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ABSTRACT

An overview of participative exercises of the game/simulation/case study type is provided, and seven distinct types of exercises are identified and briefly described; i.e., "pure" games; "pure" simulations; "pure" case studies; simulation games; games used as case studies; simulated case studies; and simulation games used as case studies. The educational strengths and weaknesses of games and simulations are then examined and three basic areas in which games and simulations can make a contribution in tertiary education are discussed: (1) helping to achieve basic cognitive objectives; (2) teaching laboratory skills; and (3) achieving non-cognitive aims. In conclusion, suggestions are offered for choosing an exercise, carrying out any necessary modifications, and using the exercises effectively with a class. Five general books and 16 books related to specific subject areas are suggested for further reading. (ME3)

This booklet was written by Dr Henry Ellington of the Educational Technology Unit at Robert Gordon's Institute of Technology, Aberdeen.

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How Games and Simulations can be used in Tertiary Education

Introduction

This booklet is a sequel to booklet number 5 in the series, "A guide to the use of group learning techniques", which it is suggested should be read *before* the present booklet.

In "A guide to the use of group learning techniques", we saw that participative exercises of the game/simulation/case study type are achieving increasingly widespread use in virtually all sectors of education and training. In this booklet, we will take a more detailed look at such exercises, beginning by surveying the game/simulation/case study field, then examining the educational strengths and weaknesses of exercises of this type, then discussing the different ways in which they can be used in tertiary education, and finally offering some practical hints on their selection and use.

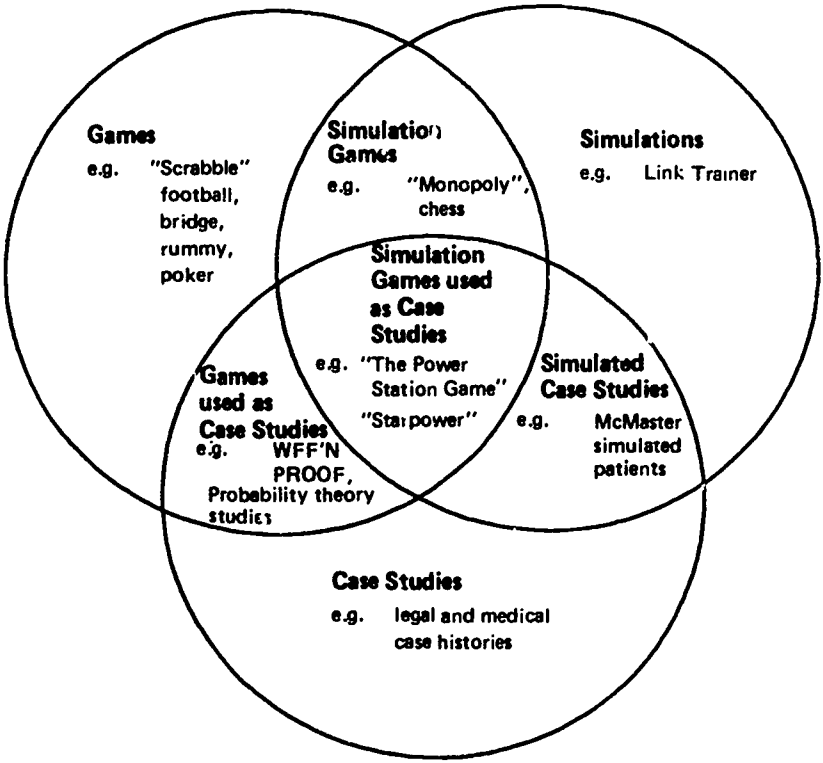
Readers who are interested in designing their own games, simulations or case studies are also referred to booklet number 19 in the series, "How to design educational games and simulations", which offers detailed guidance in this area.

The Game/Simulation/Case Study Field

Since some readers are probably unfamiliar with educational games, we will start by defining a few basic terms and taking you on a short 'tour' of the game/simulation/case study field.

A *game*, first of all, is 'any content (play) among adversaries (players) operating under constraints (rules) for an objective (winning, victory or pay-off)'. Thus, to qualify as a 'game', an exercise must have two basic characteristics, namely, *overt competition*, and *rules* (arbitrary constraints within which the players have to operate).

A *simulation*, on the other hand, is 'an operating representation of central features of reality'. Thus, to qualify as a 'simulation', an exercise must again have two basic characteristics, namely, it must represent a *real* situation, and must be *on-going*. (Static analogues such as circuit diagrams do not, in other words, qualify as simulations, whereas working models of all types do.)



Finally, a *case study* is 'an in-depth examination of a real-life or simulated situation carried out in order to illustrate special and/or general characteristics'. Thus, to qualify as a 'case study', an exercise must again have two essential features, namely *in-depth study* carried out in order to *illustrate particular characteristics* (either characteristics specific to the case under examination or more general features of the broader set of which it is a member).

In practice, games, simulations and case studies are in fact closely inter-related, their sets overlapping in the way shown in the above Venn diagram. We see from this that there are at least seven distinct types of exercises, namely three 'pure' types and four 'hybrid' types. Let us now illustrate these by means of examples.

1. *'Pure' Games* These are exercises which have both the essential characteristics of games *(competition* and *rules)* but not those of simulations or case studies. 'Scrabble' and football are two

well-known examples, as are familiar card games such as bridge, rummy and poker.

2. *'Pure' Simulations* These are exercises which have the essential characteristics of simulations (i.e. are *on-going representations* of *real* situations) but not of games or case studies. Training simulators such as the Link Trainer developed during the Second World War to teach flying skills are good examples of the genre.

3. *'Pure' Case Studies* These are exercises which have the essential features of case studies (*in-depth study* carried out to *illustrate special characteristics*) but not of games or simulations. Conventional legal and medical case studies fall into this category.

4. *Simulation Games* These are exercises which have all the essential features of both games *and* simulations, but not of case studies. 'Monopoly' and chess are good examples.

5. *Games Used As Case Studies* These are exercises which have all the essential characteristics of games *and* case studies, but not of simulations. A good example is *WFF'N Proof* – a game that was developed at the University of Michigan for use in the teaching of symbolic logic and mathematics. Further examples include the use of simple gambling games (such as coin tossing and craps) as case studies in probability theory.

6. *Simulated Case Studies* These are exercises which have the essential features of both simulations *and* case studies but not of games. The 'simulated patient' technique developed at McMaster University in Canada for use in medical training is a well-known example.

7. *Simulation Games Used As Case Studies* These are exercises which have *all* the essential features of games, simulations *and* case studies. Examples are 'The Power Station Game' (a large-scale simulation of the processes involved in planning a new power station that was developed at Robert Gordon's Institute of Technology during the mid 1970's) and 'Starpower' (a well-known simulation of class conflict that was developed at the Western Behavioural Sciences Institute in California during the late 1960's).

In addition to the above classification by *function*, games, simulations and case studies are often classified by *format*. Here, the most important distinction is between *computer-based exercises* (which involve the use of a computer of some sort for their delivery, management or execution) and *manual exercises* (which

do not involve the use of a computer). Manual exercises can themselves be classified into a number of distinct types, three of the most important being *simple manual exercises* (which involve the use of nothing more complicated than simple resource materials such as role sheets and briefing booklets), *card games* (which involve the use of one or more packs of specialised cards of some sort) and *board games* (which are played on a specially prepared surface of some sort).

Educational strengths and weaknesses of games and simulations

(a) Strengths

Games and simulations have a number of characteristics that make them extremely useful from an educational point of view.

(i) They constitute a highly versatile and flexible medium whereby a wide range of educational objectives can be achieved in a variety of academic subjects. As we will see later, they can be particularly useful for achieving higher cognitive and affective objectives.

(ii) The use of a simulated as opposed to a real situation allows the *situation* to be tailored to meet the needs of the *exercise* rather than requiring the exercise to be designed within the constraints imposed by the situation. Also, use of simulation allows a highly-complex real-life situation to be reduced to manageable proportions.

(iii) Games and simulations can achieve *positive transfer of learning* (the ability of participants to apply skills acquired during the exercise in other situations).

(iv) In many cases, games and simulations constitute a vehicle whereby the participants can utilize and develop their initiative and powers of creative thought – a particularly important characteristic in view of the progressively greater emphasis that our educational system is now placing on the cultivation of divergent thought processes.

(v) Many games and simulations help foster a wide range of non-cognitive skills (such as communication, interpersonal and decision-making skills) and desirable attitudinal traits (such as willingness to listen to other people's points of view and appreciate that most problems can be viewed in a number of different

ways). Exercises that involve interaction between the participants are especially effective in this regard.

(vi) One advantage that games and simulations have over more traditional teaching methods is that student involvement is normally very high. Also, most people find them highly enjoyable.

(vii) Where a competitive element is present (not necessarily at the expense of cooperation) this undoubtedly provides strong motivation for the participants to commit themselves wholeheartedly to the work of the exercise.

(viii) Many games and simulations have a basis in more than one academic discipline, a feature that can help the participants to integrate concepts from otherwise unrelated areas.

(ix) Another valuable characteristic of multi-disciplinary exercises is that they often provide a situation in which people with expertise in different subject areas have to work together in order to achieve a common end. Interpersonal skills of this type are vital for success in later life, and constitute an area of education in which simulation games are virtually the only means of providing practical experience in a school or college environment.

(b) Weaknesses

There are, however, also a number of problems and pitfalls associated with the use of games and simulations in educational situations, and it is just as important that potential users should be fully aware of these.

(i) Games and simulations are often rather difficult to fit into the normal curriculum, particularly in the case of large-scale simulation exercises, which sometimes require several days to play. One of the exercises mentioned on page 3, for example ('The Power Station Game') needs at least two full days to run, although this problem can be overcome by fitting it into a succession of laboratory periods over a number of weeks (this is the solution adopted in Robert Gordon's Institute of Technology, where the game is regularly used in this way with engineering students).

(ii) There is always a danger of using games and simulations for the wrong reasons, e.g. using them as 'diversions' or 'time-fillers' rather than for some specific *educational* purpose. Also, with some so-called 'educational games', it is possible for students to play them *purely as games*, without deriving any worthwhile educational benefit, because the 'educational' and 'gaming'

elements are not fully integrated. (A number of commercially-available card games tend to have this weakness to some extent).

(iii) If a game or simulation is to be of any real use in a given educational situation, it must not only be capable of achieving the desired educational outcomes but must also be properly matched to the target population with which it is to be used, i.e. must be of a suitable *level*. It is, however, very unusual to find an exercise that is ideally suited to the purpose one has in mind, so it may be necessary to carry out a certain amount of adaptation or modification, or even to 'start from scratch' and design a completely new exercise. Obviously, this requires a certain amount of expertise and (preferably) some previous experience.

Using Games and Simulations in Tertiary Education

Let us now turn our attention to the different ways in which it is possible to make use of games and simulations in tertiary education. There are at least three basic areas in which they can make a significant contribution, namely, in helping to achieve the basic cognitive objectives of a course, in helping students to acquire laboratory and laboratory-related skills, and in helping to develop a wide range of non-cognitive skills. Let us now look at each of these in more detail.

1. Helping to achieve basic cognitive objectives

If properly used, games and simulations can make an extremely valuable contribution to achieving the basic cognitive objectives of a wide range of courses. Extensive research (mainly carried out in the USA) has shown that such exercises are no more effective that traditional expository or individualized methods in teaching the basic facts and principles of a subject (the lower range of the cognitive domain); they are, however, particularly useful for achieving high-level cognitive objectives relating to such things as application, analysis, synthesis and evaluation. Thus, it it *not* advocated that games and simulations should be used as a main front-line teaching technique, but rather as a complement to and support for traditional methods, e.g. for reinforcement, or to demonstrate applications or relevance. For example, they can be incorporated into many courses as illustrative case studies, or, in some cases, can be used as an alternative to conventional worked examples.

2. **Teaching laboratory skills**

Simulations and simulated case studies can be used as a supplement to, and, in some cases, as a substitute for, conventional laboratory work. The various types of mechanical/electronic training simulator have, of course, a long history of use in laboratories of all types, but the recent advent of cheap microcomputers now means that students can be given direct experience (through simulations) of a far wider range of experimental situations than was feasible before they came on the scene. Specific areas where such computer-based simulations can be used include:

- situations where a conventional experiment is either extremely difficult or impossible (e.g. experiments in astrophysics and human genetics and 'thought experiments' such as the investigation of non-inverse-square gravitation);
- situations where experimental apparatus is either not readily available or too complicated or expensive for general laboratory use (e.g. experiments in reactor physics and industrial processes of all kinds);
- situations where actual experimental work could be dangerous (e.g. work with explosive mixtures, highly radioactive materials, toxic chemicals, virulent pathogens, etc);
- situations where a conventional experiment would take an unacceptably long time to complete (e.g. experiments in genetics, sociology or population dynamics).

3. **Achieving non-cognitive aims**

Students undergoing higher education are normally expected to 'pick up', in the course of their studies, a wide range of non-cognitive skills (e.g. decision-making, problem-solving, communication, library and interpersonal skills) and desirable attitudinal traits (e.g. open-mindedness). In many courses, however, most of the teaching effort is concentrated on the learning of cognitive skills, with the vague hope that these associated skills and traits will somehow 'rub off' on the students. Participative simulations, games and case studies are capable of making a very significant contribution to achieving such non-cognitive aims, however, and have been used for this purpose by many workers. For example, many of the science-based games, simulations and participative case studies that have been devel-

oped at Glasgow University and Robert Gordon's Institute of Technology since the early 1970's have been specifically designed for achieving education 'through' science, i.e. using a science-based exercise as a vehicle for achieving a wide range of educational objectives that go far beyond those that would normally be associated with its intrinsic scientific content. (Further information about many of these exercises can be found in the book by Ellington, Addinall and Percival listed in the 'Further Reading' section at the end of this booklet.)

A further advantage of such exercises is that they help to demonstrate the vital part played by science and technology in modern industrial society. Thus, as well as being used with science and engineering students as 'mind broadening' exercises, they can be used with non-science students in order to help bridge the 'two-culture' gap. Many of the science-based exercises mentioned in the last paragraph are now being used in these different ways in schools, colleges and universities throughout the world.

Choosing and using Games, Simulations and Case Studies

In conclusion, let us take a brief look at how to set about the task of choosing an exercise of the game/simulation/case study type for a specific purpose, carrying out any modifications that may be necessary, and using it effectively with a class.

How to choose an exercise

This is best done in the following three stages, each of which involves seeking answers to a number of questions.

Stage 1 : establishing your objectives

Before you start to think about choosing an exercise, you should be quite clear as to the job that you want the exercise to do. This is best done by asking yourself the following questions:

- With whom is the exercise to be used?
- For what basic purpose?
- What specific educational objectives do you want to achieve?

Stage 2 : deciding what type of exercise to use

Once you has established your educational objectives, you should then give some thought as to what *type* of exercise you think would be best suited to helping you to achieve these objectives. Specifically, you should ask yourself the following questions:

- What *basic type* of exercise do you think would be suitable? (A case study? A simulation game? A role-playing simulation? – and so on).
- What *format* of exercise do you want to use?

Stage 3 : choosing a specific exercise

Once you have clarified your ideas about the basic type and format of the exercise that you would like to use, you should then set about the task of seeing whether exercises of the type you want are in fact available, and, if so, choosing the one that you feel would be most suitable to meet your needs. The task should again be tackled by seeking the answers to a number of questions.

- Is an exercise of the type you want available 'in house', i.e. within your own establishment or within any larger organisation of which it forms a part? (If it is, get hold of it and use it.)
- If a suitable exercise is not available 'in house', could such an exercise be obtained from an external source? (Here, probably the best advice that can be given to would-be users of games, simulations and case studies is to get in touch with SAGSET – the Society for the Advancement of Games and Simulations in Education and Training (address : Centre for Extension Studies, University of Technology, Loughborough, Leics. LE11 3TU). SAGSET produce a series of resource lists, each of which gives details of the materials that are currently available in a particular discipline or subject area. These lists represent an invaluable bank of information on the game/simulation/case study field, and are highly recommended to anyone who wishes to make use of such exercises.)

If you find that an exercise of the type you want is *not* available 'in house' or from an external source, you can, of course, always design your own. Detailed guidance on how to do so is given in booklet number 19 in this series – "How to design educational games and simulations".

Carrying out any modifications necessary

Even when you have found an exercise that appears to meet your needs, you will often find that it is advisable to modify it in some way before putting it to use. Such modification may be necessary for a variety of reasons, e.g.:

- because the *level* is not quite right for the target population you have in mind;
- because the *length* of the exercise is too long or too short;
- because the *logistics* of the exercise are unsuitable as they stand;
- because the *content* is not quite appropriate for what you have in mind.

Such modifications can be carried out in two basic ways. The first is to use the existing resource materials in a different way from that recommended by the game designer, e.g. by omitting certain materials, sections or activities, altering the programme or time scale, re-organising the structure, and so on. The second is to modify the actual resource materials, e.g. by removing unwanted sections or items, altering or extending sections or items, adding completely new material, and so on. You should never be afraid to carry out such modifications, since the educational outcomes that *you* want the exercise to achieve may well be different from those that the designer of the exercise had in mind. Indeed, once you have acquired a game, simulation or case study you should feel free to make use of it *in any way you see fit;* it is, after all, simply a collection of resource materials.

Preparing to run an exercise

Let us now turn to the various stages in the actual running of an exercise, beginning with the preparatory work. Assuming that any modifications needed have already been made, this can be broken down into the following tasks:

(i) Make sure that the package of resource materials is available and complete.

(ii) Make sure that all other facilities needed for running the exercise will be available as and when required (e.g. accommodation, audiovisual or computer facilities, extra staff);

(iii) Check that you will have a suitable number of participants to ensure that the exercise can be run effectively (if necessary,

'borrow' students from another class in order to make up the numbers);

(iv) Make yourself *thoroughly familiar* with the *complete* package, and, in particular, with the 'teacher's guide' (if one is supplied);

(v) Carry out any preliminary teaching that may be necessary;

(vi) Issue any introductory or background material, and make sure that the participants know what the exercise will involve; if necessary, allocate students to roles (or groups) and issue any briefing or resource material.

All these points may seem rather obvious (especially to those with some experience of running games and simulations) but tney are all essential if the exercise is to run smoothly.

Running the exercise

Unless you are deliberately departing from the method of organization recommended by the designer, the key to the successful running of a game, simulation or interactive case study is to make sure that you follow the instructions given in the teacher's or organizer's guide. If such a guide is not included in the package, it is strongly recommended that you prepare your own, as this will be extremely helpful in sorting out your ideas and plans.

The debriefing

Practically all workers in the gaming and simulation field agree that a debriefing session of some sort is *essential* if full educational value is to be derived from a game, simulation or case study. The form of this debriefing will depend on the nature of the exercise involved and the context in which it is being used, but should generally include the following three elements:

(i) Review of the actual work of the exercise, and discussion of any important points that are brought up by the participants;

(ii) Discussion of the relationship between the exercise and the subject matter on which it is based (e.g. discussion of the degree of realism of the exercise in the case of a simulation);

(iii) Discussion of any broader issues raised by the exercise.

If the exercise was itself being tested in any way (e.g. if you were trying out a newly-modified version of an existing game or simulation), a fourth element should be included, namely, discussion of possible methods by which it could be improved.

The debriefing session is particularly important in the case of exercises that involve role play or place the intrinsic subject matter in a social, political, economic or environmental context; indeed, in these cases, it is usually the most important part of the entire exercise.

Further Reading

A large number of books dealing with different aspects of gaming and simulation are now available, some of the most useful being listed below.

(a) General books

1. *Simulation and Gaming in Education*, by P.J. Tansey and D. Unwin; Methuen, London; 1969. (An extremely useful introductory text for those new to the field.)
2. *Learning and the Simulation Game*, by J.L. Taylor and R. Walford; Open University Press, Milton Keynes; 1978. (Another extremely useful introductory text.)
3. *The Effective Use of Role Play – a Handbook for Teachers and Trainers*, by M. Van Ments; Kogan Page, London; 1983. (An invaluable practical guide for those wishing to use role play in their teaching.)
4. *Gamesters' Handbook – 140 Games for Teachers and Group Leaders*, by D. Brandes and H. Phillips; Hutchinson, London; 1977.
5. *Gamesters' Handbook Two*, by D. Brandes; Hutchinson, London; 1982.

(b) Books related to specific subject areas

6. *Games and Simulations in Science Education*, by H.I. Ellington, E. Addinall and F. Percival; Kogan Page, London; 1981.
7. *Games in Geography*, by R. Walford; Longman; 1968.
8. *Handbook of Management Games*, by C. Elgood; Gower; 1981.
9. *Economics Games People Play*, by S. Maital and S.L. Maital; Basic Books; 1984.
10. *Planning Games*, by M. Wynn; Spon; 1985.
11. *Art-Based Games*, by D. Pavey; Methuen; 1979.

12. *Theatre Games*, by C. Barker, Methuen; 1977.

13. *Communication Games*, by K.R. Krupar; The Free Press; 1973.

14. *Exercises in Teaching Communication*, by S. Marshall and N. Williams; Kogan Page, London; 1986.

15. *Games for Social and Life Skills*, by T. Bond; Hutchinson; 1986.

16. *Handbook of Simulation Gaming in Social Education*, by R. Stadsklev; Institute of Higher Education Research and Services, University of Alabama (USA); 1974.