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The Validity of Games

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One way to deal with complex situations is the simulation approach: build a simplified model of this reality, learn from this simplified model, and, finally, translate the findings or knowledge back to the reality. Gaming is based on this idea. If we want to make inferences about reality based on experiences and knowledge acquired in a game, we have to be sure that the game model is a good, or valid, representation of the real situation. In this article, the concept of validity is explored in relation to games and simulations; four aspects of validity that apply to simulations and games are distinguished. These aspects are related to three applications of games. The article concludes with factors that may threaten validity during the process of the game design; a few suggestions are made to avert these threats.

KEYWORDS: *education; game design; gaming; research; simulation; threats for validity; validity.*

In the field of research, it often occurs that we have to answer research questions about situations that cannot be investigated directly. Research on future situations is a clear example. Vissers, Heijne, and Peters (1995) mention other instances in which the situation under study is inaccessible for researchers. Similar problems occur in teaching. In many situations, it is impossible to teach or train students in the real situation, for example, because the situation is too complex or because one is required to have certain

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knowledge or skills before one can be admitted to that situation (cf. the training of a pilot or surgeon). A third field is the development of new policies. If a policy maker wants to experiment with new policies to assess effectiveness and to explore possible negative side effects, the real situation is not an appropriate place for these exercises.

In all these instances, the researcher, the teacher, or the policy maker can resort to gaming (or another form of simulation) to answer the research questions, transmit the desired knowledge, or get insight into the effect of policies.

The Simulation Approach

If we use simulations to learn from or teach about problems or situations, we first make a simplified model of the situation; next, we learn from or teach about this model; finally, we translate the findings or knowledge acquired in the model back to reality. The problem or situation that is the subject of our research, teaching, or policy is called the reference system. It is the point of departure for the simulation approach. To create a model, we describe the elements of the reference system and the relations between them in terms of another (known) system.

We can use various types of models. In the case of a mathematical model, we use variables and mathematical functions to describe the elements and their relations; in a conceptual model, we use concepts to indicate the elements and linking arrows to establish and describe the various relations; in a physical model, we have physical objects and the spatial arrangements between them. In the case of gaming, elements of the reference system and their relations are represented by design elements like scenario, events, roles, rules, and accounting system.

The process of designing and applying a game can be represented as in Figure 1. The arrow at the left indicates the process of the game design. The reference system has to be translated into a usable game. That is, we have to get a good understanding of the characteristics of the reference system and transform these characteristics into the elements that constitute a game. Next, the game is played by participants; this will result in new information and/or new knowledge and experiences. Depending on the kind of application and the objectives of the game, the output of playing the game can be of interest for the researcher or for participants themselves. For this, observations and experiences made in the simulation have to be translated back to the reference system. This is indicated by the arrow at the right. In the context of education and policy, this is often referred to as debriefing (see, e.g., Lederman, 1992).

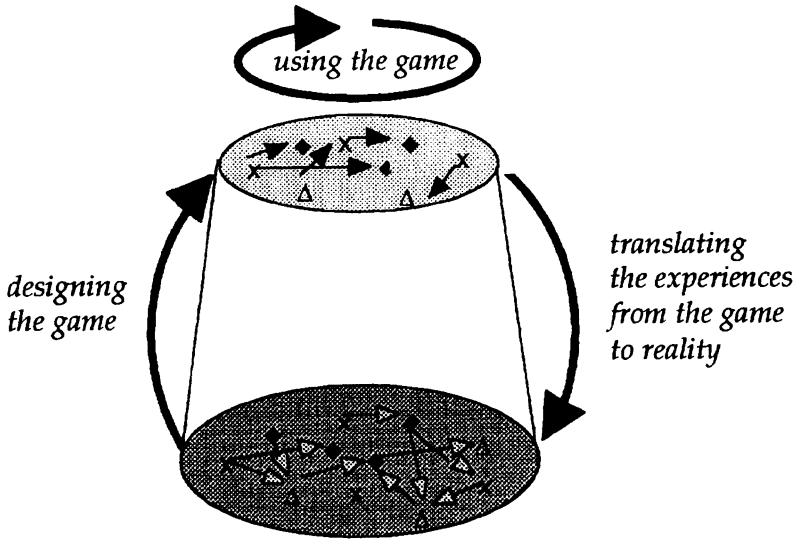

FIGURE 1: Designing and Applying a Game

The arrow shows that the reference system can be considered to be the target point for the gaming process. Because the reference system is also the starting point of the gaming process, we see that the simulation or gaming circle is closed.

When games are applied in the described context, the basic assumption is that we are able to translate acquired knowledge and experiences from one system to another. The extent to which this translation will be successful depends, among other things, on the degree to which the game is a valid representation of the reference system. In other words, the strength of our conclusions about the reference system is determined by the validity of the game model.

The Concept of Validity

There is a vast amount of literature about the concept of validity, but this literature focuses mainly on the validity of experimental situations (cf. the concepts of internal and external validity) or on the validity of measurement instruments (cf. the concepts of content and construct validity) (Cook & Campbell, 1979; Cronbach & Meehl, 1955). These aspects of validity refer

to the correspondence of a specific research method (e.g., the experiment) or the results of a research act (e.g., data gathering by means of a questionnaire) and the reference system, that is, that part of reality the researcher wants to investigate. The concept of validity in relation to simulations and games as a simplified model of a complex reference system is hardly elaborated in the literature.

A very general definition of the concept of validity in relation to games is that the validity of a game is the degree of correspondence between the reference system and the simulated model thereof. This is not a very accurate definition, because the concept of correspondence is not clarified. If correspondence means that each (relevant) element of the reference system has to be literally translated to the game model, we have a very narrow definition of validity; this definition implies that games that are based on a metaphor cannot be valid. But if we relax the definition of the word correspondence, what does it mean then? What criteria do we have to apply to assess the correspondence? In addition, the question regarding whether the correspondence is sufficient depends on the objectives of the game. For one purpose, the game can seem to be a valid representation, whereas it is not for another purpose.

With respect to the use of gaming in research, Raser (1969) has defined validity of models in the following way: "A model can be said to be valid to the extent that investigation of that model provides the same outcomes as would investigation in the reference system." This definition does not stress the correspondence between the two models, but validity is based on the results of the use of the model. This utilitarian definition of validity can also be applied to other applications by replacing the word *investigation* with terms like *learning*, *taking decisions*, and so on.

Raser (1969) has suggested four criteria for the validity of gaming as a research tool: psychological reality, structural validity, process validity, and predictive validity. The first criterion for validity, according to Raser, is psychological reality. A game is valid to the degree that it provides an environment that seems realistic to the players. If they fail to see the game as realistic, they possibly tend to show different behavior than they would in real-life situations or they tend to take more risks. The result will be that behaviors in the game do not correspond to behaviors in the reference system.

Structural validity is the second criterion for validity distinguished by Raser (1969). This criterion is formulated as follows: "A game is valid to the degree that its structure (the theory and assumptions on which it is built) can be shown to be isomorphic to that of the reference system" (p. 144). Above, we have pointed at the elements in the reference system and the relations between them. These elements (actors, information, data, laws, norms, etc.)

and the way they are connected should be reflected in the game model. The word *isomorphic* indicates that these elements and relations in both systems do not necessarily have to be similar, but there must be a congruency between them. Because modeling means that we try to build a simplified model of the reference system, it is not necessary that all elements and relations be represented in the game model. So, this aspect of validity implies that the most important features of the reference system should be included in the game model in an isomorphic way.

Process validity—the third criterion for validity—implies that "a game is valid to the degree that the processes observed in the game are isomorphic to those observed in the reference system" (Raser, 1969, p. 144). The previous criterion stated that there should be a congruency between the elements in the game system and the elements in the reference system. In a similar way, this third criterion states that there should be a congruency between the processes that take place in both systems. In this respect, we can, for instance, think of flows of information or resources, interactions between actors, and negotiations.

The last criterion is predictive validity: "A game is valid to the degree that it can reproduce historical outcomes or predict the future" (Raser, 1969, p. 144). This criterion refers to the accuracy of the outcomes of the game: Are we able to make a good estimate or prediction of what happens in the reference system? We can assess the validity of a game by trying to reconstruct known situations. The results of the game can then be compared with the result in reality. If this so-called postdiction proves to be sufficient, we feel more confident about the game and its predictions about future situations.

These four criteria for validity help us to get a better understanding of the general concept of validity. Raser (1969) has described them in relation to simulations and games for research purposes. We will look at three different applications of games to see whether and to what extent these four criteria are applicable.

Table 1, derived from Geurts and van Wierst (1991), gives a short characterization of three applications of games. We will explain each application shortly and, next, see how the criteria for validity apply to the specific situation.

Gaming as a Research Tool

If a game is applied as a research tool, a researcher has one or several research questions about the reference system, although without being able to collect necessary information in the reference system itself (e.g., because it is inaccessible or the questions concern a future situation). A game model is constructed to collect the desired information, and the game is played. After

TABLE 1: The Characterization of Three Types of Application of Games

	Function of the Game	*Dominant Communication*	*Desired Outcome*
Research	Offer a stimulus	Model→researcher	Data to answer research questions
Teaching	Conveying medium	Game→players	Cognition and skills
Policy	Create conditions	Players→players	Policy options & solutions

gathering the information before, during, and after the game, and after analyzing it, the researcher has to translate the findings to the reference system, that is, the researcher has to draw conclusions about the original problem. The position of the game in the research process can be compared with other situations in which the researcher can collect the desired data: the real-life situation, a test situation, or an experimental situation. The need to draw valid conclusions about the reference system on the basis of information gathered in a game makes high demands on the game. The game should be constructed in such a way that it is plausible that participants behave in more or less the same way as they would in reality. Therefore, the game should appear as realistic to participants. There must be a rather strong resemblance between the game model and the reference system (structural and process validity), and the researcher must also have indications that the outcomes of the game (i.e., the data gathered) are of a high quality, that is, have a high predictive validity toward "reality."

Gaming as a Teaching Tool

The second application of the gaming approach is the situation in which we want to teach people about the reference system or how to act in a new situation. They have to acquire insight in the reference system and/or they have to learn skills. If this reference system is too complex, we can use a game to provide students with new knowledge or to offer them the possibility of training in new skills. After the learning or the practice, students will have to apply their new knowledge or skills in the real situation.

A special feature of the application of gaming as a teaching tool is that the teacher and the game designer know beforehand what has to be learned by the participants; in other words, the desired output (knowledge and skills) of the game is known and so are the standards that must be met by the participants. The learning elements needed to acquire the desired knowledge and skills must be included in the learning environment (i.e., the game), and they must be conveyed to the participants. If the knowledge and skills have

to be applied directly in reality, the game environment should have a strong resemblance with that reality (e.g., the training of a pilot in a flight simulator). If, on the other hand, the game pertains to more general knowledge and skills (e.g., a game about negotiation skills), there is more latitude for game design. The fourth criterion—predictive validity—seems less important in this application. Because the desired output is known in this kind of application, the earlier mentioned utilitarian definition of validity seems to apply very well: The game is valid to the degree that the learning objectives are achieved by the participants.

Gaming as a Policy Tool

In the third application—gaming as a policy tool—the game is designed as an environment in which participants can explore possible policy options to solve a problem or to improve a situation. They are placed in a situation in which they can invent options, experiment with them, consider the results of these options, and compare options in terms of effectiveness, efficiency, and so on. Playing the game shows these results to the players within a very short period of time, in contrast to reality in which it may take months or even years before the impact of a policy becomes perceivable. The game environment should at any rate be open, meaning that it should not guide the participants to only one solution. Rather, the environment should challenge participants to explore several solutions. It is obvious that against this background the concept of validity is valued as different from the two former applications. The reference system should be represented in the game model but not in a very restrictive way: Participants should be able to explore new strategies and behaviors. Because the results of the game give information about the reference system, the outcomes of the game must have some predictive power toward the reference system.

This exploration of the concept of validity in relation to different uses of simulations and games has shown that there are several aspects one has to bear in mind when talking about the correspondence between game model and reference system. These criteria seem to apply to all situations in which gaming is used. But the exploration has also shown that it will not be possible to give general guidelines about how to apply each of these criteria. The value of each criterion, and the balance between them, is highly dependent on the specific objectives of the project of which the game is a part.

We started this section with the observation that there is hardly any literature on the validity of games. In fact, the book by Raser (1969), cited several times in this article, is the only book found by us in which this subject is treated systematically. Some authors have used Raser's ideas, but there

have been no genuine renewals of the thoughts about the validity of games. Raser's book was published in 1969, 5 years before one of the bibles on gaming was published: Duke's (1974) *Gaming: The Future's Language*. Since then, thinking about gaming, the game design process, and the applications of games have gone through an enormous evolution. Thinking about the validity of games seems to be in the same phase as in 1969. We think it is time that Raser's important work on the validity of gaming be updated in light of the new developments in gaming.

In the rest of this article, we will identify some factors that might threaten the validity of games, and we will describe some guidelines that might be useful in avoiding these threats. In this article, we will limit ourselves to factors that are related to the process of the game design, that is, the arrow at the left in Figure 1.

Threats of Validity

The design process of a game is based on three principles, namely, reduction, abstraction, and symbolization. In the process of translating the reference system into a simplified game model, we apply these three principles. Reduction means that we make a selection of elements from the reference system that have to be included in the game model: We include the elements that seem relevant to us, and we leave out the elements that are less important. The second principle—abstraction—implies that the elements included in the game model are not necessarily as detailed as they are in reality: We deliberately simplify them to make our model less complex. The last principle—symbolization—deals with the fact that the elements and relations of the reference system are molded into a new symbolic structure, namely, into scenario, roles, rules, and symbols, which are the most important basic elements of a game. Some game elements may quite resemble their counterparts in reality, but other elements may undergo a metamorphosis and have a complete different appearance in the game model.

During the design process, we can make errors concerning each of the three principles just mentioned. We can wrongly decide to leave out some very essential elements or relations from the simulated model, or we can include elements of minor importance in it; both errors result in the wrong aspects being emphasized in the game model. Or we can introduce in the game model too vague or too detailed elements, which may have the same result. In addition, we can transform elements into such a symbolic structure that the participants fail to see the link with the reference system.

Making these types of errors can be imputed to several causes. One possible cause is that a designer fails to take full account of the objectives of the game. Another cause might be lack of thorough knowledge of the reference system on the part of the game designer; in that case, the designer will not be capable of estimating the relative importance of the elements of the reference system correctly, and thus runs the risk of making the wrong decisions concerning the inclusion or exclusion of elements. Furthermore, making wrong selections may be caused by a designer being too strongly focused on the game model and the eventual game; as a consequence, a designer may be guided by the opportunities and/or the restrictions of the game instead of by the features of the reference system and the objectives of the game.

All errors mentioned jeopardize the extent to which a game model corresponds to the reference system; in other words, these errors are a threat to the validity of the game. During the design process, we can take some measures that help to prevent us from making such errors. We will mention a few possible precautions and checks here.

The first guideline concerns the design process. In fact, it is very simple: Work systematically. This advice might seem like hammering on an open door, but it is a first requirement for a good result. We can be a bit more precise in this. Working systematically means a thorough analysis of the reference system; this analysis should focus on the structure of the reference system as well as on the processes in that reference system. A second precautionary measure is to make clear deductions and small steps during the design process. That is, one should not translate the reference system at once into a game model, because in such a way one cannot sufficiently be aware of how elements of the reference system are expressed in the game model. It is advised that one should discuss the decisions one has made with other persons, especially with the client for whom the game is designed. A participative way of working, in which the client is highly involved in the design process, will give the opportunity of a constant discussion of the steps and the decisions. The methodology, described in Greenblat and Duke (1975) and later adapted and elaborated by many other game designers, offers the necessary support for working systematically.

Another way to improve the validity of a game is to check the validity explicitly, that is, to present the concept of the game to other persons and ask them for their opinion about the correspondence between the game model and the reference system. There are two possibilities for doing so. One can discuss the validity of the game with other game builders and ask them to judge the game from their expert view. Alternatively, one can discuss the game concept with experts on the subject of the game. This discussion should

encompass all four aspects of validity distinguished by Raser (1969) that have been described in a previous section. This way of discussing the game and its validity with experts (either on the game-building process or on the content) is referred to as *peer debriefing* in traditional methodological literature (Guba & Lincoln, 1982). The other option is to present the game concept to future game players (because the game is not ready yet, we have to use future players) and ask them for their opinions about the validity of the game; this procedure is referred to as *member check* (LeCompte & Goetz, 1982). Because one can expect that the experts and the future players will focus on different aspects of the game and its validity, these two approaches can be considered complementary.

The third way to check the validity explicitly is to test the game extensively. Most games are tested before they are released and applied officially. However, these tests tend to focus mainly on the logistics of the game: Are all descriptions clear to the participants, do we have sufficient forms, can the players accomplish their tasks within the available time, and so on. But we should also use these test runs to confront, if possible, the games explicitly with the reference system. It can be very useful to have the test runs attended by observers concentrating exclusively on questions concerning aspects of validity.

We have pointed out a few measures a game designer can take to improve the validity of a game. There are other measures, concerning the phases of using the game and the debriefing, that have not been discussed in this article. We have explored the concept of validity in relation to games and simulations. This exploration has shed some light on the phenomenon, but it also has made clear that there is need to further clarify the concept of validity.

References

Cook, T., & Campbell, D. T. (1979). *Quasi experimentation. Design analysis issues for field settings*. Chicago: Rand McNally.

Cronbach, L. J., & Meehl, O. E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, *52*, 281-302.

Duke, R. (1974). *Gaming: The future's language*. Beverly Hills, CA: Sage.

Geurts, J., & van Wierst, P. (1991). Spelsimulatie: Oefenen met complexiteit [Gaming: Exercising complexity]. In J. Kessels & C. Smit (Eds.), *Spelsimulatie in managementopleidingen* [Gaming in management training] (pp. 1-16). Deventer, The Netherlands: Kluwer.

Greenblat, C., & Duke R. (1975). *Principles and practices of gaming/simulation*. Beverly Hills, CA: Sage.

Guba, E. G., & Lincoln, Y. S. (1982). Epistemological and methodological bases of naturalistic inquiry. *Educational Communication and Technology Journal*, *30*, 233-252.

LeCompte, M. D., & Goetz, J. P. (1982). Problems of reliability and validity in ethnographic research. *Review of Educational Research*, *52*, 31-60.

Lederman, L. (1992). Debriefing: Toward a systematic assessment of theory and practice. *Simulation & Gaming: An international Journal of Theory, Practice, and Research*, *23*(2), 145-160.

Raser, J. C. (1969). *Simulations and society: An exploration of scientific gaming*. Boston: Allyn & Bacon.

Vissers, G., Heijne, G., & Peters, V. (1995). Spelsimulatie en bestuurskundig onderzoek [Gaming and research on public administration]. *Bestuurskunde*, *4*(4), 178-187.

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