



Jan Ulrich Hense, LMU München  
Willy Christian Kriz, FH Vorarlberg



## Improving the quality of gaming simulations: Can we learn anything from evaluation?



jan.hense@psy.lmu.de  
 willy.kriz@fhv.at





Evaluation activities in the field of G&S

40 years of evaluation research in the domain of simulation and gaming (S&G):

S&G are an **effective**, yet not always the most **efficient** method for teaching and learning in a number of content areas (e.g. Faria, 2001; Wolfe, 1997; Wolfe & Crookall, 1989)

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 2








Evaluation activities in the field of G&S

Main **stages of research** on business games (Faria, 2001):

1. Demonstrating **effectiveness** of games versus other teaching methods
2. Finding correlates of **simulation performance** (=learning performance?)
3. Identifying **knowledge and skills** learned in business games

| Most research activities have been directed towards answering **summative evaluation** questions

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 3

Evaluation activities in the field of G&S




Summative evaluation (Scriven, 1972ff):

- Making **final judgments** on the merit or worth of a finished product or program
- Focus on **determining outcomes** of G&S

```

    graph LR
      Inputs[Inputs] --> S&G[S&G]
      S&G --> Effects[Effects]
  
```

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 4

Evaluation activities in the field of G&S




In many contexts it is desirable for evaluation to have a formative role, i.e. to **provide information for improvement**.

But: to know **if** a gaming simulation works does not tell us a lot about **why** it does (or does not) work.

| To do so, we need to pay attention to input, process and context data alike.

“[w]e have to spend more effort on understanding how programs work than on the effort to find out whether or not they actually work in some specific and nongeneralizable instance” (Chen & Rossi, 1983; Chen, 1991, 2004)

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 5

Theory-based evaluation

```

    graph LR
      Inputs[Inputs] --> Process[Process]
      Process --> Effects[Effects]
      Theory[Theory-based evaluation] -.-> Process
      Black[„Black-box evaluation“] -.-> Effects
  
```

Main goal of **theory-based evaluation**: understanding failure and success (Hense, 2004; Kriz & Hense, 2006).

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 6

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Theory-based evaluation Fachhochschule Vorarlberg University of Applied Sciences

### Logic models

- Variables that are relevant in the context of the evaluated simulation game
  - antecedent variables ("input")
  - variables related to interaction with S&G ("process")
  - variables related to S&G effects ("outcome")
- Descriptions of their mutual relationships

### Sources in our context:

- learning & instruction research
- education
- gaming and simulation theory

Input	Process	Short-term Outcomes	Long-term Outcomes
<ul style="list-style-type: none"> <li>Needs</li> <li>Resources</li> <li>Context</li> <li>Facilitator</li> <li>Game</li> </ul>	<ul style="list-style-type: none"> <li>Interaction</li> <li>Engagement</li> <li>Learning</li> <li>Transfer</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge</li> <li>Attitudes</li> <li>Skills</li> <li>Behaviors</li> </ul>	<ul style="list-style-type: none"> <li>Performance</li> <li>Quality of Life</li> <li>Health</li> <li>Well-being</li> </ul>

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 7

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Theory-based evaluation Fachhochschule Vorarlberg University of Applied Sciences

### Steps of theory-based evaluation (cf. Reynolds, 1998):

- Develop a **logic model** of the simulation
- Measure the **outcomes** of participation (= "classical" evaluation)
- Collect data on **input, context** and **process** factors
- Estimate **main effects** of participation
- Test **causal mechanisms** of the logic model → analyse which factors contributed the most, and which factors had detrimental effects
- Identify formative uses of findings for **improvement**

Input	Process	Short-term Outcomes	Long-term Outcomes
<ul style="list-style-type: none"> <li>Needs</li> <li>Resources</li> <li>Context</li> <li>Facilitator</li> <li>Game</li> </ul>	<ul style="list-style-type: none"> <li>Interaction</li> <li>Engagement</li> <li>Learning</li> <li>Transfer</li> </ul>	<ul style="list-style-type: none"> <li>Knowledge</li> <li>Attitudes</li> <li>Skills</li> <li>Behaviors</li> </ul>	<ul style="list-style-type: none"> <li>Performance</li> <li>Quality of Life</li> <li>Health</li> <li>Well-being</li> </ul>

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 8

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Improving G&S by evaluation Fachhochschule Vorarlberg University of Applied Sciences

### What kind of improvement?

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 9

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Improving G&S by evaluation Fachhochschule Vorarlberg University of Applied Sciences

### Points of leverage for improving G&S:

Three mechanisms for quality improvement by evaluation

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 10

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Improving G&S by evaluation Fachhochschule Vorarlberg University of Applied Sciences

### Improving the application and use of G&S within a specific context:

- Learning goals & curriculum
- Learners' preconditions
- Facilitator competencies & behaviour
- Game didactics
- Debriefing procedures
- ...

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 11

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Improving G&S by evaluation Fachhochschule Vorarlberg University of Applied Sciences

### Improving the design of G&S:

- Simulation model
- Game rules
- User interface (on- or offline)
- Game materials
- Instructions for players and facilitator
- ...

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 12

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Improving G&S by evaluation Fachhochschule Vorarlberg University of Applied Sciences

### Improving the conceptual foundations of G&S :

- Gaming & simulation theories
- Instructional theories (in the context of G&S)

Two problems:

- Generalising results from single evaluation studies
- Accumulating knowledge from different studies

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 13

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Fachhochschule Vorarlberg University of Applied Sciences

### Two case examples of improvement-oriented evaluations:

Simgame

StartUp!

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 14

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Two case examples of improvement-oriented evaluations Fachhochschule Vorarlberg University of Applied Sciences

simgame Leonardo da Vinci

The project Simgame – “The Simulation of Economic Processes and Decision Making as a Training Module” - was a Leonardo-da-Vinci-program of the European Union and was carried out in 2003 and 2004. Simgame is also the name of a board-based business simulation game for economy lessons in secondary schools, which was developed, implemented and evaluated within the project (Hense, Kriz & Wolfe, 2007; Kriz & Hense, 2004).

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 15

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Simgame Fachhochschule Vorarlberg University of Applied Sciences

Input	Process	Short-term outcomes	Long-term outcomes
<b>Students</b> <ul style="list-style-type: none"> <li>previous knowledge</li> <li>previous experience</li> <li>motivation</li> <li>expectancies</li> <li>age</li> <li>gender</li> </ul> <b>Gaming simulation</b> <ul style="list-style-type: none"> <li>content quality</li> <li>game/simulation quality</li> </ul> <b>Teacher</b> <ul style="list-style-type: none"> <li>training experience with gaming</li> <li>summations</li> <li>expectancies</li> <li>preparation</li> </ul>	<b>Individual learning</b> <ul style="list-style-type: none"> <li>intensity of involvement</li> <li>over-/underchallenged</li> </ul> <b>Interaction with the game</b> <ul style="list-style-type: none"> <li>access to contents</li> <li>debriefing</li> </ul> <b>Social learning</b> <ul style="list-style-type: none"> <li>student-student <ul style="list-style-type: none"> <li>intensity</li> <li>quality</li> </ul> </li> <li>student-teacher <ul style="list-style-type: none"> <li>instruction</li> <li>support</li> </ul> </li> </ul>	<b>Learning effects</b> <ul style="list-style-type: none"> <li>cognitive knowledge</li> <li>social</li> <li>motivational</li> </ul> <b>Acceptance (students)</b> <ul style="list-style-type: none"> <li>of the game</li> <li>of the method</li> </ul> <b>Acceptance (teachers)</b> <ul style="list-style-type: none"> <li>of the game</li> <li>of the method</li> </ul> <b>Organisational effects</b> <ul style="list-style-type: none"> <li>class climate</li> </ul>	<b>Individual outcomes</b> <ul style="list-style-type: none"> <li>school success</li> <li>vocational success</li> </ul> <b>Simgame Project</b> <ul style="list-style-type: none"> <li>implementation of the game</li> <li>dissemination of the method</li> </ul>

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 16

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Simgame Fachhochschule Vorarlberg University of Applied Sciences

quality improvement

concept **design** **application** evaluation

gaming simulation

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 17

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN Two case examples of improvement-oriented evaluations Fachhochschule Vorarlberg University of Applied Sciences

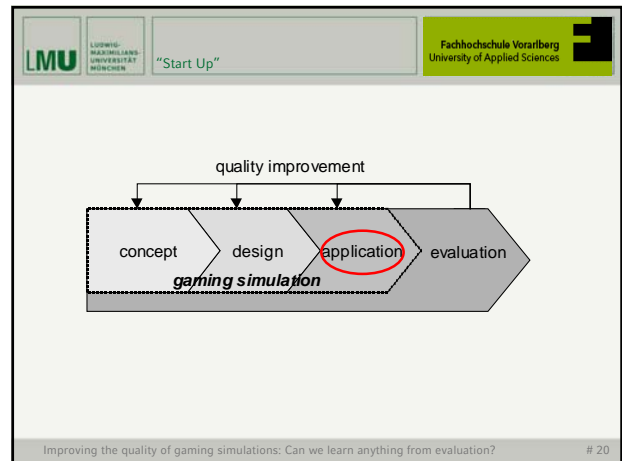
EXIST Cup GROW

The computer supported business simulation game “Topsim StartUp!” covers all stages of a StartUp! business and is used in entrepreneurship education in German universities in the project „Grow” under the auspices of the German Federal Ministry for Education and Research and is used in the project „exist-priME-Cup” under the auspices of the German Ministry of Economy. (Kriz & Auchter, 2006; Kriz, Auchter & Wittenzellner, 2007).

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 18

Input	Process	Outcome
<ul style="list-style-type: none"> <li>Sociodemographical data</li> <li>Age</li> <li>Gender</li> <li>Stage in Studies</li> <li>Course of Studies</li> <li>Disposition &amp; Motivation</li> <li>Intension for own Start-up</li> <li>Start-up disposition in the family</li> <li>Previous experience/Attitude in simulations and „StartUp“-teamwork</li> <li>Technical- &amp; Methodology Skills</li> <li>Knowledge of economics</li> <li>Skills for business plans</li> <li>Social Competence</li> <li>Entrepreneurial Competence</li> <li>Innovatory tendency</li> <li>Attitude to risk</li> <li>Proactive orientation</li> <li>Personality dispositions</li> <li>Achievement Motivation, Belief in internal control, Willingness to prevail, Emotional stability, Desire to be independent, Propensity to lead, Self-efficacy</li> </ul>	<ul style="list-style-type: none"> <li>Individual Learning</li> <li>Over/underchallenged</li> <li>Motivation und roletaking in simulation</li> <li>Causal attribution</li> <li>Interaction in the simulation</li> <li>Learning time / Duration of the simulation process</li> <li>Type of simulation (product option „easy“ or „Production“ and playing option „one 3-day-block“ or „several sessions during the whole term“)</li> <li>Social Learning</li> <li>Student-Student-Interaction (Quality &amp; intensity of teamwork)</li> <li>Student-Trainer-Interaction (Intensity &amp; quality of support / facilitation)</li> </ul>	<ul style="list-style-type: none"> <li>Learning</li> <li>Technical &amp; methodological competence</li> <li>Knowledge of economics</li> <li>Preparation of business plans</li> <li>Preparation of StartUp!</li> <li>StartUp! competencies</li> <li>Social &amp; personal competence</li> <li>Team competencies</li> <li>Recognize own strengths &amp; weaknesses</li> <li>Motivational</li> <li>Intension to go for a Start-up</li> <li>Simulation success</li> <li>Acceptance of „StartUp!“</li> <li>Same</li> </ul>

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 19



Improving the quality of gaming simulations: Can we learn anything from evaluation? # 20

**Conclusion**

Evaluation can have a number of different **functions** in different contexts.

Within the gaming and simulation domain, a main focus of past efforts has been on its **summative role**.

This has only been natural, since summative evaluation can answer some very basic questions on the effectiveness and efficiency of gaming simulation as a learning method.

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 21

**Conclusions**

It is also important to stress evaluations' **formative role**.

Our model is a **framework** for analysing and discussing different mechanisms to improve gaming simulations.

The case examples illustrate the improvement of simulations' **design or application**.

**Logic models** can help to identify the key variables that need to be considered in the evaluation. They provide a frame of reference for interpreting the simulation's workings as a learning environment. They can indicate areas for improvement in the simulation's design or application.

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 22

**Conclusions**

The third component of our model addresses, though, quality improvement directed towards the **conceptual foundations** of a simulation game.

It will be an **important endeavour** for future evaluations to concentrate more on this point of leverage for the improvement of gaming simulation quality.

Improving the quality of gaming simulations: Can we learn anything from evaluation? # 23