BRIDGING THE GAP:
Transforming Knowledge into Action through Gaming and Simulation

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Evaluation of the EU-Project “SIMGAME” in business education

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1. Introduction

“Simgame” is the short name of the project “Simulation game of economic processes and decision making”. The game design, application and evaluation is part of the European Union educational program “Leonardo da Vinci”. Different partners from six European countries are involved. Simgame itself is a rigid rule board business game without computer simulation.

The overall goal is to improve business education. On one hand Simgame is aimed to be a problem-oriented and experiential learning environment that enables students to gain knowledge and skills related to business and management. On the other hand Simgame is considered to be a fruitful instrument to change the traditional learning culture in education from passive reproduction of “inert” knowledge to a new learning culture of active production of applicable knowledge (see Mandl, this volume). Therefore Simgame also promotes the acquisition of new didactic skills of the teachers that are necessary to realize this new paradigm of learning and instruction.

The target group of Simgame are students who attend business courses in secondary schools and trainees in business professions. These students and trainees are trained in entrepreneurship, managerial decision making and teamwork skills. Two versions of the game are being developed: A so called “static version” where team-members (who run a company together) only interact with each other and a “dynamic version” where several teams compete with each other in one common marketplace. A detailed description of Simgame is given by Puschert & Weinert (see this volume; www.simgame.org). This paper cover of the evaluation of the static version, because the dynamic version’s development is not yet finished and empirical data is not available.

The evaluation of Simgame is carried out at the Ludwig Maximilians University in Munich, lead by the authors. The main goal of evaluation is quality assurance. Secondary goals are a) Accountability: Control project’s progress and outcomes; b) Development: support project’s improvement (for example results from the evaluation of the static version are right now used for optimizing the static version and for the design of the dynamic version); c) Decisions: facilitate decision making on implementation of project outcomes; d) Public relations: Gather arguments to promote project’s dissemination and e) Scientific progress: Gather knowledge for future projects and research.
From the researchers’ point of view, the purpose of the evaluation is not only to study the effects of Simgame, but also to explain those mechanisms that make participation in the game a successful learning environment. Therefore we applied a theory-oriented evaluation approach that is discussed together with the implemented evaluation concept in detail in Hense & Kriz (see this volume). Figure 1 illustrates the program theory (logic model), that has been developed for Simgame. It is basically an input-process-outcome model. Outcome is divided in short-term and long-term outcomes. The results that are presented later in this paper will be discussed in relation with the program theory. The evaluation in this paper concentrates on the short term outcomes, because the project is still running and long term effects measurements are not yet available.

Figure 1: Simgame program theory (logic model)

2. Method

2.1. Procedure and Instruments

The evaluation of the static version of Simgame started in June 2003 with a phase of preparation. We used interviews and questionnaires to gather relevant background information and expectations of the project partners. The implementation of the static version was carried out in the schools between October 1st 2003 and February 16th 2004. Before implementing the game, the teachers attended a Train-the-Trainer-workshop, facilitated by the Czech
consulting company CONSIM. This company is also responsible for the design of the game. During this workshop, the teachers resp. the subsequent facilitators of Simgame, were introduced to the evaluation concept and the implementation of the evaluation was discussed. The reason for this was that the evaluation budget did not allow visits at the schools. This means that the teachers were responsible to give the evaluation instruments to the students. The teachers also got detailed written instructions on how to implement the evaluation. The students did not attend class in the corresponding subject between the beginning and the end of Simgame. To play Simgame, the students formed three to six teams per class. The task of every team was to manage a company.

The instruments consisted of two questionnaires. The teachers were asked to fill out a questionnaire before and after they facilitated Simgame and also the students had to fill out a questionnaire before and one after the game. The processing time for a questionnaire was about 15 to 20 minutes. The requested expectations and appraisals were rated on the basis of a 5-step Likert-scale (e.g. 1=totally disagree to 5=totally agree). In addition to the questionnaires we developed in cooperation with experts a knowledge test to collect data about the knowledge that is relevant for playing Simgame. This multiple choice test was done by the students before and after Simgame, too. The processing time was also about 20 minutes. The following figure 2 illustrates the procedures of the evaluation. Results on the long-term outcomes cannot be discussed in this article, because the collection of data is still running (this data is collected by a third questionnaire and a knowledge test, to measure long term effects that should be used for a further optimization of the simulation game).

![Figure 2: Procedure of the evaluation](image)

### 2.2. Participants and Input Variables

Five nations from the European Union took part in the testing and evaluation of the static version of Simgame: Czech Republic, Slovakia, Germany,
Austria and Italy. Most of the classes of the study come from the Czech Republic. A total of 25 classes with 37 teachers and 468 students took part in the evaluation of the static version of Simgame.

Nearly one half (49%) of the teachers facilitated Simgame alone in their class and the other half (51%) facilitated the game with the help of colleagues. In the following section we will shortly describe the so-called input-factors of the program-theory (see Figure 1). Later we will combine the measured variables with the process- and outcome-variables and analyze them in depth.

**Students**

*Age and gender:* The students were between 15 and 21 years of age (M=17.3 years of age). As well as the teachers, the students that participated were about 2/3 female. This effect derives mainly from the large number of female participants in the Czech Republic.

*Previous experience with Gaming Simulation:* For the students the gaming simulation method was unknown for 91.3 %, the rest had already experienced simulation games.

*Expectancies:* On the one hand the students were asked, if they expected positive effects because of playing Simgame in regard of improving professional, social and motivational skills (increase of professional knowledge, team-competence, enjoy business management). These aspects were combined in the scale “positive expectations”. It could be shown that the expectancies were positive and the students expected an enlargement of their professional and social competencies. They also expected to have an interesting and motivating lesson.

*Previous knowledge:* The students were asked to rate their current professional knowledge (e.g. “I am good in the subject”) and their team orientation (e.g. “I like to learn in a team”). The results showed that this rating lies in the middle area of the scale, but in average it is slightly positive. The knowledge pre-test also offered an objective degree of performance of the students in the field of business management, but one has to say that this result can only be interpreted in an useful way in the context of the results of the knowledge post-test (see below).

*Motivation:* The students were mainly very motivated and positive towards playing the simulation game. Only a few students appeared to be in a negative mood (8.8%).

**Teachers**

*Previous experience with Gaming Simulation:* 43.8% of the teachers have never been confronted with a simulation game before. Another 25.0% had already experienced one gaming simulation, while the rest already participated in 3 to 5 simulations.
Preparation: Most of the teachers (73.0%) participated in the Train-the-Train-er workshop in Prague (September 2003). Only two of the 25 classes played the simulation without a teacher that took part in the workshop. In the other classes at least one of the teachers attended the workshop. But only 56.7% of the teachers felt well-prepared for this new teaching method and 32.4% felt insecure about the implementation of Simgame. Additionally the teachers spent an average of M=10.2 hours for their own individual preparation (but with a large range of 2-20 hours).

Expectancies: The teachers were also concerned about the expected problems when implementing Simgame. 51.4% of the teachers expected general problems, 18.9% were uncertain and 29.7% expected no problems. In the questionnaire the teachers were asked about different areas of problems. The teachers mainly expected problems with the agenda resp. the time scale, followed by –but not expected from the majority- problems of discipline or problems with the organization of the lessons.

Motivation: The majority of the teachers was motivated and thought positive about Simgame. Only a few of them (6.1%) were negatively positioned.

Experts

In the framework of the evaluation of the dynamic version we plan a more exact survey of experts. Different aspects of quality of the static version were rated by small group of experts via an interview and a questionnaire (N=8). Additionally Simgame was played at the LMU Munich with teachers-in-training. The students are also trained in a special course to become facilitators and designers for simulation games (N=24). Regarding the literature of gaming simulation, 42 relevant quality-aspects and their performance in Simgame were evaluated. At first these criteria were allotted to the content quality (e.g. correct description and simulation of business management interdependencies) and secondly to Gaming Simulation Quality (e.g. the game offers well-done visualizations of the simulated workflow and structures of the company). 27 of these 42 criteria were achieved very good, while 8 showed opportunities for improvement and 7 were insufficient (a closer look on the criteria and the single ratings is not possible here and will be published in a special paper in a short while). One has to keep in mind that the 42 criteria of quality are the theoretical optimum, which is not really possible to be achieved in reality. Compared with other simulation games in this field, Simgame performs very well, because nearly all of the existing products have significant quality deficiencies in regard of the criteria (e.g. many games lack a concrete instruction that is conducive towards transfer with debriefing methods based on the latest point of research of pedagogical psychology and which is tailored to the target group).
3. Results and Discussion

3.1. Process Variables

Individual learning

Inteval intensity of involvement: Teachers as well as students were asked how involved and motivated they were during the game. Both groups stated a high motivation and involvement in the game.

Over/underchallenged: Teachers and students were asked if the students had been over- or underchallenged. From both groups’ point of view, there were no longer lasting phases of neither over- nor underchallenge.

Interaction with the game

Time on task: Playing Simgame took an average of M= 10,7 h. Classes played Simgame on 3 consecutive days.

Adequacy of contents: A list with 11 criteria in the form of statements was given to teachers und students. They were asked to mark their degree of compliance on a 5-step scale. Criteria related to the adequacy of the contents (e.g. “This game encourages thinking about economical interrelationships”, “This game encourages thinking about consequences and side effects of business decisions”). Here from both the teachers’ and the students’ point of view Simgame was evaluated very favorably concerning the integration of relevant subject-related contents. Being asked about the students’ interaction during the game, teachers and students stated an above average interaction with the subject.

Debriefing: Participating teachers were asked about debriefing. It showed that duration and quality of the debriefing could still be greatly improved. (There were almost no instructions on debriefing in the training guide.).

Social learning

Student-student interaction / intensity and quality: Teachers and students were asked to what degree different group-dynamic aspects could be observed in the teams’ behavior. (e.g. “Playing Simgame..” “...I cooperated well with others”, “…I communicated efficiently with others”, “…I argued with others”, “…all students were equally involved”). It showed that according to both groups, an intense cooperation with highly involved team members and a successful cooperation in the teams could be found.

Student-teacher interaction / support and instruction: Teachers and students were asked how the teachers performed as a trainers in the game. Students judged for example how well the teachers were prepared, if they had explained well and enough etc. Teachers were questioned on the same aspects, but also if they were overstrained with the subject or the organization.

Results show that teachers and students both regarded the teachers to be well prepared in the average, and that they gave a good introduction. Still, both
groups agreed that teachers had to explain and help a lot. Students claimed that this support helped them well or very well in the end. Teachers were not overstrained on the subject but some stated organizational problems. Especially the already expected problems with Simgame's timeline were confirmed.

3.2. Short-Term Outcome Variables

Teacher acceptance (game and method): Before the game the acceptance of simulation as an effective learning method was surveyed. This question was also asked after the game. The acceptance before the game was as high as an average of $M=4.4; SD=.52$ (on a five-step scale with 5 being the highest level of acceptance). This level could be maintained after the game. This high level of acceptance is understandable, if you consider that the teachers volunteered to participate in Simgame. 91.7% stated, they would recommend Simgame to other teachers. Teachers were also asked if Simgame meant additional workload to them and if this effort was worthwhile. 87.9% answered, that the game meant more work for them. Still, the vast majority claims that this effort was well rewarded. The high average of $M=4.2; SD=.45$ on a five-step scale (1=effort was not worth it at all to 5=Effort was very well worth it) is proof to that and emphasizes the high level of acceptance for Simgame.

Students acceptance (game and method): In order to measure students’ acceptance of Simgame, they were asked 3 questions. Would they like to play Simgame once more, would they like to play other simulations in class and had they apprehended economic interrelationships better than in “normal” classes? There was a very favorable resonance to that with an above average result on the five-step scale.

Organizational effects – class climate: Teachers were asked to judge the effect of Simgame on the climate in class. With $M=3.8, SD=.88$ (on a five-step scale) they saw an above average amelioration of the climate in class.

Learning effects (cognitive, social and motivational effects): In the questionnaire, teachers and students marked their judgment on how well the learning targets were achieved using Simgame. A list with 16 items was to show if Simgame had resulted in learning effects on the students’ side.

The items contained statements to show if Simgame had promoted the students’ ability...
...to work in teams.
...to communicate.
...to think interdisciplinary.
...to criticize and to cope with criticism.
...to apply theoretic knowledge practically.
...to understand basic economic interrelationships.
...to do basic mathematic calculations and operations.
...to understand the essence and the structure of a balance sheet.
...to understand basic issues of costs accounting.
...to produce calculations of operating results.
...to compose current reports of costs accounting.
...to calculate and interpret economic key figures like assets, profitability, work productivity and cash flow calculation.
...to recognize the company's outside relationships.
...to understand internal interrelationships and the decision process.
...to express themselves in appropriate business terminology.
...to fulfill business tasks responsibly for all subjects involved.
All 16 learning targets were achieved above average according to teachers and students (M=3.2 to M=4.8).

Simgame’s learning effect was additionally measured by the teachers’ judgment on the students’ advancements on the professional, social and motivational level. Again, this analysis underlines that teachers regard the students’ skill acquirement through Simgame as above average on all levels. Teachers rated the advancement on the professional level with M=4.1, on the motivational level with M=4.0 and on the social level with M=3.9 (on a 5-step scale). In the pre-tests, teachers were questioned on their expectancies regarding the students’ advancement through Simgame on these 3 levels. T-tests with paired samples showed that these expectancies were fulfilled on the professional and significantly excelled on the social (p<.01) and motivational level (p<.07).

To complete the outcome analysis for the teachers, the efficiency of Simgame regarding the achievement of professional, social and motivational goals compared to normal methods of instruction was surveyed in the questionnaire. Simgame proved to be successful above average (M=3.7 to 4.1; SD=.78 to 1.12) from the teachers’ point of view, meaning that they judged Simgame essentially more successful than regular classes.

In order to test learning effects and the achievement of learning goals the survey mainly relied on the questionnaires, monitoring subjective evaluations from teachers and students. Concerning professional knowledge, a multiple-choice test was developed together with the experts. It was conducted before and after Simgame in identical form. The test contains 20 items from different aspects of the curriculum for economic science. It was one of Simgame’s goals to foster this knowledge. There were 4 alternative answers to every item on the list, with at least one or more than one alternative being correct. Altogether, there were 34 correct answers. An initial test analysis showed that the items complied with the main quality criteria of test-theory. Students had (depending on their grade) different pre-knowledge levels. But this was no issue, as the test concentrated solely on the knowledge gain.

Comparing the results of the test before and after the game, there is an average improvement of 2.8 correct answers. This learning effect is significant. The t-test with paired samples calculates t=-5.64; df=360; p<.001. The significant knowledge gain can be kept up, even if a guessing correction is applied.
3.3. Further Results – Correlations of Input-, Process- and Outcome-Variables

Both genders benefited in the same way from the knowledge gain with Simgame. (a t-test for independent samples showed no significant differences in the average values). Younger students seem to learn more from Simgame than older ones (significant correlation r=.12), but this effect is very weak. There were significant differences for grades and nationality, but in order to guarantee anonymity, these will not be reported here. Still, future analysis will have to look for conducive or impedimental conditions for the achievement of learning effects. In the following section we will therefore explore some interesting interrelations of the factors defined in the logic model of Simgame (see figure 1).

Teacher preparation: A t-test for independent samples showed that classes had significantly more knowledge gain when teachers had participated in the preparatory training (classes of teachers who did not participate showed no knowledge gain).

Students pre-knowledge and motivation: As expected, students that regarded themselves as better students and stated more interest in economic sciences and the relevant subjects achieved better results. So interest in the subjects and performance in class had effects on the performance in the knowledge test.

Time on task: The duration of the Simage (in hours) is significantly correlated to improvements in the knowledge tests and achievements in social learning goals (r=.25), so as expected, a longer duration of the game is to be recommended.

Teacher instruction: Another source of influence on students’ performance are teachers’ trainer skills, as perceived by the students. Items were listed for the teachers’ behavior (e.g. teacher was well prepared, instructed students well, supported the students) and put together on a scale of „teacher quality“ (the reliability analysis showed a high alpha =.82). This teacher quality significantly correlates with the students’ performance in the knowledge test (though rather weakly with r=.10). It correlates to a medium and high degree with the learning effects on the professional (r=.28) and social level (r=.42). So teachers’ didactic and instructional qualities are an essential influence in the achievement of learning effects with Simgame.

Teacher expectancies and acceptance of Simgame: Various items were included on scales (Reliability analysis showed an alpha > .75 for each). Namely a scale “teachers expectancies” was formed of items, which related to the teacher’s attitude towards Simgame before the game started. These items derive from the first teachers’ questionnaire on simulations as an effective method, to looking forward to the classes with Simgame but also to the expectations regarding the sum of positive learning effects. From this questionnaire a scale „teachers’ expected problems“ was formed out of items that related to expected problems with the time-frame, organization and discipline during Simgame. Finally, a third scale was calculated out of items of the second questionnaire (after play-
ing Simgame). These items related to the evaluation of realized learning success with Simgame and the acceptance of the game (e.g. questions if it was worth the effort, if they would recommend it, how high they estimate the learning effects – also compared to „normal“ classes). This scale was named „teachers’ acceptance of Simgame“. It is interesting to analyze the correlation of these three scales to the indicators of learning effects and observed teacher quality. Using the median as parting line, two groups of teachers were formed with relatively low (below the median) vs. relatively high (above the median) values on the three scales. Then t-tests for independent samples were calculated (each with a level of significance p<.05).

Looking for significant results, it became clear that in classes with teachers with negative expectancies compared to classes with teachers with positive expectancies,

- students evaluated the trainer quality of their teachers significantly lower.
- students made less improvements in the knowledge test (they even had negative results, i.e. an actual decrease of performance).
- teachers as well as students evaluated the professional and social learning effects much lower.

It seems to be a self-fulfilling prophecy: in a vicious circle negative expectancies leads to a decrease of instructional quality (at least from the students' point of view) and decreased teaching success of the students.

The same applies to teachers with a high level of expected problems. Significant results were that while playing Simgame in classes with teachers with a high level of expected problems compared to classes with teachers of low levels of expected problems

- students evaluated the training quality of their teachers lower.
- students made less improvements in the knowledge test (they even had negative results, i.e. an actual decrease of performance).
- teachers as well as students evaluated the social learning effects much lower.
- more problems actually did arise in class (at least from the teachers' point of view).

Regarding these significant differences, again there is a self-fulfilling prophecy, as the expectation of problems seemingly induced actual problems in class. In another vicious circle, this might well have lead to the teacher's lower instructional quality (from the students' point of view) and therewith to essentially less learning success.

Comparable significant results derive from the third scale „acceptance of Simgame“, as - after the game - in classes with teachers with negative acceptance after the game

- students evaluated their teachers' training quality significantly lower.
- students made less improvements in the knowledge test (they even had negative results, i.e. an actual decrease of performance).
– teachers as well as students evaluated the professional and social learning effects much lower.

**Debriefing:** It is part of didactical skills to reflect on the game with the students and to promote learning processes in a well moderated debriefing. In one more comparison of groups of teachers (with median as parting lines and t-test for independent samples), who stated that they reflected relatively less extensively on the game with the students in the debriefing, as expected students gained less knowledge improvements (subjective evaluation and knowledge test) and consequently evaluated the teacher’s quality lower.

The point is here again the correlation to the lower observed teacher quality. That is the over all key to a successful class with Simgame. The most reasonable next action would be a specially designed teacher training in order to promote Simgame. A teacher training for Simgame should therefore also include methods of reflection on simulations and, as well as the didactics, practical hints to overcome potential obstacles. Another goal of this training should be to foster a more positive preposition of the teachers toward this method of teaching.

**4. Conclusion**

The evaluation results show that the implementation and testing of the static version of Simgame was successful. Regarding the rating of teachers and students the learning objectives in the professional, social and motivational field were all achieved. Both groups are positive about using simulation games as teaching method and think it is more effective than “normal” lessons. The experience they made with gaming simulation and its consequences are all rated in a positive way.

Regarding the position of the teachers, one has to say that Simgame achieved all the objectives well or very well. Particularly the team-competence of the students has improved very much. The climate in the class was also improved. The learning success in the professional field is also rated above average. Although Simgame meant a lot of work for the teachers to be prepared, the teachers also stated that it was really worth it, regarding the achieved learning success. The vast majority would like to go on using Simgame in their classes, although it cannot be played in the specified timeframe. The students also rated Simgame in a very positive way, both for the advancement of social competencies (like e.g. successful team-work, communication etc.) and in the field of professional competencies (understanding of business and company’s interdependencies, to transform theoretical knowledge into action, understanding of balance sheets and accounting etc.). The design of the game was rated as very attractive and the students want to go on having simulations as learning tool. The reason for this is that, from their point of view, Simgame not only fosters having fun in understanding business management, but also because the simulation helps to understand business and companies’ interdependencies better than “normal” lessons could do this.
With the help of the business management knowledge test a significant increase of knowledge could be observed. This increase may be comparatively small, but it is feasible that playing only once a simulation game cannot work wonders, particularly if no further transfer-increasing modules (e.g. debriefing) are integrated in the simulation game. The knowledge areas that were fostered by the simulation show a significant improvement in the performance of the students. In particular, it is also important that Simgame motivated the students to deal with the simulated management interdependencies in a multidisciplinary way. The motivation that has been achieved can have a positive influence on the interest in the professional content. In the long run it might also effect the professional performance, if one succeeds in implementing and connecting Simgame in/to regular lessons.

Some analyses show the importance of the trainer quality for achieving the learning objectives (e.g. through this competence of the teachers, the game is either unchallenging or overextending for the students). The trainer competence of the teachers was mainly rated very good. The teachers also felt very well prepared for themselves. The analyses also show the importance of a Train-the-Trainer workshop. Teachers with a negative attitude and a high level of expectancy towards problems when implementing Simgame are significantly rated worse and their students achieve significant lower learning effects. The uncertainties and fears in regard of using simulation games can surely be reduced with training for these teachers. One has to keep in mind, that simulation games are completely new and an unknown learning method so far for most of the teachers, who do also not possess the specific gaming simulation didactical competencies. A Train-the-Trainer workshop or an introducing seminar to the method, which still has to be designed, should obligatory be assumed.

Analyses also show the importance of a well-designed manual and a clear game-design. All peoples involved (experts, teachers and students) see room for improvements for these two aspects. The simulation model itself (the reference between game and represented reality) is seen as valid. This quality aspect of the simulation game – regarding differentiated analyses – is also a major factor for achieving the different learning objectives. All in all, the potential of Simgame has already been used very effectively, but it can be improved with arrangements in the sense of long-term effects. The insights gained from the evaluation of the static version are being applied to the improvement of the second (dynamic) version of Simgame.

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