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

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On the path to a new learning culture – the contribution of web-based business games

HEINZ MANDL

1. A new learning culture

Even today, learners in all different courses of study are finding that teaching and learning takes place in environments in which the instructor plays mainly an active role while the learner plays mainly a receptive role (Reinmann-Rothmeier & Mandl, 2001a).

At the heart of such a passive form of learning is the assumption that knowledge results from learning facts and routines and can be passed along from one person to another as a kind of commodity. In the framework of this traditional form of instruction, “inert knowledge” is often the result, that is, knowledge which is theoretically learned in the classroom, but that cannot be applied in practice (Renkl, 1996). A new learning culture is emerging which is based on a constructivist learning concept which challenges this notion. One of the basic assumptions of this approach is that knowledge is not a product which can be simply passed on from one person to another. Knowledge is not simply absorbed, but is actively acquired based on an individual’s prior knowledge, motivation and attitudes. The active learner is at the forefront of this concept. Based on a constructivist view of teaching and learning, the following characteristics of the learning processes are relevant:

Learning as an active process: Effective learning requires the active participation of learners. They should be motivated to learn and at least develop situative interest for the learning task.

Learning as a constructive process: The learner builds new knowledge on top of existing knowledge.

Learning as a self-directed process: The learners themselves steer and control the learning process.

Learning as a social process: Not only does learning take place through social exchange, it is also dependent on overall social, economical and political influences.

Learning as an emotional process: Especially for motivation and learning the emotional component is essential.

Learning as a situative process: Learning is always embedded within a specific context from which the subject matter is interpreted. This context works to either limit or foster learning experiences.
When implementing learning environments based on these principles, it has been shown that despite the fact that the learners play an active role in the learning process, they still require a certain degree of instruction (depending on learning pre-requisites) in order to learn effectively (see Renkl, 1996; Gräsel, 1997). Fully self-directed learning often leads to learners becoming overwhelmed. This means that learners must be supported when questions or problems arise, for example by ensuring that they receive feedback on their findings.

The creation of problem-oriented learning environments provides a pragmatic opportunity to implement the new concept of teaching and learning and to combine these concepts with insights gained through research. A balance between instruction and construction forms the basis of problem-oriented learning environments. At the core of this notion is the idea that the active learner is guided, supported and given advice throughout the learning process (Reinmann-Rothmeier & Mandl, 2001a).

This new culture of teaching and learning can be realized through problem-oriented learning environments. For the concrete implementation of problem-oriented learning environments, guidelines have been devised which will be briefly presented in the section below. These global structuring principles can also be utilized for virtual or web-based learning environments (Reinmann-Rothmeier & Mandl, 2001b).

**Authenticity and applicability:** Learning environments should provide and encourage interaction with real problems and authentic situations. The problems presented should be of relevance for the learners and should generate interest which promotes motivation and applicability.

**Multiple contexts and perspectives:** In order to ensure that situatively acquired knowledge does not remain fixed to a specific context, it is necessary to create learning environments in which the subject matter is embedded in various contexts and ensure it can be viewed from multiple perspectives. Learning through multiple perspectives encourages flexibility in applying the material.

**Social context:** When creating learning environments, it is important that social learning arrangements are used as much as possible. This promotes cooperative learning and problem solving and also promotes processes that encourage the development of learning and practice communities. The social context ensures that an expert community evolves.

**Instructional support:** It is necessary to guide and support the learners through instruction so that they are able employ self-directed and social tactics and consider multiple perspectives. Instructional support also ensures that learners don't become overwhelmed. The learning environment should be structured such that the knowledge needed to solve problems is provided and should offer diverse opportunities for independent learning.
Learning in the context of a problem-oriented learning environment is based on two aspects, **self-directed learning** and **cooperative learning**.

Business games are credited with having the potential to realize problem-oriented learning environments which implement self-directed and cooperative learning settings. Business games simulate real events and processes. An interactive game is achieved on the basis of a model which contains (manipulatable) parameters and related actions. Business games are basically able to simulate all describable and mathematically realizable scenarios (e.g. economic, ecological, military). In the following sections, we will discuss the most widespread type of business game, the corporate business game, which today is mainly computer-supported. In classical instructional settings, opportunities for individual learners to actively influence the learning situation and the learning process are rather limited. Learning environments, study time, and approach are prescribed. On occasions when the learner is called into action, these actions are both time and effect limited so that the learner is more likely to sense his own limitations rather than his own potential. Active and constructive learning is only seldom possible. On the other hand, business games provide many opportunities for participants to make their own decisions, which has a motivating effect on the learners (Deci & Ryan, 1993; Mandl, Reiserer & Geier, 2001).

In the following sections, the e-business game learning environment will be described and then analyzed with respect to the realization of the guidelines for problem-oriented learning environments.

### 2. The “e-business game learning environment”

In order to explore a new educational model for the qualification requirements of e-business, the Berufliche Fortbildungszentrum der Bayerischen Wirtschaft developed a web-based learning platform e-business game. The learning platform is embedded within a framework learning environment made up of face-to-face events and online learning phases. The e-business game is implemented as a supplementary measure to academic instruction and operational training, in order to promote knowledge and skills in the area of e-business.

**Target group.** The “e-business game learning environment“ is aimed at commercial occupation groups and should be able to address trainees as well as act as an instrument for professional further education initiatives. In addition to commercial occupation groups, the e-business plan should also be made available for technical occupation groups (IT Specialist, Media Designers), who could thereby acquire an economic additional skill.

**Structure.** The “e-business game learning environment“ is set-up as a hybrid learning arrangement which alternates between face-to-face meetings and online learning phases. The lynchpin of the learning environment is a corporate business game which is integrated within an online learning plat-
form. In the business game, several groups made up of about five people play against one another in the virtual marketplace. According to the game scenario, each group is responsible for managing an air-conditioning company which is a subsidiary of a larger firm and is run solely as an e-business company. This means that all the firm’s business processes are handled through electronic services and channels. Each group manages their company through a decision mask into which they enter parameters for the areas of Sales/Purchasing, IT/Services and Finance/Planning (e.g. prices, personnel, server equipment, advertising, etc.). The manipulatable parameters can be activated individually by the game leader. This is so that it is possible to begin the game with a reduced complexity model and then increase the complexity step-by-step throughout the game. The decisions are submitted each period. One game period lasts one to two weeks and relates to a virtual company quarter. In addition to an introductory description of the game scenario, each participant receives so-called economic reports which describe the general market situation and trends such as global characteristics and changes in the market simulation. Participants also receive “company reports” which provide feedback on the previous game period and reflect the current characteristics of the firm (financial statements, profit and loss calculations, etc.) as well as provide a comparison of one group’s firm with the competing firms, for example, on the basis of sales data. If a group’s company invests in market research, that company receives even more precise data about the competitive situation and market forecast.

In addition to the business game simulation, the learning platform web-based training module contains information on the following e-business topics: Basic principles of e-commerce/e-business, customer management in e-commerce, e-logistics, purchasing and distribution in e-business, payment systems in e-commerce, legal framework for e-commerce/e-business, security of e-commerce/e-business, technical standards in e-business. On the one hand, these modules should provide the basic foundation for managing the business game and also provide more detailed information on specific topics. The web-based training modules contain different exercises. More complex tasks, such as creating a strategic business concept is corrected and evaluated by the game leader. In addition, there are smaller practice tasks which can be worked on interactively and are automatically corrected by the system, such as matching criteria to their corresponding e-payment system. There are some exercises of a multiple choice nature, while others require identifying the relationships between concepts (by drawing lines which link them to one another), categorizing concepts or sorting concepts according to certain criteria.

The user interface of the e-business game is divided into a personal workspace and a group workspace. In the personal workspace, each player can use the help function and work within the web-based training module. The system keeps track of which lessons and practice exercises have been done and offers the ability to add bookmarks and comments. Through the group workspace,
participants are able to access the communication interfaces and the decision input masks of the business game simulation. In order to communicate with other participants and the participants managing the game, e-mail, a chat function and two asynchronous forums (so-called “bulletin boards”) are available. One of these bulletin boards is restricted to the members of the group and one is open for all participants to use. At certain intervals a chat (“live discussion”) takes place which is moderated by the game leader.

Process. The “e-business game learning environment“ begins with a kick-off seminar in which all participants get to know one another and are introduced to the management and structure of the e-business game program. In addition, exercises on the use of internet services are carried out (e.g. conducting research using a search engine). This is followed by an online phase, during which the first learning modules are worked on. The corporate business game begins after one further face-to-face session in which the most important (company) parameters are introduced and the players are familiarized with the feedback (company reports) provided by the system. After a few rounds, a further face-to-face session takes place. During this time, the players present the strategies they have employed and then receive a detailed report from the game leader on the development of the individual companies. Both poor and successful business decisions should be identified and discussed during this time. After 12 rounds (in the pilot phase of the model after 8 rounds), the e-business game ends with a concluding seminar in which the participants again receive feedback and are also given the opportunity to reflect on and evaluate the education initiative. In the pilot phase, the e-business game was completed in 8 months.

3. “e-business game learning environment“: Realizing the guidelines of problem-oriented learning

We will investigate the degree to which the framework of the e-business game learning environment follows the guidelines for the creation of problem-oriented learning environments.

3.1. Authenticity in an “e-business game learning environment“

The creation of authentic problem situations is an integral part of the business game concept, especially because business games attempt to simulate real problem situations as accurately as possible. The authenticity of the business game is highly dependent on how successful the simulation model reflects reality. This means implementing a relevant selection of decision parameters and their relationships.

The simulation used in the framework of the “e-business game learning environment“ basically shows each of the following characteristics, as described by Dörner (1989).
Complexity and interlinking. The simulation contains 64 parameters in total which relate to different business areas at varying levels of detail (pricing structure, costs of employee trainings, product range, advertising costs). It would theoretically be possible to activate all 64 decision parameters at the beginning of the game. The game is structured in such a way that the number of parameters which can be manipulated increases with each decision phase. For example, at the start of the game, only parameters relating to sales and purchasing can be manipulated. This is done so that the participants are not overwhelmed by a high degree of complexity when making their initial decisions. The approach should be determined according to the pre-knowledge of the participants.

Lack of transparency and momentum. After each group has submitted their decisions, the market simulation begins in which the decisions of the groups affect one another. Transparency exists with respect to the market principles which are embedded in the simulation. These principles can be taught during the seminar by the seminar leader or through web-based training modules or assumed to be prior knowledge. From the time of the group's decision on the market simulation to the respective “performance“ of the group, there is a lack of transparency. This is due to the fact that the groups are not aware of the decisions of the other groups, despite the fact that the other groups’ decisions determine their performance to a large degree. In addition, the reaction of the market is not only determined by the decisions of the other virtual companies. The market also changes momentum of its own accord, for example, according to seasonal fluctuations.

Goal plurality and goal clarity. The “business reports“ which the participants receive in each round serve as feedback on the previous decisions and also serve as a basis for future decisions. Goal plurality and goal clarity result from the fact that the participants must focus on different business-related goals depending on the situation. It does not make sense for the long-term to concentrate solely on maximizing company profits. Depending on the current state of play, several influencing factors must be taken into consideration, such as increasing the level of brand recognition or improving technical equipment.

3.2. Multiple contexts and perspectives in the “e-business game learning environment“

The computer-supported “e-business game learning environment“ offers the game leader the opportunity to make changes to the simulation. This can be done by adding or excluding certain variables or by modifying the initial state of certain variables. By altering the simulation, business games can reflect a number of situations and are therefore able to provide learners with an opportunity to view the subject matter from various perspectives and within multiple contexts (see Stark, Graf, Renkl, Gruber & Mandl, 1995).
For example, the demand situation of an industrialized country could be replaced with that of a newly industrializing country or the market could be restricted through virtual competitors. It is important in principal that no new learning material is conveyed in the various contexts, but that a sub-area of the whole system is brought to the forefront or modified in order to highlight specific problem areas. Individual participants may also swap or rotate roles in order to achieve multiple perspectives. In this way, various perspectives on the issues at hand can be gained.

In addition to the company simulation, the “e-business game learning environment” contains qualitative tasks which relate to the activities of specific jobs within the company. For example, participants may be asked to create a website for the company or to carry out a competitive analysis using business data of real air-conditioning companies. These tasks are then evaluated by the game leader and are given as bonuses (e.g. credits) for the business game.

3.3. Social contexts in the “e-business learning environment”

In the “e-business game”, groups compete against one another. On the one hand, a competitive situation arises between the groups, who view themselves as competitors in the virtual market. The communication between the groups plays a secondary role and mostly takes place on a general level, for example during face-to-face sessions. The processes which take place within each of the respective groups are key for the social context. It is the job of each participant to cooperatively make decisions with other group members in order to ensure that the simulated company is as successfully placed within the market as possible. The first task of the group is to acquire the relevant domain-specific knowledge which is necessary for analyzing the problem. Building on this knowledge, hypotheses which relate to the relationships between the simulated systems are generated and tested. For example, participants must decide the order in which the parameters should be changed, make predictions with respect to the expected state of affairs, make the relevant changes or interpret the newly received results. Finally, it is the group’s task to evaluate the learning behaviors in order to make any necessary changes for the subsequent learning activities (see De Jong & Njoo, 1992). A key component of the “e-business game” is therefore the cooperation within the group. The interpersonal processes and especially the decision-making processes, are, as previously mentioned, largely dependent on the communication options available. The conception of the “e-business game learning environment” allows for two options. The first is that the members of a group are in the same physical location. In this case, the cooperative learning effort takes place face-to-face. The conception also allows for the possibility that group members from various locations work together. The learners in this situation are able to utilize text-based communication tools such as e-mail and chat. Depending on the nature of the group (face-to-face vs. dispersed), the “e-business game learning environment” offers
3.4. Instructional support in the “e-business learning environment”

The above considerations illustrate that the business game method fulfills the main criteria of problem-oriented learning. It has also been shown that learning with business games places high demands on the learners with respect to self-directed (Simons, 1992) and cooperative (Renkl & Mandl, 1995) learning skills. Business games learning environment can easily overwhelm learners who do not have a great deal of learning experience and who are asked to work in a self-directed manner. Instructional support must be adapted to the competence level of the learners and not only relate to content issues, but also support self-directed and cooperative learning.

The “e-business game learning environment” begins with a one-day kick-off seminar in which participants are introduced to the structure and the user interface. This is followed by a general introduction to the company parameters and the entries in the business reports. This information is also provided to participants in the form of a user handbook. During the business game, the game leader is contactable via e-mail or is available at certain times for chat. The game leader informs the participants in advance of upcoming changes through the “Management Newsletter”, for example if a new parameter is about to be activated.

Because participants in the business game are not only spatially dispersed, but may also work on the game at any time, it is seldom possible that a game leader will be able to immediately answer questions as they arise. It is very difficult to generate a brisk exchange of questions and answers via e-mail. Chat is also unable to provide support for problems which may spontaneously arise since the game leader will only be available to chat during certain times. Basic information which is relevant for controlling the simulated company can be obtained from the web-based training modules of the “e-business game learning environment”.

4. Evaluation of the “e-business game learning environment”

When evaluating the “e-business game learning environment“, three main areas were analyzed: acceptance, learning process and learning success (Mandl & Geier, 2004). After a subjective evaluation by the participants – who analyzed the learning process - the change in the knowledge structure of the participants was analyzed using concept-mapping. The three main areas of analysis (acceptance, learning process and learning success) were given sub-questions which aim to highlight the central aspects of creating problem-oriented learning environments:
4.1. Topics of evaluation

Acceptance:
The acceptance of an initiative forms the basis for its success. In addition to asking participants to evaluate the learning environment as a whole, it is often helpful in complex learning environments to ask the participant’s opinion on individual components of the learning environment. The main topics of interest are the components of instructional support, such as the face-to-face sessions, the game leader and the additional on-line learning modules. Participants should also evaluate the success of the individual components of the learning platform and assess their relevance for the learning platform as a whole. These evaluations help to create a picture of how the individual building blocks of instructional support can be most effectively incorporated into the learning environment.

Due to the computer-based nature of the learning platform, the participants should also evaluate the structure of the user interface.

Learning Process:
According to insights gained from research on problem-oriented learning, the success of an initiative is closely related to processes which take place during learning. This includes both the motivation of the participants and their ability to learn in a self-directed and cooperative manner. The participants are asked about their motivation throughout the initiative. They are asked to estimate how successful they were at developing new knowledge independently and how they would rate the cooperation with the other participants. Participants are also asked to assess the time burden and qualitative workload. This is especially key due to the fact that complex learning environments which allow learners a high degree of freedom can sometimes lead to learners being overtaxed. This can especially be the case when such learning environments, as in the case of the e-business game, are integrated as additional educational initiatives in an already densely packed education program.

Learning Success:
In order to analyze learning success, both the subjective evaluations of the participants and the change in their knowledge of economic relationships are investigated using concept mapping.

4.2. Method
At the end of the initiative, the participants (N = 63) were given a questionnaire and were asked to rank the applicability of certain statements on a five-point scale. The change in their knowledge of relationships was measured through pre-post concept maps in which the participants are asked to illustrate the relational structure of a company. In addition to the 33 par-
ticipants in the “e-business game learning environment”, 13 further trainees were asked to participate as members of a control group.

4.3. Results

Acceptance:
With respect to general acceptance, the vast majority of participants liked the e-business game. All of the components of instructional support and the structure of the user interface received positive feedback. The business game leader was also given an especially positive assessment. He was viewed as being the most relevant source of information for the successful management of the business game. On the other hand, there were mixed reviews regarding how relevant the learning modules were to managing the business game: half of those asked said that the learning modules did not provide information which was necessary for controlling the game. This also was reflected in the relatively low usage of the learning modules.

Learning Process:
The majority of participants viewed the e-business game learning environment as motivating and interesting. Participants also positively evaluated communication and cooperation in the e-business game. However, there was a mixed appraisal of the workload experienced in the learning environment. One group of participants felt that the business game was arduous. There were also mixed reviews regarding the opportunity for participants to learn how to gather the relevant business game information in a self-directed manner.

Learning Success:
Overall, participants positively rated their learning success. However, when asked whether they would be able to apply the material within a work context, the participants tended towards a negative assessment.

When analyzing participants’ knowledge of economic relationships, a content shift became apparent. In business effect structures, which were constructed using concept maps, the participants chose different areas of emphasis following the initiative. They chose more concepts from the business area “sales” and picked the field of e-business out as a central theme, focused on areas which were the most important for the effective management of the business game.

5. Conclusion

The evaluation of the “e-business game learning environment” supports the findings which prove the business game to be a widely accepted and motivating teaching and learning method. In addition, the “e-business game learning environment” provides a suitable context for promoting cooperative learning processes and can, as seen in the analysis of relational know-
ledge, influence knowledge structures. A more inconsistent picture is created with respect to the business game’s ability to promote self-directed learning and the effect of the workload on the participants. These considerations will form the basis for some closing thoughts.

The effectiveness of a business game learning environment is dependent on several different factors. On the one hand, when the business game is developed and executed it is important that problems are authentic, relevant to the learners and able to be viewed from various contexts and perspectives. On the other hand, the task should not be so complex that the learners are overtaxed. This could namely lead to the business game becoming disassociated from practice-related questions and applicability and can lead to the game only being played for its own sake. This means that participants would lack a basic understanding of the fundamental relationships in the simulated system (see Berry & Broadbent, 1984; Leutner, 1992; Renkl, Gruber, Mandl & Hinkofer, 1994). In order to tap the full potential of the business game method, it is necessary for both learners and instructors to have adequate competencies. Firstly, learners in a computer-based group business game are expected not only to have sufficient subject-matter knowledge, but also possess competencies related to self-directed and cooperative learning. Secondly, to carry out the business game, the instructor must have a high degree of subject-related and didactic competencies to be able to guide and support the learners in their construction of knowledge. This is especially true for groups of learners who do not yet possess the essential competencies related to self-directed learning. The conceptual design of web-based business games must explicitly consider the aspect of instructional support. Special consideration must be given to ensure that the leader has as intensive a contact with the learning group as possible in order to intervene as quickly to curtail any unfavorable developments in the learning process. It may also make sense to provide learners with instruction and aids to improve learning activities on both an individual and a group level (see Reinmann-Rothmeier & Mandl, 2000). For example, in the context of the “e-business game learning environment”, learners could be given strategies for dealing with hypermedial systems (see Astleitner & Leutner, 1997) which make it easier for them to search for and use the knowledge relevant for controlling the business game simulation. A further option would be to provide learners with a problem-solving schema which would optimize the decision-making processes within the group (see Stark, Graf, Renkl, Gruber & Mandl, 1995). In order to avoid overwhelming the learners, it is beneficial to identify the logical fit between the pre-knowledge of the participants and the complexity of the simulation. In order to do this, it is necessary to assess the basic knowledge of the target group, for example through a pre-knowledge test (Weber, 1994). In addition, it must be possible to alter the learning environment and the characteristics of the market simulation in a flexible manner.
References


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