributes. In addition, this study is significant because it demonstrates effective simulation use for in-service training, a use not previously reported.

Another example of a simulation constructed for use in programs which prepare or retrain teachers for central city schools with predominantly black populations is Inner City Simulation Laboratory. Participants assume the role of a teacher in an inner-city school. They receive Community Action Agency data, advice to new teachers written by their fellow teachers, sociometric data, cumulative record folders, and a faculty handbook of rules and regulations. Following a period of study and reaction to the protocol materials, the sequence of problem solving is begun. Incidents are presented using films, role plays, and written incidents. Feedback is received through small and large group discussion.

An important study utilizing simulation as a means for producing transfer of learning outcomes was conducted by Gaffga. He generated a set of fourteen hypotheses to answer three basic questions:

1. Was subject behavior in the simulation consistent with subsequent student teaching behavior?

2. Does simulation experience change subject behavior?
3. Is evaluation of a student's behavior in a simulated situation a better predictor of student teaching performance than ratings typically given by college professors?

Test results indicated that teacher trainee behavior in a simulated situation was consistent with subsequent teaching behavior. The results also proved that simulation does produce a change in teaching behavior and that evaluation of the student trainees behavior in simulated situations is a better predictor of student teaching performance than college professors' ratings.

The importance of this study lies in the transfer effect which can be attributed to the simulation training. Since one of the major purposes of simulation is its ability to serve as the link or the intermediary stage between theory and practice, the reported results support this often mentioned advantage of simulations transfer value.

Another important study is by Vlcek. Vlcek also focuses upon simulation as a means for producing transfer outcomes. Vlcek's study used simulation for training teacher trainees to identify and resolve classroom problems prior to student teaching. He also investigated the transfer value of simulation experience and the effect of simulation training on the participants self-confidence in his ability to teach.

The results of the study indicated that:

1. simulation was effective in helping participants learn responses to classroom problems
2. simulation helps the participant organize principles for problem solving

3. principles developed in simulated situations transfer to student teaching
4. simulation increases the teacher trainee's self-confidence in his teaching ability.

Ryan also conducted a study to investigate the effect of simulation on transfer of learning. Ryan tested four instructional modes accompanied by simulated situations in order to determine which instructional mode was most effective in increasing the transfer of principles of educational psychology to problem-solving tasks.

Results indicated that simulation was an effective means for creating realistic problem-solving situations and that there is a direct relationship between practice in problem-solving and student ability to solve problems. In other words, as practice in problem-solving increases, students' ability to solve problems increases.

It was also reported that allowing students to select a mode of instruction combined with simulation practice was effective in increasing transfer of learning.

Emmer conducted an experiment to study transfer of teaching skills. The purpose of the study was to determine whether instructional behavior learned during a series of simulated teaching experiences using peers as students would transfer to a school setting in which real pupils were students. Trainees presented a series of lessons in a teaching laboratory with peers serving as students for the simulated teaching. In the laboratory sessions the trainees practiced instructional skills which corresponded to the

simulation objectives. These were as follows: (1) determining readiness; that is, assessing student's entering behavior such as interest, skill, and prior knowledge which is relevant to the lesson's content. (2) Clarifying objectives; that is, helping students understand the purpose of the lesson and the kind of behavior that is expected as a result of the lesson. (3) Motivating; that is, providing conditions for attentive student behavior. (4) Evaluating; that is, determining the extent to which pupils learned from the lesson.

The laboratory sessions focused on one of the above skills and practiced the specific behaviors associated with it. In subsequent sessions when a new skill was to be practiced, trainees were told to focus not only on the new skill but also to attend to the preceding skill. Thus laboratory sessions allowed for repeated attention to preceding skills and by the final laboratory session the trainees were expected to attend to all of the behaviors mentioned above. Results indicated that trainee behavior changed during the period of simulated teaching with peers. It was also evidenced during a teaching assignment that the instructional behavior acquired during simulated teaching with peers transferred to a live classroom setting using actual pupils.

Summary

This chapter has presented a wide range of simulation applications. The important implications for education are:

1. Teaching problems can be realistically presented through simulation.
2. Teaching behavior can be modified through simulation exercises.
3. Simulation can provide a safe yet realistic setting for uniting theory and practice.
4. Simulation training promotes transfer of learning.
5. Simulation can be used to teach principles and problem-solving behaviors.

Some of the most frequently reported advantages of simulation are:

1. Simulations are relevant because they are founded upon realistic problem solving situations.
2. Simulation allows the trainee to be himself; that is, to test and apply his own knowledge, skills, and ideas to a given classroom situation.
3. Simulations actively engage the trainee in a situation.
4. Simulations are controlled, thus providing trainees the opportunity to attend to specific behavior in a given situation.
5. Simulations can serve as substitutes for some field experiences.

6. Simulations are as effective as traditional instruction.
7. Simulation provides trainees practice in decision-making, much like the type in which they will be engaged in the classroom.
8. Simulation can provide immediate feedback.
9. Simulation is effective in pre-service as well as in-service teacher-learning.

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