DOCUMENT RESUME

ED 350 978 IR 015 788

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TITLE How To Evaluate Multimedia Simulations: Learning from the Past.
PUB DATE Jun 92
NOTE 7p.; Paper presented at the European Conference on Educational Research (Enschede, The Netherlands, June 22-25, 1992).
PUB TYPE Information Analyses (070) -- Reports - Evaluative/Feasibility (142) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Aptitude Treatment Interaction; *Computer Simulation; Evaluation Criteria; *Hypermedia; Instructional Effectiveness; Instructional Innovation; *Interactive Video; Literature Reviews; Media Research; *Multimedia Instruction; Research Design; Research Methodology; Simulation; *Television Research
IDENTIFIERS Multimedia Materials

ABSTRACT

Although multimedia technologies offer a great potential, educators and decision makers need to see evidence regarding the instructional effectiveness of multimedia in order to integrate it into the educational processes. The main purposes of this paper are: (1) to identify and discuss the main criticisms of media research, including the research format, characteristics, results, and recommendations made between the 1950s and early 1970s and between the mid-1970s and the present, including the aptitude-treatment interaction approach; (2) to discuss the state of current interactive video simulation research in the light of criticisms being made; and (3) to identify the most important points that need to be considered by media researchers in order to avoid making similar mistakes in the future, particularly in the areas of cognitive and attitudinal effectiveness and the theoretical basis of the design of interactive video simulations. It is suggested that educators should abandon the task of trying to prove the effectiveness of multimedia simulations in comparison to other technologies and concentrate on exploring their potential in relation to learning tasks and learners' characteristics. (Contains 10 references.) (ALF)

HOW TO EVALUATE MULTIMEDIA SIMULATIONS: LEARNING FROM THE PAST

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1. INTRODUCTION

As we all know, multimedia technologies, such as IV, CDI, and DVI, offer a great potential to educators. Interactive video (IV), for example, which is the most commonly available one, comprises quality still and moving pictures, perfect digital sound, fast and accurate data processing power, and effective image and graphics display. Such a technical potential enables educators to create various types of IV simulations which, theoretically, are capable of meeting the requirements recommended by learning theories for effective learning processes to occur. It is that capability which makes educators eager to harness the potential of multimedia technologies. Despite that, educators and decision-makers need to see some evidence regarding the instructional effectiveness of multimedia in advance if they are to be convinced for their integration into educational processes. Because such an integration requires a considerable amount of investment. Such evidence can be obtained through evaluation studies which investigate the concept from different perspectives in relation to real-life educational settings. To this end, educators have been conducting evaluation studies since the 1950's. The problem is that such studies have been criticised, since then, for being useless for a number of reasons (Clark, 1983, 1984, 1985; Salomon & Clark, 1977; Clark & Salomon, 1986). Similarly, multimedia simulations, in practice, may not live up to expectations. Thus, The main purposes of this paper are:
1- to identify the main criticisms of media research,
2- to discuss the state of current IV simulation research in the light of the criticisms made,
3- and to identify the most important points which need to be considered by media researchers in order to avoid making similar mistakes in the future.

2. THE MAIN CRITICISMS OF MEDIA EVALUATION STUDIES

Let us first identify the main criticisms which have been directed towards media evaluation studies between the 1950's and early 1970's, and between the mid 1970's and the present. That may enable us to see how far we have progressed, since the fifties, in terms of the quality of results obtained, regarding the instructional effectiveness of media.

Just to refresh our memory about the kind of research that was carried out in these two periods, it might be better to examine briefly not only the criticisms but also the research format, the research characteristics, and the recommendations that had been made in order to overcome the criticisms.

2.1) Media Evaluation Research Between 1950's and early 1970's

2.1.1. Research format

- comparative (single medium vs traditional instruction)

2.1.2. Research characteristics

- focused on distinguishing the effects of one treatment variable to one outcome variable, with no recognition of individual characteristics (Lumsdaine, 1963; Stickwell, 1963; Copeland, 1986; Moore, et al., 1986).

2.1.3. The Most Common Result

- no significant differences between control and experimental groups (Stickwell, 1963; Chu & Schramm, 1967; Jamison et al., 1974).

criticisms:

- producing 'uninterpretable' findings (Seatler 1968),
- producing 'meaningless' data (Fleming 1970),
- not producing enough information to determine the unique features of various media and whether they were effective in teaching different skills in various situations (Allen 1971)
- being 'fruitless' (Levie & Dickie, 1973).

Other limitations of the comparative approach have been identified as:

- inadequate treatment definition,
- incomplete specification of treatment dimensions,
- failure to measure treatment implementation, and
- insufficient relevance to practical decision-making (Reeves, 1986).

2.1.4. Recommendations made in that period

- within-media variables "e.g. compare the effectiveness of films which have optical effects with those which do not" should be investigated (Fleming, 1970).
- different design strategies (which relate to media characteristics, subject matter, and task characteristics) should be used (Campeau, 1974).
- more emphasis should be placed upon what is to be learned and the role of the learner rather than upon the nature of the media (Levie & Dickie, 1973).
- multivariate designs (in which results would not only show main effects but also interaction among variables which could improve learning) should be used (Campeau, 1974).
- more effort should be devoted to replication (to confirm findings of a particular study) and follow-up studies (to determine under what conditions, for which students and for which learning tasks particular instructional media will produce the most learning) of previous research (Campeau, 1974).
- more research should be conducted on media 'content' (i.e. looking not only at a particular medium but also at very specific characteristics of a particular medium).

As can be seen, all the recommendations were basically about the replacement of the search for the generally effective medium by a more

atomistic analysis of the characteristics of the medium employed in relation to the task demands and learners' characteristics.

2.2) Media Evaluation Research Between the mid 1970's and the present

The main development in that period was the emergence of the Aptitude-Treatment Interaction (ATI) approach which was initiated by Cronbach and Snow (1977) during the late seventies. Its main assumption was that learning involves an interaction of task, learner, and media characteristics. Thus, researchers should focus on determining the relationships between these factors and their effect on learning rather than merely comparing the effectiveness of two media. did researchers abandon the comparative format and follow the ATI approach? Although researchers who designed CBI studies were urged to do so (e.g. Clark, 1985), the literature reveals that evaluators continued to conduct large numbers of studies using the comparative format, hardly focused on ATI, and progressed very little from the 1950's and 1960's. Indeed, one of the major sources of support for the use of computers for instruction has been the results of comparative research studies (Clark, 1985) which claimed increased efficiency for the new technology. The literature also reveals that not only computer studies but also most of the IV studies, to the date, have been conducted in a comparative format (Reeves, 1986; Cushall et al., 1987; Slee, 1989). It could therefore be argued that the same comparative approach is still being applied for media research and that the findings probably deserve the same criticisms.

It should also be pointed out that studies which followed the ATI approach have been criticised as well. Thus, here, we would like to briefly examine the criticisms in the same way.

Aptitude-Treatment Interaction (ati) approach

2.2.1. Research characteristics

- research data are based on comparison between control experimental groups
- experiments are conducted in laboratory settings in order to overcome problems of precision and control (Snapiro, 1975).

Indeed, the majority of the work on ATI have been completed in laboratory settings, and few attempts had been made to apply ATI to actual classroom settings (shapiro, 1975).

2.2.2. The most common result

- no significant difference between control and experimental groups (e.g. Cohen et al., 1981).

2.2.3. Criticisms made

- lack of useful results, because of the design employed (Reeves 1986).
- lack of research carried out in the real life educational world and conducted with real materials (Salomon & Clark, 1977).
- lack of integration in the design between media attributes and learner aptitudes (Clark and Angeri, 1980);

- lack of control on variables such as instructional method, curriculum content, and novelty (Clark, 1983, 1984, 1985);
- lack of guidance to the most experiments by a theoretical framework (Bates, 81); and
- lack of consideration concerning individual differences in responses to different media (Bates, 81).

2.2.4. Recommendations made

- research studies employing experimental and quasi-experimental designs to compare instructional technologies should be abandoned (Reeves, 1986).
- media research should focus on learning factors affected by the new medium, by the characteristics of the learners, and in the manner by which these media exhibited their effects (Salomon & Gardner, 1986).
- media research should be carried out in real educational settings with real materials (Salomon & Clark, 1977).

As can be seen from both the criticisms and the recommendations made for that period, problems of control over variables and relevancy to the real world have caused the main dilemmas for the laboratory-controlled experimental method. While this method allows a better control over variables which leads to a better internal validity, and allows better conceptualization and understanding, it lacks representativeness, and hence, has only remote relevance to educational practice (Salomon & Clark, 1977). On the other hand, studies carried out in the real world of education, dealing with complex variables, are most often highly specific and do not warrant generalization. They also have a poor internal validity because of the complexity of the phenomena they deal with. Salomon & Clark (1977) conclude that internal validity may be sacrificed if the study is a summative evaluation, which involves 'judgement of worthwhileness'. The sacrifice is worth making because it allows media being studied to be used to its fullest advantage or to be exploited fully.

Having had a short chronological analysis of media evaluation studies since the fifties, let us identify what, at the present, we know about the instructional effectiveness of IV simulations.

3. THE EVIDENCE AVAILABLE ON INSTRUCTIONAL EFFECTIVENESS OF IV SIMULATIONS

The main findings, based on an extensive literature review, can be identified as follows:

- IV simulations have a positive attitudinal effect on learners,

- effective use of IV simulations in secondary school science lessons may improve standards of laboratory work and save time in comparison with setting up normal experiments (Doulton, 1984),

- tutorial IV simulations in science can significantly increase student performance on laboratory reports and test scores (Smith et al., 1986),
- there is no significant difference between the cognitive effect of IV laboratory simulations and standard laboratory instruction in teaching college level pure science (Stewens, 1984),

- IV's visual images can help college students to understand some physics principles better (Cordes, 1988),

- IV simulations can enable students to visit a real place and move around in time and space to investigate, sample, analyze, and test possible ideas within the environment (McCormick, 1987).

4. CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCHERS

In the light of the literature and the reported research findings on the instructional effectiveness of IV simulations, the following conclusions can be drawn:

1- most of the studies have applied the comparative format,

2- none of the studies has compared the cognitive and attitudinal effectiveness of various types of IV simulations (e.g. Surrogate, Competitive, Experimental) in teaching a particular learning task (e.g. problem solving, fact acquisition, concept acquisition, extension of existing knowledge, transfer of knowledge and applications, understanding of procedures and processes, handling of evidence), in relation to learners' characteristics (e.g. gender, academic achievement, social background),

3- none of the studies has compared the cognitive and attitudinal effectiveness of various types of IV simulations in teaching different learning tasks, in relation to learners' characteristics,

4- none of the studies has investigated the cognitive and attitudinal effectiveness of studying IV simulations in different ways (e.g. pair, single) in relation to different learning tasks and different learners characteristics,

5- little work has been done on the theoretical basis of the design of IV simulations.

As can be seen, there are still criticisms to be made about the way that new technology is evaluated. The striking point seems to be that although the comparative approach has been strongly criticised since the 1950's, evaluators have continued to stick to it. The main reason for the continuity of the comparative approach seems to be that such studies are driven by decision makers' questions, in education, commercial, and military contexts where the main purpose is to prove the effectiveness of the medium introduced by comparing it with the existing one. The question that arises then is: are educators going to continue to evaluate multimedia applications in the same way or are they going to take the criticisms into account? It seems that educators should abandon the task of trying to prove the effectiveness of multimedia simulations in comparison to other technologies and concentrate on exploring their potential in relation to learning tasks, and learners' characteristics.

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