ACCELERATING LEARNING THROUGH GAMING?

Lessons from interactive and online gaming in business and business education.

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Gaming as a tool for learning in business settings and in business schools is gaining in importance. New interactive technologies enable innovative strategies for enhancing the learning experience and the learning outcomes. This development evokes the question: Can gaming, as a form of simulating business reality, accelerate learning?

This question will be the topic of this paper. In this paper we present the impact of two economic games. We evaluate the games based on a Media Functionality Framework (Vernooij, Thijssen, Schermerhorn, 2001) developed from literature research on learning practices and media functionalities and disfunctionalities.

The first game is an entrepreneurship game for students at the Vrije Universiteit, called *Economy Class*. The second game is an *Innovation Game* as part of a course for innovation consultants of the Dutch Government. The proposition is that interactive experiences have greater impact than one way communication as in traditional methods of instruction. The learning points of the two games are made explicit and implications for innovative education and learning are indicated.

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1. Introduction

Gaming as a tool for learning in business settings and in business schools is gaining in importance. New interactive technologies enable innovative strategies for enhancing the learning experience and the learning outcomes. This development evokes the question: Can gaming, as a form of simulating business reality, accelerate learning? This question will be the topic of this paper.

We will present the impact of two economic games. We evaluate these games based on a Media Functionality Framework (Vernooij, Thijssen, Schermerhorn, 2001) developed from literature research on learning practices and media functionalities and disfunctionalities.

Brief history on gaming
In contrast to common perception, video gaming is not new. The first computer game was designed by A.S. Douglas in 1952, as can be learned from PBS.org website with a timeline of the development of computer games:
http://www.pbs.org/kcts/videogamerevolution/history/timeline_flash.html.

And as early as 1958 we could play tennis with a computer, based on a game designed by W.A. Higginbotham. The father of computer gaming is considered to be R. H. Baer who registered patent 3.728.480 in 1968, which was awarded in 1973 and subsequently sold to Magnavox. Magnavox in turn released 12 games in 1972. Since then computer gaming has taken a flight with Atari, Magnavox Odyssey 2 and Sony Play Station 2 in 2000.

Just recently Microsoft entered the gaming market. The number of new game introductions since the year 2000, cannot be counted. Gaming has become part of daily activities. Gaming has also become a social concern, where games are portrayed to have a bad influence on child development. One of the claims is that violent games raise violent children.

Some myths debunked
A large gap (Jenkins, 2005) exists between the public's perception of video games and what the research actually shows. The following is an attempt by Jenkins to separate fact from fiction. It is quoted from the article with the title: *Reality Bytes: Eight myths about video games debunked*.

The eight myths about video games concern: youth violence, scienctific evidence for links between violent game play and youth aggression, children are the primary market, girls do not play computer games, war games teach kids to kill, video gaming is not a meaningful way of expression, games are socially isolating and desensitising. Jenkins meets these arguments.

Henry Jenkins (2002) is the director of comparative studies at MIT and the unit recently entered into a joint venture on gaming with Microsoft with the name Games-to-Teach. As the gaming industry is booming, the research on gaming at universities lacks behind. There is no theoretical knowledge about gaming as a potential educational tool and little is known about the impact on learning. Gaming is often still associated with on-line entertainment. In

education, where simulating business reality is often referred to as ‘serious gaming’, gaming has taken a flight in the past ten years (Van Dijk & Keulemans, 2006).

As we will demonstrate in this chapter gaming is seen as learning by doing in a simulated business education setting, using computers and networks and other technical tools for interactive practice. Traditional learning in lectures and books as opposed to ‘serious gaming’ includes seeing, hearing and reading in a passive way on the part of the student. ‘Serious gaming’ engages the student fully with all senses and renders a better learning outcome according to research of the educationist Edgar Dale at Stanford University regarding the Cone of Experience (Dale, 1946).

Gap between business and business schools

Teachers and researchers may adhere to the above myths about video games saying that games are not a meaningful way of expression and therefore avoid learning about the positive potential use of gaming in educational settings. This may even increase the generation gap between students and teachers. The new generation learns in a different way and most business schools continue to hang on to the traditional teaching methods in classrooms, transferring knowledge through lectures.

Business schools are more and more criticised for being detached of business reality (Bennis and O’Tool, 2005) and because of that do not prepare students well for the competencies required by modern business. Many businesses today require on-line skills to communicate, work collectively on a project with a (virtual) team, and create new business models to generate value with and for clients, through the use of new social software technology. It is proposed that gaming can contribute to the development of these competencies and accelerate learning.

Gaming as a new technology

New technologies enable new forms of business and innovative ways of teaching and learning, reaching business and learning objectives that traditional media do no cater for. In 2001 a conceptual framework was presented (Vernooij, Thijssen, Schermerhorn, 2001) to guide the process of decision-making in designing innovative education. It regards the development of effective learning environments, by focusing on two sides of the construction process.

The first is the side of the media and their functionalities, both activated and potential, and their disfunctionalities. Functionality can be described as the quality of being suited to serve a purpose well. In the case of media (new and old) for education and learning and their functionalities we study the quality or lack of quality of media to be able to reach learning objectives.

The second side is the exploration of three types of learning activities: cognitive, regulative and affective. Based on these two sides of the construction process, we are in pursuit of an optimal mix of media, traditional and new to accelerate our learning activities. Our central research question at that time was: ‘What combination of media offers an optimal mix of

learning functions to support the learner's activities, necessary to reach his or her desired learning outcomes?'

Considering the characteristics of the media, the design of a new instruction environment is not just the choice of a new mix of media, but the choice of functionalities and disfunctionalities of these media. In other words do these media show qualities to be able to reach existing and or new learning objectives? The crucial point in innovation is exploring the potential functionalities a new medium has.

The most professional group to advise about that in an educational environment, are the students themselves. They bring in their experiences with new media and all of their disappointments with learning environments can be transformed into information and knowledge about potential functionalities. In this way we may bridge the first gap mentioned earlier, the generation gap between students and teachers. So we suggest that students can be co-designers of meaningful learning environments, based on their hands on experience with functionalities and disfunctionalities of new media enabling learning activities.

The innovation matrix
To introduce new learning it is important to become aware of what a learning medium can attain (functionality) and what it can not attain (disfunctionality). Each learning medium has potential opportunities to support the development of certain learning outcomes. The point is to become aware which disfunctionalities the existing learning media have, causing the exclusion of important learning outcomes.

In other words, if some learning outcomes are not attainable with existing media, those learning outcomes are excluded from the curricula. The surplus value of new technologies is to be found in the incorporation of new learning outcomes that where unattainable with the existing media. Figure 1 shows the relation between media and learning outcomes as presented in an innovation matrix (Vernooij, 2002).

Innovation matrix	Traditional learning outcomes	New learning outcomes
Traditional media	traditional education	spinoff
New media	efficiency trap	innovative education

Figure 1: the innovation matrix

If traditional learning outcomes are taken for granted and new media are incorporated with the idea that nothing changes in the learning outcomes of the learning process, the introduction of new media may fall in the efficiency trap. The most important aim becomes the replacement of man power by computer power in order to save money. However new media offer the opportunity to attain learning outcomes that are unattainable with traditional media, offering the possibility to create innovative education.

Quite often opportunities are discovered to attain those new learning outcomes as well with the traditional media. That results in a spin off, enriching traditional education The awareness of the innovation matrix opens the opportunity of combining traditional and new media in a way that traditional and new learning outcomes can be attained.

Pedagogy: the characteristics of the learning process
In traditional learning the assumption prevails that education is essentially the transfer of knowledge from an external source to the learner. This opinion is increasingly under pressure. More recent theories, like the constructivist theory, state that learning is not a passive 'absorptive' process of knowledge but an active, constructive and self-regulated process of the learner (Bedmar et al., 1991). To bring about this construction of knowledge, students need skills to guide this process or in other words: 'they need to learn how to learn' (Boekaerts and Simons, 1993; Boekaerts, 1997).

New learning must be introduced in stages: guided learning, experiential learning and action learning (Simons, Van der Linden and Duffy, 2000). Aims of new learning include the acquisition of learning, thinking and regulation skills (Ten Dam, Vernooij and Volman, 2000). This approach makes it possible to work on the development of competencies (Stoof, Martens & Merrieënboer, 2001).

Vermunt (1992) argues that the quality of higher education hinges on the quality of the learning processes students deploy. This implies that not only *instruction theories*, but also *learning theories* have to be taken into account when designing effective educational experiences.

Thus, there are two sides to learning, namely learning theories (demand side) and instruction theories (supply side). Vermunt (1992) combines these into a coherent learning theory, in which the activities students deploy are central. Gradually the students must take over the activities of the instruction and start instructing themselves.

He divides the activities that support the learning process into three domains:

- Cognitive domain: mental activities that lead to learning results such as knowledge, skills and competences.
- Regulative domain: mental activities focused on the coordination and control of learning processes.
- Affective domain: attribution of emotions that occur during learning activities. They influence the motivation and self-esteem of the students and enhance or constrain the cognitive and regulative functionalities.

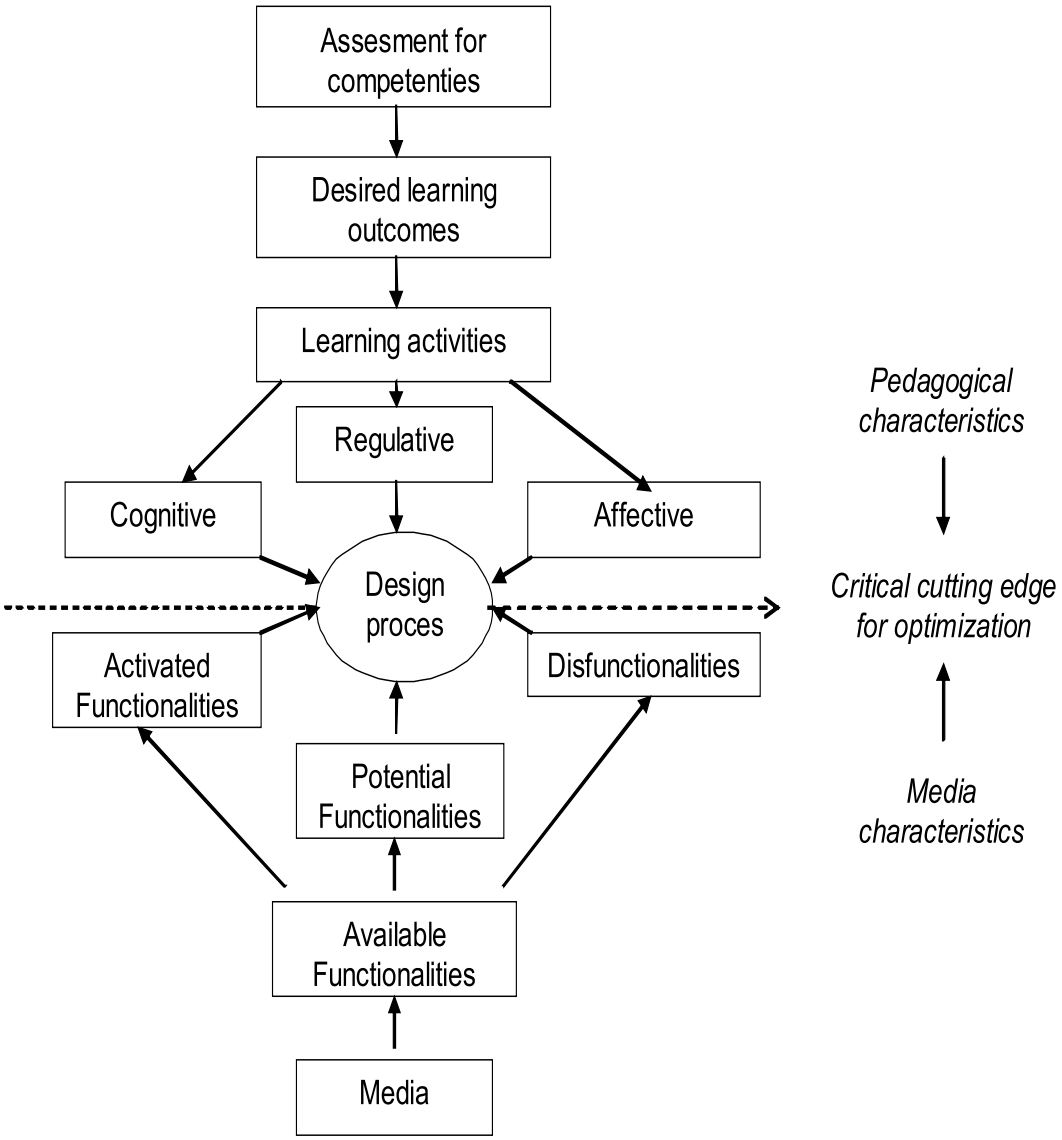

Figure 2: The Media Functionality Framework

According to Vermunt (1992) all activities can be undertaken by the student or by the teacher. For instance teachers can try to motivate their students, but students as well can try to motivate themselves, just like employees must do, once they are in a job.

In the same way, the learning processes can be guided internally or externally. Internally means that the students have an intrinsic motivation driven by personal interests. Externally means that the content of the course and the learning process is tightly controlled by an external source. This can be a teacher, but also a peer-group or a fellow student. As example of structuring the study of a book as a traditional medium: the teacher can prepare summaries or can leave this to the student.

Technology, Pedagogy and Innovation
We introduced the concept of technology and pointed at the functionalities, either activated of potential, and the disfunctionalities of media. In the previous paragraph, we introduced pedagogy and pointed at the different learning processes like cognitive, affective and regulative processes. In constructing an innovative learning environment these two (media and learning processes) must be bridged in an adequate way.

The *media characteristics* meet the *pedagogical characteristics* at a critical *cutting edge,* as depicted in **Figure 2.** The top half of the figure shows the (desired) learning outcomes, which have to be translated in learning and (self) instruction activities to attain them. The bottom half depicts the media characteristics.

We will use the Media Functionality Framework (as shown in Figure 2) as a model for our research. In section 2 we explain the purpose of the research and in section 3 the research methodology of our case studies. In section 4 we will provide an overview of two cases and discuss findings in section 5. Finally in section 6 we list the implications for innovative education, learning and innovative business.

2. Purpose of the research

The research at hand can be seen as exploratory research as there is only an emergent body of academic knowledge about the use of new media, such as gaming, in educational settings. The gaming business however has over 50 years of experience. So we draw from experiential knowledge, from e-learning developers, from professional training consultants and from commercial businesses to describe and explain learning experiments with games.

The purpose of the research is to generate both presentational knowledge and propositional knowledge on the topic of gaming and accelerated learning. If we can prove to teachers, researchers, students and practitioners that gaming does indeed accelerate learning and increase business effects, a wider introduction and adoption in Business Schools and Business may be the effect of it.

3. Research methodology

Experiments and case study methods are generally accepted as tools for exploration and theory development (De Vries, 2003: Yin, 1994). This is a multiple embedded case study (Yin, 1994). We studied two different cases (See Table 1).

TABLE 1 OVERVIEW OF CASE STUDIES

Site	Unit of Analysis	Level of Analysis
Case 1: Free University	Entrepreneurship game for students at the Free University, called *Economy Class.* The game is based upon entrepreneurial trading practices and includes the actual trading by students in an interactive digital environment.	Individuals and teams of students in the age group of 20-25
Case 2: Syntens/ Boertien Training	*Innovation Game* for professional innovation consultants working for the Dutch Government to advice small and medium size enterprises in matters of growth, innovation and innovation capabilities	Individuals and teams in the age group of 38 -60

We use multiple data sources for data collection and as such it is a hybrid approach between concept development, experiments and case studies. Sources used are an extensive literature review, interviews, workshops, training, management meetings, reflection meetings, documents and files of the cases and consultancy reports. The complementary use of these data sources is quite usual in case research (De Vries and Roest, 1999).

The data collection approach differed per case site and the purpose of each case presented is to explain theory development and practice development. On the part of accelerated learning the cases are described based on hands-on information and experience with the cases by the authors and full access to all information sources at the case sites and includes direct observation and participant observation.

The case studies will be described according to the Media Functionality Framework in section 4 and findings are discussed section 5. Conclusions will be drawn and recommendations made for further research. The implications for business schools and business will be formulated in section 6.

4. Cases

The first game is an entrepreneurship game for students at the Vrije Universiteit, called *Economy Class.* The game is based upon entrepreneurial trading practice and includes the actual trading by students in an interactive digital environment. Based on assumptions of market characteristics and expectations about the behaviour of competitors, entrepreneurial decisions are made according to the cycle of planning & control. Prices are set to compete and gain competitive advantage and make profit.

Students learn to apply costing in an interactive environment, both as an ex-ante activity and an ex-post activity. They predict their own results and are confronted with the actual results,

thus allowing for an evaluation of the strategy chosen. The didactical structure allows students to practice entrepreneurship in a dynamic digital environment, developing entrepreneurial competencies and practicing tools for decision making under uncertain conditions.

The second game is an *Innovation Game* as part of a course for innovation consultants of the Dutch Government. The innovation game is based on LEGO Mind Storm and the consultants take on different roles: entrepreneur, consultant, marketing & finance, design and production, ICT.

Two teams identify market trends and consumer needs, develop a product idea and a concept, develop a marketing & financial plan, build a proto type in LEGO Mind Storm with intelligence on board and present it at 5 pm the same day to the group of participants. The innovation game is reflected upon and learning points are explicated.

The hypothesis is that interactive experiences have greater impact than one way communication as in traditional instruction.

Case descriptions
For the description and explanation of the two cases we will follow the Media Functionalities Framework. For this purpose we translated the model into a table as shown in table 2. For an analysis of the cases it is considered important to make an extensive analysis of all the elements that are mentioned in the framework.

However such an analysis is too extensive for the question we tackle in this article. For that reason the analysis is restricted to a general description of learning outcomes that is common for the two games. As far as the learning activities and the media are concerned we offer a short overview of details according to the extensive data sources available to us.

TABLE 2 MEDIA FUNCTIONALITY FRAMEWORK

Pedagogical characteristics	**Media characteristics**
Assessment for competencies	Media selection
Desired learning outcomes	Suitable functionalities
Learning activities: ? Cognitive ? Regulative ? Affective	Functionalities: ❑ Activated functionalities ❑ Potential functionalities ❑ Disfunctionalities
Design of Learning Process	Design of Learning Process
Evaluation	Evaluation

The term ‘evaluation’ is added to be able to describe and explain the effects of the learning process based on empirical findings. Below we will describe and explain each of the two cases.

Case 1: Economy Class

Pedagogical characteristics

- **Assessment for competencies**

De game is used as an introduction in Marketing and Accounting. So only general competencies are required as a prerequisite: a basic general knowledge about buying and selling on a market and basic understanding of communication.

- **Desired learning outcomes**

The learning outcomes are related to the role of an entrepreneur to perform the Cycle of Planning & Control in his business:

- The competence of formulating and reconsidering goal and strategy of the company
- The competence of operationalising goal and strategy into targets and decisions
- The competence of estimating the results (like net profit) under chosen conditions
- The competence of computing the final results and comparing them to the estimations.

But an entrepreneur must as well be able to communicate and has to develop:

- The competence of participating in teamwork
- The competence of presenting the results both verbal and written
- The competence of learning from experiences

- **Learning activities**

Students operate as teams performing the role of an entrepreneur in a market where they all buy and sell the same product (i.e. sun glasses). They sell their product via Internet and compete on this one product in a market of maximal 10 companies. Each team has access to an online program and has a certain time to take decisions and estimate the results. It is up to the instructor to set the deadline.

The program is interactive which means that teams are guided through the cycle of planning & control depending upon their own choices. They get feedback on every step and a new instruction how to continue.

- *Cognitive*

As far as marketing is concerned the availability of the marketing mix and the correct way to use it, is the most important activity. As far as accounting is concerned the way to compute net profit and market share are important as well as supporting computations like stock and accumulated profit.

- *Regulative*

Important skills are the use of spreadsheets to explore the relations between variables under different conditions and expectations. Further more the planning process is important as well as the ability to evaluate the results by comparing them to the estimations and distilling incentives for decision making in the next cycle.

- *Affective*

The most important attitude to develop is to take decisions and to cooperate with other people in order to get the optimal results. Then there is the presentation of the company in written reports and personal presentation in verbal reports.

Media Characteristics

- **Media**

The media used are Internet (both browser and MSN), game, spreadsheet and PowerPoint.

- **Suitable functionalities**

For each medium it is possible to describe the most important functionalities why it is chosen. Of course the game is the central medium, which evokes the use of other media. In principle the game Economy Class can be performed simultaneously in a computer room, but it is as well possible that the teams play at separate locations and at separate times. It is even possible that members of a team play from different computers at the same time as the game has a multiple entrance facility per team.

As spreadsheets are important in companies, the game is created to support the use of spreadsheets in their natural environment. As the cycle of planning & control is performed several times, the usefulness of a spreadsheet to optimise and to compute the final results is to be discovered by the students.

- *Activated functionalities*
  - On line connection with the game
  - Immanent instruction and planning of the learning process
  - Immediate reaction on all the student actions performed
  - Screens with information to call upon when needed
  - Ability to present dilemma's as part of the decision taking process
  - Ability to split up computations as part of the feedback process

- *Potential functionalities*

  Students expect a lot of action in a game, but that is (as well for financial reasons) impossible to build into a learning game. So many visual and action effects are lacking. A separate style must be developed where a balance is found with the experience of students elsewhere.

- *Disfunctionalities*
  - A learning game represents reality, but in order to be able to control the situation simplifications must be made. Options that are available in reality are excluded as part of these simplifications.
  - A deadline procedure must be used, but this requires waiting until the final results are there.

Design of Learning Process

- Teams are presented with the cycle of planning & control and they will have to take decisions and make the computations as required by the program.

- Goal and strategy can be evoked and later on be used in evaluations of the results of a team. A wide range of goals (even wrong goals) can be accepted by the program and used as basic material for feedback.

- The possibility of evaluating every step and adding information about the computation makes it possible to start with the ultimate question in estimating the results: How big will your profit be? Or how big will your market share be?

- In every computation mistakes can be made, but as the program knows all the decisions and expectations it can react not only on correct answers but as well at predictable mistakes.

- Every cycle an evaluation is made and after a chosen number of cycles the evaluation is presented to other teams and to the instructor.

Evaluation

The Economy Class game engages students in a full Planning & Control business cycle. Students learn to work together in defining a goal and a strategy and make decisions using spreadsheets to make calculations. The desired learning outcomes of operationalising goal and strategy into targets and decisions (right or wrong) are fully realised, as are the competences of estimating the results under chosen conditions and computing the final results and comparing them to the estimations. Particularly entrepreneurial competences are exercised as participating in teamwork, presenting the results both verbal and written. Reflecting on the results enables students to learn from the experiences of the game.

Case 2: Innovation Game

Pedagogical characteristics

- **Assessment for competencies**

The assessment of competencies is to be conducted by an expert team of innovation consultants. They defined the competencies of the innovation consultants need to stimulate growth, innovation, and innovation capabilities on the part of the small and medium size enterprises in the Netherlands. The competences required are as follows: 1) Knowledge about innovation processes 2) Stimulating the entrepreneur to innovate 3) Teaching innovation 4) Supporting innovation.

- **Desired learning outcomes**

The Innovation Game is a game to be played at the start of a 7 day innovation consultancy course and is intended to allow participants to play and experience various roles, such as the

entrepreneur and staff members as marketing and finance, design and production, ICT and the role of innovation consultant. The desired learning outcome is the *experience of fun and excitement in working as a team to realize an innovative product prototype in just a few hours. Understand each role and the importance of communication. Understand the role of innovation consultant to be negotiated with the entrepreneur and focus on the process of innovation and not on hands on work.*

- **Learning activities**

The Innovation Game starts with a creativity exercise in teams of 5, just to warm up and set the stage. Then the consultants are asked to pretend that they are responsible for a company named Legoistics, successful in designing and marketing gadgets. The teams are up to 8 members and the roles are assumed. The instruction is through Power Point by the instructor.

The start is around 12.00 o'clock and the team is put under pressure because they have to present their innovative gadget at a simulated trade show around 16.30 hours.
Then the team is on their own with traditional media as flip charts, a classroom and new media as Internet and Lego Mind Storms. The product prototype has to be built in Lego Mind Storms with intelligence on board (software to be programmed to perform certain defined tasks).

- *Cognitive*

The team generates ideas about market trends and consumer needs. Analysis of the competition is carried out through the Internet. Identification of potential market segments for a new gadget and the specific market needs. From a wide range of new product ideas, one idea is selected.

- *Regulative*

Team members take on the above roles and have to regulate and coordinate the innovation process by themselves.

- *Affective*

During the innovation process most teams perform a brain storm session and have a lot of fun in sharing idea's and concepts and enjoy their respective tasks. In some teams the consultant does not negotiate his or her role in the innovation process with the entrepreneur. In the 23 times the Innovation Game has been played, 3 consultants where 'fired' before they could even start.

Media Characteristics

- **Media**

The game offers a rich combination of old and new media as: the classroom setting, a flip chart, access to Internet, Laptops and the use of Lego Mind Storm (intelligent Lego bricks with programmable software).

- **Suitable functionalities**

- *Activated functionalities*

Participants can write ideas on a flip chart and through face-to-face contact generate a number of trends in consumer needs and develop original concepts. Searching for information on the Internet accelerates the learning process, and pictures and photographs are collected to visualise the ideas and concepts in a PowerPoint presentation. With the use of Lego bricks and intelligent software a prototype of a gadget can be built and demonstrated.

- *Potential functionalities*

Each of the mentioned media has a range of functionalities. Instructors and participants can choose which functionalities to use and which not.

- *Disfunctionalities*

Lego Mindstorm has limited functionalities. So the prototype created will have limited functionalities as well. Role-playing is not always perceived as real, consultants play the role of the entrepreneurs or employee when in fact they are not. As consultants know each other well, they naturally accept a leading role for the innovation consultant in leading the innovation process. The instructor is present and intervenes sometimes when for instance the ICT person is ignored, which was the case in more than half of the 23 games played, thereby preventing the participants to fail in creating a working prototype.

Design of the Learning Process

The facilitator, through a PowerPoint presentation, instructs the participants. The first instruction is to brainstorm in groups of 7 about trends in the market for intelligent gadgets and identify the major trends. The second instruction is to form a company and divide roles in the group (1 person as entrepreneur, 2 persons on marketing and finance, 2 persons on product design and 1 on software development and 1 innovation consultant). The task of the group is to design and create, in a period of less than 4 hours, a working prototype of the intelligent gadget (using LEGO Mindstorm as a tool) and prepare a simulated trade show presentation.

The presentation should include the business proposal to tradeshow participants, the marketing plan and a demonstration of the intelligent gadget. At the trade show presentation, members of other groups play the roles of venture capitalist, journalist or representative from retail and comment on the presentation and the new gadget. The comments are reflected upon to improve the product design. Formal reflection on the roles and teamwork uncovers lessons learned in the innovation process from trends, needs, product idea, product concept, marketing plan and trade show demonstration and presentation.

Evaluation

The desired learning outcome is the experience of fun and excitement in working as a team to realize an innovative product prototype in just a few hours. Understand each role and the importance of communication. Understand the role of innovation consultant to be negotiated with the entrepreneur and focus on the process of innovation and not on hands on work.

Participants certainly enjoy ‘playing roles’ a great deal and get fully engaged in the innovation process, often losing track of time. Teams that perform well develop both a clear vision on market needs as a group and a clear set of product requirements. Individuals find it easier to contribute from their specialist role when a common goal is clear. The reverse appears also true. Lack of common understanding hinders the contribution of specialists.

The role of the innovation consultant is performed better when the entrepreneur and the innovation consultant communicate before, during and after on what contributions are needed from the consultant. Innovation consultants perform worse when such communication is absent or implicit.

The innovation game demonstrates the fun and complexity of product innovation in a very short period of time. Under time pressure participants learn to work together on developing a vision and a common goal, identify opportunities for product innovation from trends, actually build a prototype and make a presentation and create a value proposition to potential buyers. They learn that innovation is fun and applying a diversity of talents in the creation process. An added advantage is that participants learn to know each other even better, thereby setting the stage for accelerated learning in the rest of the seven-day course.

5. Findings

The two cases studied indicate that games as a simulation of business reality offer functionalities for learning activities for students to gain experience in a number of business tasks in addition to acquiring subject knowledge. As such the pedagogy of games activates not only cognitive learning, but also regulative learning such as working in teams, creativity, decision making and communicating.

Perhaps the main advantage of games as a way of learning is that students are affected and inspired. The activities are considered fun. They influence the motivation and self-esteem of the students and enhance the cognitive and regulative learning activities.

We have also noted shortcomings of the games studied. Popular games in the consumer market offer great graphic design as well as audio effects and students have grown accustomed to high speed and special effects. The current state of gaming technology in entertainment and the use of computers and Internet raise the expectations of students for the functionalities of ‘serious games’ as well. The games studied lack the characteristics of entertainment games.

Also some students find role-playing difficult (i.e. not real). Furthermore working in groups in a game can have similar drawbacks as teamwork in other settings, where individual students are not always invited to contribute to the project at hand or do not take the initiative by themselves. The business game does not by itself overcome these problems.

After studying two cases, it is far to early for conclusions to be drawn. The evidence is limited. The question posed at the start of the article is: Can gaming, as a form of simulating business reality, accelerate learning? This question can only be answered after more extensive research. Indications however are, that the games studied allow for a richer learning environment as compared to for in stance traditional lectures where the student is generally a passive listener. In games students can identify with the role of the entrepreneur and in doing that they come to another perspective in tackling business problems.

The main advantage of games is that students like them and have fun while they learn. This characteristic is used to support learning and experiencing the entrepreneurial approach. Games offer a way to get actively engaged in simulated business activities and as such the subject knowledge is enriched with contextual knowledge (often lacking in traditional education) and more importantly with experiential knowledge and regulatory experience.

The conclusion of this exploration is that the serious games studied invoke learning by doing and by interaction. Students are in control of their own actions, they receive immediate feedback and acquire cognitive, regulative and affective business skills faster and better than in traditional class room teaching where the student is often a passive listener and is not provided with opportunities to practice skills.

6. Implications for innovative education and learning

Entrepreneurship, creativity, cooperation and value creation are required business competences in today's dynamic business environment. It is hard to acquire these competences from textbooks or from traditional lectures. The pedagogical design of education in business schools can benefit from new media such as games where indeed these competences can be practiced in simulated business settings. More learning outcomes can be part of the curriculum as more media with distinguished functionalities are available.

It is too early to prove to teachers that games do have significant advantages over traditional learning methods, because of the lack of empirical research on the topic. The two cases we have studied, contribute to empirical evidence that indeed games accelerate learning as students are actively engaged and acquire more skills in a shorter period whilst enjoying the learning experience.

The main implication for innovative education and learning is that many more educational games and their impact will need to be studied to prove the proposition that games accelerate learning. We can however generate a number of recommendations for further research from our study.

(1) The innovation matrix invokes the incorporation of learning outcomes as part of the construction of a learning environment. Learning outcomes cannot be taken for granted any longer as they are related to functionalities and disfunctionalities of a medium.

(2) The Media Functionality Framework may offer a suitable frame for studying and comparing cases. It gives a list of items to incorporate in the study in order to get a complete research program.

(3) Teachers are invited to experiment with games as a tool for learning and educating and share their experience. They as well must be ready to think about the required learning outcomes of their teaching.

(4) Also students can be invited in the design of educational games as they have considerable gaming experience and ICT-skills that often exceed the experience of the teaching staff. They especially are the experts to point at potential functionalities that remain unused because teachers may stick to the traditional perspective on learning.

(5) By engaging students, teachers, researchers and business professionals in the design and implementation of business games, all participants can benefit from the suggested accelerated learning as the gap between business and business schools is being bridged when business cases are simulated to reflect business reality (relevance) as well as academic practice (rigor).

(6) The audio visual functionalities of serious games can be improved to match the expectations of students from entertainment games, if business schools can be convinced that gaming delivers other learning outcomes in a faster way. Then they can decide to invest more time, money and expertise in designing serious games.

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