



EVALUATION

Der „EXIST-priME-Cup“, gefördert vom deutschen Bundesministerium für Wirtschaft und Technologie, ist ein bundesweiter Planspielwettbewerb für Studierende. Dabei sind jährlich über 150 deutsche Hochschulen involviert. Seit 2007 wird das Programm von den Autoren laufend evaluiert. Die folgende Veröffentlichung ist im Rahmen der wissenschaftlichen Evaluation des exist priMECup entstanden.

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Evaluation of Games for Entrepreneurship Education

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Abstract

Since 2005 we have carried out several studies in the area of entrepreneurship education with games that simulate starting up business processes, further called "start-up games". These studies are conducted under the auspices of the German Federal Ministry of Economics and Technology. One part of the studies is to research the learning effects of university students enrolled in regular courses involving start-up games. Currently we have done research on more than 50 courses and on more than 1000 students. Another important part of our studies is the evaluation of entrepreneurship education in the nationwide German competition "exist-primEcup" with an actual database of over 100 Cups and more than 3000 students. Both activities (regular courses and voluntary competition cup) share the common goals of fostering entrepreneurial competencies and influencing the intention of participants to start up their own company. The same start-up games are used and the same research methodology is applied in both programs.

We put into practice the theory based evaluation approach. The evaluation of the games should have a logic model as its starting point. That logic model provides a framework for the interpretation of what takes place during the entrepreneurship games. Such a logic model consists of various variables, which can be classified under the three components prerequisites (input), processes (actions), and effects (output or outcome), and their reciprocal dependencies and mutual relations. All variables of the logic model were derived from previous research that among others provided the theoretical concepts. In addition, all factors of that logic model are measured through questionnaires, tests, and interviews with participants (students) and facilitators. Measurements are taken before, during, and after the games. In the Cup system, it is also possible to have multiple data from those participants who qualify for the next levels of the Cup.

With respect to methodology we position ourselves in bridging the gap between analytical and design sciences. The theory-oriented evaluation approach offers a link between both communities of analytical and design science. In the logic models, knowledge from both communities is integrated: research results and theories from analytical sciences and concrete experiences from design practice. Game designers must use knowledge from the analytical sciences for the game design in order to produce games that really support effective learning. Our approach does not only assess outcomes and proves whether a game works, but also explains how and why it works (or fails to work) in a given context of use and this supports the further testing of theories. At the same time it also helps to increase the usability of games in specific situations with specific target groups, which helps to achieve the objectives of the design science. In the research programs designers, facilitators and evaluators (and researchers) of the start-up games are working hand in hand.

Introduction

In Germany and Austria teaching and training in entrepreneurship are in great demand in universities, and also in the field of start-up consultancy. To get a new company started is a complex task and requires from its founders a wide range of competencies and knowledge (Kriz & Auchter, 2006). The computer supported business simulation game "TOPSIM-Startup" represents the complexity and the relevant variables in different start-up situations, and covers all stages of a start-up business from collecting information, checking the business idea to transforming the business idea to a successful company in a competitive situation (Auchter, 2003; Auchter & Keding, 2004). Since 2005 we have carried out several studies in the area of entrepreneurship education with games that simulate starting up business processes, further called "start-up games" (e.g. Kriz, Auchter & Wittenzellner, 2008). These studies are conducted under the auspices of the German Federal Ministry of Economics and Technology. One part of the studies is to research the learning effects of university students enrolled in regular courses involving start-up games. Currently we have done research on more than 50 courses and on more than 1000 students. Another important part of our studies is the evaluation of entrepreneurship education in the nationwide German competition "exist-priMEcup" with an actual database of over 100 Cups and more than 3000 students. Both activities (regular courses and voluntary competition cup) share the common goals of fostering entrepreneurial competencies and influencing the intention of participants to start up their own company. The same start-up games are used and the same research methodology is applied in both programs. The purpose of our formative and theory-based evaluation approach is to find out the extent to which the games contribute in qualifying and positively predisposing students to embark on an entrepreneurial risk. Evaluation of the learning effects connects our approach to theory testing in the analytical science tradition (e.g., educational psychology and entrepreneurship research). At the same time our assessments of the impact of the game on the educational system fits into the design sciences tradition. It generates practical usability with regard to optimizing the educational programs for students (Kriz & Auchter, 2007). The theory-oriented evaluation approach therefore offers a link between both communities of analytical and design science. In using the terms of "theory testing"/"analytical science" and "assessment studies"/"design science" we refer to a framework of two interconnected gaming and simulation communities (Klabbers, 2008). Klabbers (2006) stresses the fact that members of gaming and simulation associations represent two distinct branches of science: a) design sciences (communities of practice) and b) analytical sciences (community of observers). The basic concept of the design sciences is to build games and assess their effects and usability. The scientific methods of the analytical sciences aim at using games for developing and testing theories.

Entrepreneurship Education

Explicit knowledge alone about start up management does not suffice to produce an actionable response to the day to day challenges of entrepreneurs (Koch, 2003; Baukmann, 2001). The model of Brinckmann, Salomo & Gemünden (2006) describes tacit knowledge and technical and methodological competencies, social competencies and entrepreneurial competencies as key factors that led to profit and market success of 180 German start-up companies that took part in a research study carried out in 2005.

Entrepreneurial behaviour as a success factor has been intensely discussed (Gemünden & Konrad, 2000; Frank, Korunka & Lueger, 2002). There is widespread

opinion that entrepreneurial activities are traceable to specific bundles of competencies and motivation, which in turn are influenced by personality factors (Gemünden, 2003). Based on these insights it is suggested that the following pattern of competencies and inclinations should be investigated in connection with start up games (Auchter, 2001; Klandt, 1998):

Technical and methodological competence: By technical competence is meant the specialist knowledge that is needed to found and lead a new enterprise.

Methodological competence covers the mastery of fundamental learning and work techniques as well as the possibility of using problem solving approaches in a methodical way (Braukmann, 2001). To these belong areas such as: business plan (aim, concept, content, uses); internal and external accounting (basic knowledge of balance sheets, cost benefit accounting, contribution costing as well as their employment and interpretation in specific situations); financing (types of financing, financial and liquidity accounting).

Social competence: Social competence describes the ability of a person to work effectively together with other people. This means not only the ability to co-operate and communicate with other people, but also the ability to understand the actions of others (Gemünden, 2003): teamwork (communication, solidarity, dispute resolution); sensitivity towards others; ability to be introspective.

Entrepreneurial competence: This feature relates especially to competencies which makes the entrepreneur stand out as an entrepreneur (as opposed to a manager!). There is a one to one correspondence between competence in this sense and the idea of "entrepreneurial posture" in the conceptual model of Covin & Slevin (1991). In this respect entrepreneurial posture is made operational by three sub-features: risk taking (preference for highly risky projects with the chance of making a very high profit); proactive orientation (the willingness to initiate action and projects that competitors are forced to react to); innovation (the willingness to innovate, even when this involves taking on risks).

Entrepreneurial predisposition: By this is meant personality traits which are a prerequisite for entrepreneurial success and which have been to some degree empirically proven. Much insight in this respect can be abstracted from contemporary psychological research literature on the subject of founders of companies (Koch, Kaschube & Fisch, 2003; Lang von Wins, 2003; Müller, 2002). The following are regularly mentioned as being particularly relevant personality features: achievement motivation; belief in internal (self) control and self-efficacy; willingness to prevail; desire to be independent; emotional stability; propensity to lead.

Intention and motivation to start up a business: As well as the bundles of competencies just mentioned, we should in addition explicitly record the motivation for a start up (Krueger, Reilly & Carsrud, 2000): desire or interest in being self employed; a specific start up project; estimation of own competencies for a start up.

Startup Business Games

'Start up' games are special business games that foster the development of competencies needed to perform successfully the management tasks in a newly founded company. The main focus is on the action and decision making processes in the start up stage. Because the early stages of a start up provide prime examples of complex tasks, games provide a particularly appropriate learning environment. Since 2000 "TOPSIM-Start-up" has provided a newly developed games that simulates the start up situation and its various stages. The "Start-up" simulation was developed by the firm Tata Interactive Systems in co-operation with the University of Applied

Sciences Regensburg and the Hans Lindner Institute. There are different versions of the game in respect of the complexity and scenarios. The more earning goals are:

- Definition and realization of goals, strategies and business plans within an authentic business and market environment
- Company cost accounting, planning and controlling
- Dealing with complex decision-making situations and uncertainty
- Working together within a management-team and competition with other teams
- Simulation and forecasts with computer-assisted planning models and tools
- Presentation of own business results in front of a jury with assessors from companies

Theory-based and formative evaluation approach

The purpose of evaluation is in general terms to provide assistance with planning and decision making, with the controlling and improvement of practical measures and with the assessment of the efficacy of an intervention. The starting points of most simulation evaluations are traditionally of the summary kind, and thus output oriented in the first instance. They focus on the effectiveness of the participation in the simulation, mainly in order to establish the degree of learning that has taken place (Faria, 2001; Wolfe, 1997). This approach and the efficacy analyses of simulations that stem from it are undoubtedly justifiable methods and today they are still an important part of the evaluation, and as a result they are relevant in the research project that is being presented here. Nevertheless, this traditional approach can be regarded as being somewhat too narrow, in view of the fact that purely output oriented evaluations are not sufficiently able to explain why and how the results of learning that arise from a particular measure are achieved (Judd, 1987; Hense, 2004). In the project just dealt with it is crucial, however, because here there is a blend of classical summary and output oriented approaches coupled with a formative evaluation, which has the purpose of providing information for optimal design in future educational simulations (Kriz & Hense, 2005).

To be true to this purpose, therefore, the approach of the so-called theory based evaluation was used (Chen, 1990; Chen & Rossi, 1983). The strength of the theory based approach lies in its premise that the evaluation of interventions or learning environments such as the simulation game should have as its starting point a "logic model". Such a logic model consists of various variables, which can be classified under the three components prerequisites (input), processes (actions) and effects (output or outcome), and their reciprocal dependencies and mutual relations (Hense & Kriz, 2005; Hense & Kriz, 2007). A logic model thus provides a framework for the interpretation of what takes place in the simulation. Furthermore, it can be expected that not only will key learning be shown, but that also those elements will be identified that are responsible for such learning or for the fact that such learning does not take place. In this way important starting points can be identified that can lead to improvements in further design and use of the simulation game (Kriz & Hense, 2004; Kriz & Hense, 2006; Hense & Kriz, 2008; Hense, Kriz & Wolfe, 2009). The logic model for the evaluation of the "Start-up" simulation stems from several sources, including 1) contemporary research on simulations (Faria, 2001; Hindle, 2002; Wolfe, 1997; Kriz & Brandstetter, 2003), 2) approaches of situated learning (Brown, Collins & Duguid, 1989; Gruber, Law, Mandl & Renkl, 1995) - in this respect especially the so-called "problem oriented learning" - as well as 3) more general

models concerning the quality of teaching and the learning environment (Ditton, 2002) and 4) contemporary entrepreneurship research (see above).

Summarizing the main research goals of the evaluation are:

- To find out if the used business simulations are an efficient way of imparting the professional and social competencies, the self-confidence and the intention that start up entrepreneurs need.
- To find out the extent to which the program is making a contribution to qualify and positively predispose those considering entrepreneurial activities.
- Creating a scientifically founded basis for the further development of business games.
- To optimize the cups and events within the whole program.

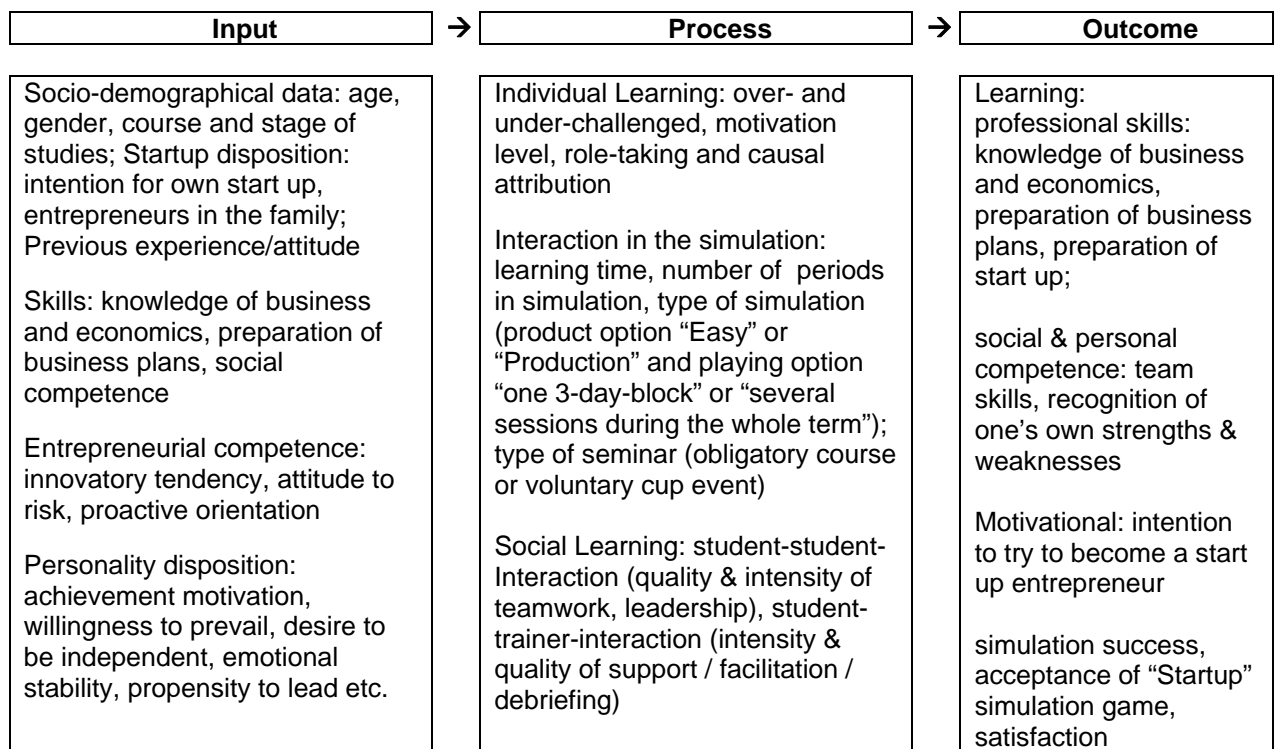


Figure 1: Logic Model of entrepreneurship education with Startup game

The impact of the theory-based and formative evaluation approach

When we discuss some results of four evaluation studies then we do it in the analytical science tradition of theory testing. Some results for example explain the main factors for learning effects we test and contribute to the development of theories within the analytical science tradition of educational psychology. We are also dealing with theory testing when we show results that discuss certain findings of entrepreneurship research about the importance of certain bundles of competencies, motivation, and personality factors in predicting performance (in the game) as well as about the increase of competencies and entrepreneurial intention as a result of participation in the game (c.f. Kriz, Auchter & Wittenzellner, 2008). Evaluation results can be also used to advance theoretical development in the domain of Gaming Simulation (Klabbers, 2008).

At the same time the evaluation approach is formative and assesses the usability of the games. Results from the evaluation of different versions of startup-games and facilitation procedures directly influence the further development and practical implementation of the games in the regular courses and in the cups, the definition of standard facilitation and debriefing processes and other supporting tools. This puts our work also in the design science tradition and our studies are partly also assessment studies of games in the operational context (c.f. Kriz & Auchter, 2008). As part of the design science process our methodology takes into account that game artifacts as products can be applied in very different contexts of use for very different learning goals. Many factors such as game didactics, learner features, facilitator competencies or debriefing procedures can be changed in order to optimize the application of a game for specific learning purposes (Hense & Kriz, 2007). Designing games is a complex task which includes several steps of planning, construction and testing (Duke & Geurts, 2004). Formative and theory-based evaluation activities can be systematically embedded within these steps of the design process.

Methodology and example results in the analytical science tradition

All variables of the logic model were derived from research results and relating theoretical concepts. In addition, all factors shown in the logic model were operationalized and measured.

For the operationalization and measurement in Study 1 three questionnaires were developed with items on a 5-point Likert scale. Questionnaire No. 1 served to measure the input variables, No. 2 was for measuring the process variables and No. 3 was designed mainly to measure output variables and partly also to collect more data about the process variables. The data for 'Study 1' was collected in 2006. A total of 606 participants from five technical universities took part in the investigation. For this a total of 31 "Start-up" simulations were carried out. All the simulations were conducted by trainers who had experience with this particular simulation game. Questionnaire No. 1 was handed out before the start of the simulation, questionnaire No. 2 was answered in the temporal middle of the simulation (i.e. usually after simulation round 3 or 4) and questionnaire No. 3 was answered after the simulation was finished and the participants had had time to reflect on it. In addition to the questionnaires, the business knowledge and the quality of making business plans were assessed by the university lecturers of entrepreneurship and business studies before and after the game.

'Study 2' was carried out as a close replication of 'Study 1' with the same questionnaires. A total of N=202 students participated in 2006 in 11 further trainings with the simulation game "Start-up". There was one important difference to 'Study 1'. Instead of using ratings of business knowledge by university lecturers, a multiple choice test was developed together with experts. The test was conducted before and after "Start-Up" in identical form. The test contains 12 items from different aspects of the curriculum for entrepreneurship and management. There were three alternative answers to every item on the list, with at least one or more than one alternative being correct. Altogether there were 16 correct answers. A test analysis showed that the items complied with the main quality criteria of test-theory.

'Study 3' is different from Studies 1 and 2. "Start-up" simulations were carried out within a nationwide cup-competition on four levels. On "Campus Cup" level teams of students compete within the same university. The best two teams of each university are allowed to enter the next level of the "Master Cup", in which teams from different universities compete. Again, the two winning teams of each Master Cup

enter the next level of “Professional Cup”, and the last level is the final “Champions Cup”. In each cup level the same simulation methodology is used, but with increasing complexity of scenarios and simulated variables. For the evaluation a questionnaire is used that is handed out after the cup. This questionnaire contains partly the same items from study 1 and 2. Participants of study 3 (and study 4) can be seen as another treatment group, because attending the cup is voluntary for interested students, whereas attending the simulation games in study 1 and 2 was a regular obligatory part of the students’ university course program. Due to time constraints of the cup system, only one questionnaire was used after each cup. However, partly different items were used in the various cup levels. We used a special codification system for the participants. This allows for the linking of individual participant’s data at different cup levels (for those participants qualifying for the next levels) and makes it possible to calculate paired sample results. In study 3 N=815 students participated 2007 on the four cup levels (in a total of 43 simulation cups). ‘Study 4’ is a close replication of ‘Study 3’ (with only some additional questionnaire items) and was carried out in 2008. A total of N=1706 students participated in 76 simulation cups. In addition to quantitative data we also used structured expert interviews. All significant results presented are significant on alpha probability value $p < .001$.



Figure 2: structure of the program “exist-priMEcup”

It is not the aim of this paper to describe the results of our four studies in detail (c.f. Kriz, Aucter & Wittenzellner, 2008). As an example of typical results we gain in the analytical science tradition from studies 1 and 2 we show here that the relation of outcome variables with their potential predictors in the input and process variables (see logic model of “Start-Up” in figure 1) was investigated via regression analyses. To maximize the precision of analysis, only cases without missing data in the variables were used for regression (list-wise deletion), which resulted in a reduced sample size of N=208 in study 1 and N=86 in study 2. All variables derived from rating-scales were z-standardized prior to the analysis. On an overall level, the combined factors in the input and process components of the models provided an explanation for 39% (R_{corr}^2) of the variance in students’ post-test scores (study 2), 53% of the variance in students’ post-game business knowledge and 56% in students’ post-game business-plan quality (assessed by their teachers; study 1) as well as for 58% (study 1) and 66% (study 2) of the variance in students’ post-game entrepreneurial intention and self-confidence to become an entrepreneur. The main significant factors (with highest beta values; β) of the models are shown in figure 3. In figure 3 the corrected partial correlations are shown.

As a second example about some results of study 4 we show the assessment of learning and motivation effects on the Professional and Champions-cup level in 2008 (N=347). We asked to rate the learning effect and the motivational effect in a grid in

the debriefing session after the game. The grid consists of two dimensions with a Likert scale from -6 to +6 (+6 means positive feelings of fun and positive assessment of a learning effect, -6 means a negative effect on these dimensions). 87% rated the cups in the most favourable segment of learning with fun and motivation. 12% expressed the opinion that they enjoyed the cup-competition without experiencing a learning effect, 1% assessed the cups as learning without fun and only 0,2% rated the cup negative (no learning and no fun). The size of the dots corresponds with the number of participants that gave the same rating.

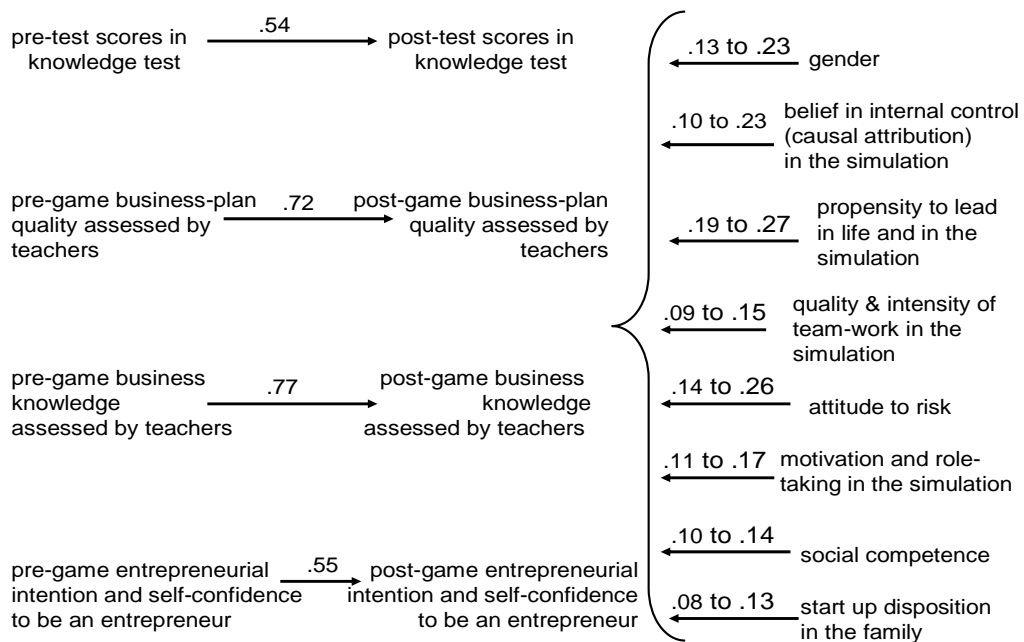


Figure 3: Partial correlations of the regression models to predict outcome variables of the Startup game

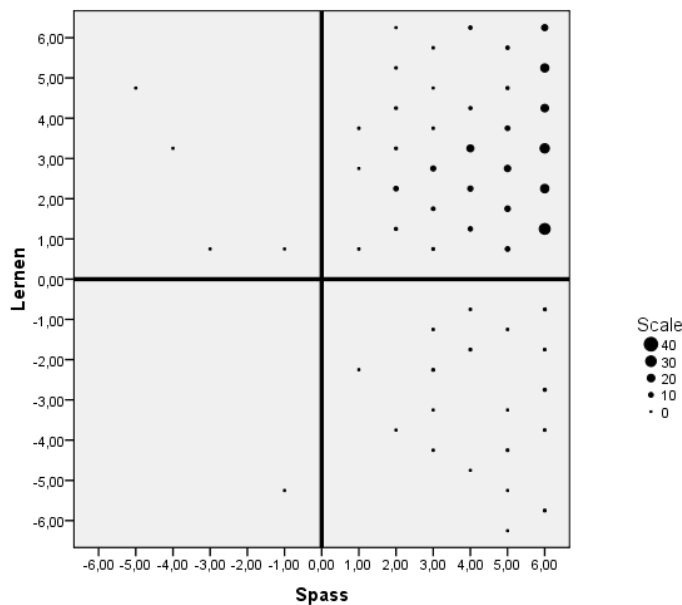


Figure 4: Grid with assessment dimensions Learning ("Lernen") and Fun ("Spass") and assessment of the participants.

In general, the results of a total sample of 42 evaluated trainings (N=808 students in study 1 and 2) with the "Start-up" simulation in regular university courses, and of 112 voluntary cup events (N=2521 in study 3 and 4), and first results from additional courses and cups in 2009, show that entrepreneurial competencies as well as self-confidence to become an entrepreneur were fostered significantly as a result of the gaming sessions. On the other hand, the simulation game did not effect one's intention of becoming an entrepreneur; even a slightly negative impact could be recorded. This result is in accordance with other actual findings about effects of programs for entrepreneurship education (without simulation games), reported by Cooper & Lucas (2006). There is not a simple cause and effect relationship between entrepreneurial self-confidence, competencies and actual intention for start up. The fact that many of the participants came to the conclusion that they would not like to start up a company cannot be attributed to a weakness of the simulation. The results show very well an increase in entrepreneurial intention within samples of participants having the "right" combination of students' dispositions and process variables of the game play. The essential process variables can be influenced and optimized by the trainers through professional support and debriefing of the game, and by selecting the adequate version of the game for specific target groups. The results also show an increase of entrepreneurial intention in the special group of voluntary and best performing students of the professional and champions cup level. Those students do also show significant higher entrepreneurial competence and predisposition than students of the regular university courses. The results of all four studies support major findings of entrepreneurship research. In general, simulation games can be considered a very effective educational method for entrepreneurship training. The startup simulation game has an outstandingly high degree of acceptance from the teachers' and students' perspective, as well as from the managers of companies that have acted as members of the jury in the cup-system. However, it seems that gender effects play too prominent a role - women profit significantly less, and within the simulation game they also do not adopt the role of an entrepreneur and of a team-leader as often and zealously as men do. In our actual research we therefore test if women can profit more when they participate in the simulation game in homogenously female groups. Another topic of our further research is the exploration of long-term effects of the regular courses as well as of the cup events.

Methodology and example results in the design sciences tradition

We asked all participants to answer some open questions for further improvement of the games, courses and cups. This was part of the written questionnaires. We made about 50 additional interviews with observers and experts. Furthermore we recorded debriefing sessions and results from written debriefing techniques. These qualitative data together with interpretation of quantitative results were used for the formative evaluation and further development of game versions, the design of new game scenarios and game and facilitation procedures, organization of courses and cups etc.

When we show analyses that provide important indications for the conditions under which a game achieves an optimal cost-benefit relationship for different target groups then we do it in the design science tradition. In the end the main purpose of the programs sponsored by the German Federal Ministry of Economics and Technology is to foster entrepreneurship competencies and intention. Therefore the startup-games and the programs in which they are applied are design-in-the-small artifacts that aim to support the design-in-the-large and change of German society in

producing a more entrepreneurial culture and to be a change agent in the sense that the number of start-ups in Germany should be increased.

As a whole, our results show for example the importance of the relationship between the complexity of a simulation and the respective target group. The analysis of various interaction effects show significantly better results for the game version "Easy Start-up", for engineering students, and students in the first part of study which is conducted in 3-day blocked seminars. Significantly better results were also recorded for the game version "Production Startup" for business studies students in the second part of the study program, and conducted in several two-hour sessions parallel to the whole semester than compared with all other combinations of course and stages of studies and game version. "Better results" are defined as: significantly greater improvement of motivation to start a company, technical competencies (e.g. business plan quality), game and method acceptance, role taking in the game etc. This difference in effects can be explained by the suitability of the simulation for the particular group of participants with regard to its complexity and how it is conducted. The technical students and the students in the basic study program have a comparatively slight knowledge of business and economics, and the lower grade of difficulty belonging to the "Easy option" appears to be more suitable for these participants. The "Easy option" is much less optimal for the experienced economics students in the main course of study. This target group apparently needs a more challenging option. At the same time the "Production option" seems to be unsuitable for the block form because the time is too short given the degree of complexity. This and further analyses, which cannot be dealt with here for reasons of space, result in concrete recommendations for the selection of game versions and game facilitation procedures for the respective target group of students.

This example shows some strengths of a theory-based evaluation, which especially at the formative stage of a project can contribute to the improvement in educational measures. Such an improvement is finally the aim of all efforts in the context of education and training. Better results of study 2 (which was carried out one year after study 1) already show that consequences taken from study 1 were successfully implemented in the execution of the game (for example aspects regarding the "teacher/facilitator quality" in conducting the game). Also in the cup system the results were taken for further optimization (especially the debriefing at the professional level was redesigned and a special training for the facilitators was implemented). Consequences from the analysis of the Master Cups and the Professional Cups were implemented already and resulted in an increased rating and excellent performance in the Champions Cup in study 3.

In 2007 our evaluation approach resulted in a list of more than 20 concrete recommendations for quality improvement. These lessons learned were summarized in a written report, communicated and discussed in workshops together with program directors and trainers and facilitators of the courses and cups. Based on this adjustments and changes were implemented which resulted in better assessments in 2008 and significant better learning effects. These evaluation activities mainly pay attention to the design-in-the-small of the game as artifact for education. In addition assessment results and their consequences are communicated and discussed within special workshops with different stakeholders (including representatives of German Ministries) in order to set up new programs and initiatives for increasing entrepreneurship in the German economy/society through educational programs.

Conclusion

Logic models are helpful for the design process in various ways (c.f. Hense & Kriz, 2008). While designing a game, the logic model can support the necessary process of reducing complexity. Logic models focus on achieving certain defined learning and change objectives. Therefore, they conduct the selection of the reality factors depicted in the game and their interdependencies. For facilitating, debriefing and meta-debriefing of the game, they provide knowledge for the interaction and the behavior of the players and facilitators on the basis of the selected process-variables. On the one hand, the logic model sets a frame for operationalizing and measuring the variables as success indicators of the game as well as for the interpretation of results in the sense of a summative evaluation of effects. On the other hand, the logic model can also be used for ongoing optimization of development and implementation of the simulation game in the sense of formative evaluation. Therefore the logic model should be designed simultaneously within the first steps of a simulation model and, in an ideal case like in the entrepreneurship education program of "exist-priMEcup", by the same project team that is also responsible for designing the game and facilitation and debriefing procedures. Naturally the logic model - as well as the game itself - can change during the design process, because the logic model and the model of the simulation are deeply interconnected with each other. Through the implementation of the theory-oriented evaluation approach in several unique design projects in practice, again universal concepts are created that explain why games are a powerful tool for learning.

The theory-oriented evaluation approach offers a link between both communities of analytical and design science. In the logic models, knowledge from both communities is integrated: research results and theories from analytical sciences and concrete experiences from design practice. Game designers must use knowledge from the analytical sciences (e.g., educational psychology) for the game design in order to produce games that really support effective learning.

Our approach does not only assess outcomes and proves whether a game works, but also explains how and why it works (or fails to work) in a given context of use and this supports the further testing of theories. At the same time it also helps to increase the usability of games in specific situations with specific target groups, which helps to achieve the objectives of the design science. In the research programs designers, facilitators and evaluators (and researchers) of the start-up games are working hand in hand.

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