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ABSTRACT

A review of the literature on simulation as an alternative to field experience programs in teacher education is presented. A review is also offered of articles on the effectiveness of simulation techniques. Future directions for simulation are discussed, including "video robotics" and computer programs. This investigation was limited to journal articles on teacher education and the use of simulation in management was excluded. References are included. (JD)

A REVIEW OF SIMULATION IN TEACHER EDUCATION TRAINING

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A Review of Simulation in Teacher Education Training

Some of the earliest accounts of programs for the training of teachers include descriptions of student teaching as an integral part of the program (Johnson, Collins, et al., 1985). For as long as there has been a process of formal training of teachers, there has been a recognition of the importance of experience in the classroom as part of that training. Accrediting organizations today require that teacher education programs incorporate a significant element of field experience during the training of the teacher education candidate (NCATE, 1979).

However, the demands on teacher education programs have burgeoned. From one quarter come the calls for devoting more time to the academic subject matter with a commensurate reduction in professional courses. And yet, the proficiencies expected of the teacher- as disciplinarian, time manager, evaluator, handicapped education specialist, legal expert, and so on- are becoming greater. Finally, as career opportunities in non-educational settings become increasingly available to the categories of students who in an earlier time would have gravitated to education, teacher education programs are more often asked to deal with many candidates who require more concrete learning experiences, and who may require additional time to master basic skills and techniques.

There can be little doubt that the most popular and most frequently used approach to providing teacher education students with practical experience is the field experience. However, field experience is not without its drawbacks. One such drawback stems from the lack of built-in linkage of theory with practice. Despite the fact that just such a linkage may be one of the prime selling points of field experience, in reality field experiences are rarely sufficiently structured as to ensure that incidents of important classroom situations will occur with regularity. Consequently student teaching may be less a time of learning than a period of application. Considering that the student's prior exposure to many of the significant classroom events may well have been confined to theory and anecdote, the field experience may well become a matter of routinizing inadequate or inappropriate strategies.

Closely related to the aforementioned problem is the concern raised by differences in the rate of learning among student teachers. Much of the literature on learning acknowledges the importance of time and practice as factors critical to the mastery of a new skill (e.g., Carroll, 1963). Ideally, each student would have mastered the rudiments of the basic teaching skills prior to actually entering the classroom. However, where theory courses provide little or no opportunity for consolidation and skill development, the field experience becomes the setting for practice. Unfortunately, the typical field experience cannot be easily manipulated to afford the amount of practice that many student teachers will require before mastery is achieved. Ironically, the very situations which might require the greatest amount of repetition and practice to master are those that arise least often or with least predictability in the typical classroom.

Another related problem arises from differences among supervising teachers. Inevitable variations in the degree and quality of supervision result in, at times, haphazard experiences on the part of student teachers. A final concern centers on the impact of inexperienced student teachers on the classroom learners. Unless the student teachers enter the field experience setting with at least partially developed teaching skills, the potential negative impact on students could be significant.

Simulation as an alternative to field experience

An alternative to field experience which has received some support is simulation. Simulation is an "imitative representation of the functioning of one system or process by means of the functioning of another..." (Miller, 1984). As such, simulation has been used to teach practical classroom skills to future classroom teachers. In doing so, many of the previously cited limitations of field experience may be avoided.

The remainder of this paper will be directed toward a general review of the literature related to the use of simulation in the teacher education setting, an examination of the research into the effectiveness of simulation, and a consideration of how simulation techniques may be influenced by technology in the future.

Before proceeding, some limits to the scope of this review must be established. The major restriction was that no attempt was made to review all literature related to simulation in education. An extensive literature exists regarding the use of various forms of simulation in the classroom, including games, role-playing, and computers. While much of this literature is fascinating in its own right, and might bear indirectly upon the topic at hand, it has not been included for consideration. One exception to this limitation has been to include articles that specifically report on the effectiveness of simulation techniques that are or might be applied in the teacher education environment. Excluded for similar reasons is the literature related to the use of simulation in management. Finally, the present investigation was limited to journal citations, where it was anticipated that most of the relevant research would be located.

An Examination of the Literature on Simulation in Teacher Education

Despite the generally glowing endorsements of simulation as a teaching tool (Coleman, 1967; Dean, 1981; Zuckerman, 1979), there have been relatively few articles published related to the implementation of simulation techniques in the training of teachers. The majority of articles which have appeared have tended to be descriptive (Broadbent, 1967; Cruickshank, 1967; Dean, 1981; Flake, 1975; Loper, et al., 1985; Lunetta, 1977; Roberts, 1974; Sattler, 1985; Strang & Loper, 1983; Wolfe & Macauley, 1975; Zuckerman, 1979) of simulation techniques or programs in place. Many of these articles offer logical arguments for the adoption of simulation techniques rather than empirical evidence of effectiveness. Some of the logical appeals have included: motivating the learner (Young & Schlieve, 1984); making the role of the student in learning more active (Bosco, 1984; Dean, 1981); making theory more relevant (Flake, 1975); interactivity (Kearsley & Frost, 1985); transfer of skills to the classroom (Zuckerman, 1979); variety in the learning environment (Blaga, 1979); and a positive relationship between the use of simulation and positive affective growth (Blaga, 1979).

Of the articles reviewed, the following breakdown by type of simulation was found: simulation games- 1 (Dean, 1981); discussion/roleplaying- 3 (Broadbent, 1967; Reynolds & Simpson, 1980; Zuckerman, 1979); videotape/videodisc- 8 (Cruickshank, 1969; Cruickshank & Broadbent, 1967; Dubois, 1974; Frager, 1985; Henney & Boysen, 1979; Legge & Asper, 1972; Utsey, et al., 1966; Wolfe & Macauley, 1975); computers- 8 (Flake, 1975; Henney & Boysen, 1979; Loper, et al., 1985; Lunetta, 1977; Reynolds & Simpson, 1980; Roberts, 1974; Sattler, 1985; Strang & Loper, 1983). One trend that appears to have been occurring in recent years has been the combining of microcomputers with video-discs to create what is referred to as interactive video.

<u>Research into the effectiveness of simulation techniques</u>

The search of the literature yielded disappointingly few studies which examined the effectiveness of simulation methods. In some instances (Blaga, 1979; Cherryholmes, 1966; Dekkers & Donatti, 1981) the focus of research has been on the use of simulation in public school classroom, and has been included only because of its potential application to the teacher education setting. Given the limited number of articles, each study will be briefly summarized, and then general conclusions drawn.

Blaga (1979) conducted a survey of secondary school social science teachers in Ohio to ascertain how extensively simulation techniques were being employed. Of those teachers responding, 58% reported using simulations regularly, 37% reported having never used simulation, and 5% indicated they had used simulation at some time but had discontinued its use. Among non-users, the most frequently cited reason was the amount of preparation required. Among users, the most frequently cited advantage was the variety it provided to the student.

Cherryholmes (1966) summarized the findings of six studies on the impact of simulation in the classroom. His findings were organized to respond to four potential advantages to simulation methods. Regarding impact on learning, it was concluded that simulations did not result in the acquisition of more facts or principles when compared to lecture methods. Students instructed through simulation were not found to retain more information, or for longer, than students taught by lecture method. Students were not found to have developed critical thinking or problem-solving skills as a result of simulation. The one area where positive findings were reported was in the area of student interest, with students indicating a greater level of interest and involvement in the simulations.

Dekkers and Donatti (1981) conducted a meta-analysis of studies related to simulation effectiveness and reported that simulations were typically found to be no more effective than lectures or other teaching methods, in terms of cognitive gain. However, where attitude change or attitude formation was involved, simulations were found to be more effective than more traditional methods.

Frager (1985) reviewed the applications of video technology to teacher training. Empirical studies he reviewed suggested that video models were more effective than symbolic (text) models; that positive models or examples of teacher behavior were more effective than negative or a combination of positive plus negative models; that videotapes used as feedback from microteaching are more effective when the subjects are young, attractive, verbal, intelligent, and successful, when supervisors have realistic expectations regarding speed of behavior change, and when feedback is unambiguously related to performance goals. Frager concluded that video technology had resulted in largely positive outcomes in the settings in which it had been applied.

Miller (1984) reviewed applications of simulation techniques and offered these conclusions: simulation has the advantage of time compression over real-life experience; simulation provides for consistency of experience among learners; simulation obliges the learner to engage in decision-making, similar to that required in the real-life setting.

Reynolds and Simpson (1980) compared the impact of discussion, roleplaying and computer simulation on teacher education students in an educational methods course. Evaluation was primarily directed at affective change, and results of surveys suggested that all approaches led to more positive attitudes, with no statistically significant differences among the methods. More anecdotally, the researchers suggested that the computer simulations required less instructor time, as students could engage in the simulation without instructor supervision, and the simulations ensured greater consistency of instruction, as variations due to instructor differences and changes over time were eliminated.

Legge and Asper (1972) investigated the impact of videotaped feedback from microteaching experiences on preservice teachers. When asked to evaluate a taped teaching lesson using the Stanford Teacher Competence Appraisal Guide, the preservice teachers who had been instructed with videotaped feedback of their own performance were reported to be more skilled than were teachers who had not received such feedback.

Boen (1983) studied the effectiveness of an interactive video computer system in the development of study skills among college students. Boen reported that CDI (computer-directed instruction) students passed a test of study skills with significantly higher scores than the non-computer group.

Dubois (1974) compared education students who learned to administer an informal reading inventory using videotaped presentations for practice with students who practiced with live student subjects. Results revealed no significant differences in any technical aspect of the ability to administer or interpret the inventory. The author did indicate that it was his impression that those students who worked with the human subjects were more "animated" and curious about their subjects than were the students using videotapes, who he described as "mechanical" and detached. Interestingly, Utsey et al. (1966) had performed a nearly identical study of students learning to administer an informal reading inventory. In the Utsey study, the students using the videotaped presentations reportedly outperformed their "human subject" counterparts in terms of error detection and interpretation.

Tansey (1970) summarized the findings of a number of early projects which incorporated simulation experiences in the teacher education curriculum. In one project the impact of image size and feedback mode was investigated with the conclusion that it was not critical that image size (or type) be realistic, nor was the mode of feedback (visual vs. audio) found to be crucial to learner effectiveness. In another project it was reported that students who practiced under simulation conditions outperformed control students in all phases of a lesson intended to develop the ability to recognize problems, respond to problems, and to apply principles to the solution of problems.

Cruickshank and Broadbent (1969) developed a simulation program based upon real problems indentified by first-year teachers through a survey. Data collected on experimental and control groups failed to confirm hypotheses regarding improved performance among student teachers receiving simulation training. They nonetheless concluded that the student teachers found the simulation experience valuable and realistic.

The findings of the studies directed toward the question of simulation effectiveness can perhaps best be summarized this way. Most studies attempting to show that simulation is superior to lecture, discussion, roleplaying, or real student teaching, in terms of enhanced learning, have failed to demonstrate this advantage. Most studies looking as simulation techniques have concluded that they are effective in changing attitudes, and that students respond positively to simulation experiences. Little evidence appears to exist to support the proposition that simulations make for deeper thinkers or more insightful teachers. Thus, much of the enthusiasm for simulation expressed in the past has been unsubstantiated. On the other hand, that same research can be interpreted as indicating that simulations are at least as effective as other techniques, students generally like them, and they can represent advantages over other techniques in other ways, such as time compression and instructional consistency. Students are more likely to be able to practice skills to mastery when that practice is in a simulation environment. It is of course obligatory at this point to pull out the time-worn cliche about the need for more research, and to call for more empirical and scientifically sound investigations of simulation techniques.

Future directions for simulation

A growth in the use of simulation techniques in the teacher education setting may take place out of necessity. If teacher training is to be accomplished in less time (as might be the case if professionalization leads to the graduate program in education as the norm) then more efficient strategies for addressing both theory and practice needs will be required. One especially promising development in simulation has been the advent of interactive video (Boen, 1983; Bosco, 1984; Brodeur, 1985; Kearsley & Frost, 1985; Young & Schlieve, 1984). Briefly, interactive video involves the combination of the videodisc with a microprocessor. The primary benefit realized through this integration is a degree of flexibility previously unrealized. As the expense of hardware has dropped (Bosco, 1984), the major consideration in deciding to commit to interactive video appears to be software availibility. As is so often the case when new technology is developing, marketing of hardware is hampered by the lack of software, while commitment to software development is tentative until the hardware market is established. It is estimated that the hardware costs might run between $3000 and $10,000 per unit (Bosco, 1984) with the cost of mastering a laserdisc being approximately $2000 and individual copies costing $15-20.

Most of the literature on interactive video is descriptive and speculative, rather than investigative, and sound research will be needed to substantiate the optimism of proponents of interactive video. Kearsley & Frost (1985) indicate that approximately 200 videodiscs are currently available under the instructional category (however, very few, if any of these are interactive, and there is no indication as to whether any of these are appropriate for teacher education applications). Kearsley & Frost (1985) suggest that the videodisc medium is highly effective as an instructional medium across all types of educational and training applications. They further suggest students who have learned via interactive video achieved better test scores with less training time when compared to other methods of instruction. Unfortunately, no empirical evidence is offered to substantiate these claims.

Many of the articles to have appeared on the topic of interactive video have addressed the matter of development and implementation of such systems. For example Johnson, Wilderquist, et al. (1985) offer suggestions on how to develop a storyboard, from which the content of the videodisc is created. Since the prime attribute of the videodisc is its random access capability, and since the power of the interactive video medium is based on the branching capability that allows the medium to "respond" to the actions or inputs of the learner, developing the "storyline" can become a very complex process.

One of the most exotic developments may be what is referred to as "video robotics" (Behnke, et al. 1985). Video robotics is essentially the "Max Headroom" of instructional technology. It requires a natural (oral) language for interaction, and very promising work has been done, resulting in a variety of languages such as LIFER, ROBOT, PLANES, BORIS, DOCTOR, CLIENT I, and of course the original natural language system, ELIZA. Video robotics, while fascinating, probably represents a long-term goal due to factors of cost as well as the availability of support technology. An excellent source of information for anyone interested in learning more about interactive video is Brodeur's (1985) article, " Interactive video: 51 places to start", which briefly describes available resources for initiating an interactive video system.

Yet another promising direction for the future is what is referred to as the "expert system". Already quickly becoming a reality in medicine and law, the expert system consists of a complex computer program which contains the cumulative knowledge and wisdom of experts in field, along with an interactive and natural language which permits non-computer specialists to access and use the program. In practice the expert system can serve as a ever present and ever-patient teacher or consultant, capable of offering tentative diagnoses based of reported symptoms, or citing relevant case law and legal precedents when presented with case details. Such a system might prove invaluable in a teacher education setting, to assist in the guidance of student teachers.

Summary

Simulation has been around in a significant way for about 20 years now, and some conclusions ought to be available regarding the effectiveness and utility of simulation in education. Unfortunately, not enough sound, empirical research has been done to permit clear-cut conclusions to be drawn. Moreover, the medium of simulation has continued to evolve- from games to computers and video. Thus it becomes risky to apply even the few empirical findings based on one medium to other forms. For all this, some tentative conclusions and future directions can be drawn.

Simulation, in the form of computer simulations or interactive videos, does represent a viable medium for instruction. While many of the investigations of simulation techniques have failed to reveal advantages for simulation in terms of amount learned or amount retained, it may be that the more significant finding is that simulation apparently works as well as more traditional methods in these areas. Students appear to enjoy simulation exercises, and simulations have not been compared to typical field experience settings, where supervision may be limited. Additionally, simulation exercises can be less demanding on instructional time and can ensure a higher degree of consistency over time and instructors.

Also, the newer forms of simulation need to be investigated more thoroughly. Appropriate indicators of student outcome must be chosen. Clearly, the ability to selectively attend to stimuli, and then make sound decisons is of prime importance, along with the ability to apply theory in the experiential setting. We need better measures of these skills, and we need pre-post measure designs for studying simulation experiences to actually examine changes in the learner.

It has been frequently the case in the past that innovation and technology have created fads in education that eventually collapsed, due either to unrealistic expectations, or poor implementation. What has been missing in most cases has been careful study of the techniques using sound empirical research methods. Simulation, especially computer simulation, may well fall into the same category, with the same disappointing results, unless it is approached as an unproven commodity whose effectiveness and utility must first be demonstrated.

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