

Authentic learning in fostering informatics students' competence in identifying business opportunities

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1. Abstract

Identification of business opportunities is a core competence for entrepreneurs and therefore this competence must be emphasized in entrepreneurship education. Because context is a crucial factor in the process of opportunity identification by entrepreneurs, context can be used in designing education in this competence. This study evaluates the effect of an authentic learning context in teaching and learning to identify opportunities.

A course design complying with design strategies for opportunity identification and with authentic learning was designed and implemented in an entrepreneurship course for masters students in computer science. Next, the feasibility of the course design was determined by evaluating the implementation of all strategies, and most strategies proved fully implemented. The effectiveness of the course design was determined by analysing learning outcomes. Students' business ideas, which were assessed by entrepreneurs, scored highly with regard to innovation and market potential. This finding was confirmed by the assessors' feedback.

Analysis shows that enhancing students' competence in identifying business opportunities was effective in an authentic learning environment. The results argue for integrating elements of authentic learning in entrepreneurship education that aims at fostering students' competence in identifying business opportunities.

2. Introduction

Business start-ups are of utmost importance for national economies, and growing emphasis on entrepreneurship exists in education. Efforts to stimulate entrepreneurship are made at all levels of education (European Commission, 2006), and higher education institutions play a fundamental role in entrepreneurship, because they represent a main source of new knowledge that can be valorized by setting up new firms. This is particularly the case for the informatics domain which is characterized by a high degree of innovation. Because opportunity identification (OI) lies at the beginning of firm start-ups, it may be considered as a core competence for entrepreneurs (Man, 2006; Nixdorff & Solomon, 2007; Onstenk, 2003), and should be explicitly emphasized in entrepreneurship education.

The concept of opportunity recognition or opportunity identification is studied (Companys & McMullan, 2007) in three research traditions: the economic, the cultural-cognitive and the social-political school. Context is an important element in the process of opportunity identification (Alvarez, 2005), and this might have consequences for the design of education on this subject. Gibb (2002) argued for the importance of the context in learning of entrepreneurs, and Lans (2009) showed the importance of social context for learning opportunity recognition by entrepreneurs in practice.

Where opportunity identification is widely studied, few studies however report on teaching the competence of opportunity identification in individuals who are at the beginning of their professional career. It implies that a need exists for strategies for the design of education that aims at fostering competence in opportunity

identification. Such strategies, together making up a design principle, will help teachers to develop entrepreneurship programmes in higher education.

Some rules of thumb for designing education in OI can be drawn from publications by DeTienne and Chandler (2004), Kickul (2006) and Saks and Gaglio (2002). Nab, Bulte and Pilot (accepted 2011) reported a design principle for teaching opportunity identification that includes strategies on idea generating techniques, on conceptualization and criteria for opportunity identification, on transfer of concepts to new contexts, and also gave recommendations on provoking the need-to-know, and on challenging students to abandon their routine thinking patterns. The evaluation of their design principle suggests that bringing in authentic elements of professional entrepreneurship might improve the effectiveness of teaching opportunity identification, and this study will investigate this hypothesis.

Design strategies for developing authentic learning in different domains were deduced from an extensive literature study by Herrington and Oliver (2000), and these strategies are of value for entrepreneurship education. Nab, Pilot, Brinkkemper and Ten Berge (2010) analysed an effective course in entrepreneurship and described a design principle for authentic learning in entrepreneurship education in informatics, and their design principle showed similarities with Herrington and Oliver's framework. Authentic learning is of importance for motivation of students and for promoting the transfer of skills and competence to professional situations at a later time (Simons, 1999). However it is not known how authentic learning in entrepreneurship education influences the acquisition of students' competence in identifying business opportunities. *Therefore this study will evaluate the contribution of authentic learning strategies on teaching and learning opportunity identification, and may thereby contribute to a further understanding of the pedagogy of entrepreneurship education.*

This paper starts by defining the concept of opportunity identification, and what is known about teaching this subject. The importance of the context in opportunity identification will be elaborated upon, as well as its implications for teaching and learning. Subsequently the concept of authentic learning as a condition for teaching and learning opportunity identification will be elaborated upon. The theory section results in two design principles, both consisting of several strategies for educational design: one on fostering opportunity identification and a second on authentic learning. The first result in this study is the course design that was designed out of the strategies, as described in the course design. This design was used for the evaluation of its feasibility and effectiveness in practice. Finally the results and the value of authentic learning design strategies in teaching and learning of opportunity identification will be discussed in the last section.

3. Theory

3.1 Opportunity identification

Recognition of business opportunities where others do not see them is a central and unique component of entrepreneurship (Shane & Venkataraman, 2000), and it is seen as one of the first stages of the entrepreneurial process (Christensen, Madsen & Peterson, 1994). Therefore opportunity recognition is considered as a core competence for entrepreneurs (Man, 2006; Nixdorff & Solomon, 2007; Onstenk, 2003). Kirzner (1979) defined an opportunity as the special knowledge an entrepreneur needs to possess regarding goods or services sold in new markets or combined and to be sold at a profit. In Kirzner's view, an idea becomes an opportunity when its commercial value is recognized. Hulbert, Brown and Adams (1997) state that business opportunities are the chance to meet an unsatisfied need that is potentially profitable. More recently Shane and Venkataraman (2000, p.220)

defined an opportunity as “those situations in which new goods, services, raw materials and organizing methods can be introduced and sold at greater profit than their cost of production”. In the present study which has a focus on education, we use the following definition of opportunity identification: it is the creation and / or discovery of something novel that is of value to the customer or society, and can have a profit for the entrepreneur. Opportunities can be recognized in the form of new products or services, new ways of production, new markets, new resources, or new ways of distribution. Ansoff (1968) distinguished four types of opportunities: product innovations, new markets, firms that are available for acquisition and joint venture opportunities. Entrepreneurship education is mainly focused on the first two categories of opportunities, because these give the possibility of experiencing all aspects of entrepreneurship on a limited scale, while the latter two are much more complex and of a strategic nature, and therefore are less suited to educational purposes. For science education the creation of opportunities through innovation can be a promising approach because of the potential that science has for valorization. Five stages have been stated in the opportunity identification process: entrepreneurial intention, incubation, insight or opportunity identification, opportunity evaluation and opportunity exploitation (Shook, Priem & McGee (2003). In this study we focus on the stage of opportunity identification and opportunity evaluation, because they can be experienced and studied in educational settings. Three main theories exist regarding opportunity recognition: the discovery theory, the creation theory (Alvarez, 2005) and effectuation (Sarasvathy, 2001). According to the discovery theory opportunities exist in the environment, independent of the individuals who discover them (Alvarez, 2005; Kirzner, 1979). A knowledge advantage enables some to discover opportunities where others do not (Shane, 2000). The entrepreneur with knowledge of market disequilibria has an advantage over others who do not, and having knowledge gives competitive advantage. In this view opportunity recognition seems to be largely a cognitive process of scanning the market for disequilibria and resources, and finding ways to exploit these. The discovery theory on opportunity recognition, from the learning perspective, leans strongly on knowledge acquisition of markets, resources, and of market disequilibria. The market context is a source of information which is the nucleus of the entrepreneur’s learning process.

In the creation view (Alvarez, 2005) the entrepreneur is the creator of opportunities. Opportunities are based on entrepreneurs’ subjective perceptions and are created by the entrepreneur or co-created through social interactions and learning processes. In the creation view, new opportunities that did not exist before are created by the entrepreneur, also through collaboration on common concerns and tasks. The creation theory of opportunity recognition has as a premise the creation of something that did not exist before. The creation view is related to (social) constructivism, which states that new knowledge is created through collaborative construction and participating in a community (Vygotsky, 1978).

The process of effectuation (Sarasvathy, 2001) is characterized by imaginative rethinking of possibilities and continual transformation of targets. Effectuation works on the premise that the future cannot be predicted and is (partially) created by wilful participating agents. Entrepreneurs in this view collaborate in partnerships to create new markets. Goals emerge by imagining courses of action based on given means. Entrepreneurs pursue opportunities thereby calculating affordable loss. Opportunities are created by a dynamic and continuous reconstruction guided by actual resources and interests, and therefore lean closely on the creation theory.

In the discovery view, context is essential for knowledge acquisition, while in the creation view as well as in the effectuation theory, social context is essential in the process of knowledge construction. In practice, processes of knowledge acquisition

and knowledge construction will occur alternately or simultaneously. In all three theories on opportunity recognition context plays a central role, and this must be a strong argument to involve the relevant elements for learning of the entrepreneurial context in education which aims at fostering competence in opportunity identification.

Opportunity recognition literature uses different terminology, and logically this terminology evokes strong associations with the theory from which it is derived. Therefore in the present study we prefer to use a more neutral terminology of “opportunity identification” which expresses that discovery as well as the creation and effectuation which can underlie this process.

3.2 Teaching and learning of opportunity identification.

While much research has been reported on the concept of opportunity identification in entrepreneurship, few empirical studies have been published on the application of this knowledge in the education of future entrepreneurs. Several scholars advocate the use of creativity in the fostering of opportunity recognition (Hills, Shrader & Lumpkin, 1999; Corbett, 2005). Saks and Gaglio (2002) examined how entrepreneurship educator-practitioners conceptualize and teach the opportunity identification process. Educators think that selection of business opportunities can be taught but as regards the creation of business concepts, opinions vary widely. DeTienne and Chandler (2004) empirically ascertained a series of interventions on stimulating opportunity recognition by creativity, and they were successful in improving both the number of students’ ideas generated and the innovativeness of those ideas. Corbett (2005) coupled opportunity recognition with the stages in experiential learning and learning styles associated with different stages. He gives recommendations for actions needed by students in each stage of opportunity recognition. Muzychenko (2008) focused on international opportunity identification and advocated a competence-based approach to teaching. This approach should not only focus on opportunity identification itself, but also on the self-perceived task competence (self-efficacy) of the entrepreneur, since self-efficacy and opportunity recognition are strongly correlated (Krueger, 2000). Kickul (2006) described strategies that foster self-efficacy and entrepreneurial intentions of students. In another study Kickul, Gundry, Barbosa and Whitcanack (2009) showed that an intuitive cognitive style is related to opportunity recognition, whereas persons with an analytical style are better at evaluating opportunities. From the studies above it appears that in education the focus lies either on increasing market knowledge and going into the real world (scanning the environment), while others focus on stimulating the use of creativity and divergent thinking, and developing not yet existing products, services or markets.

Nab et al. (accepted 2011) deduced a design principle for teaching opportunity identification, based on literature, teachers’ experience and empirical testing. This design principle includes three strategies for teaching opportunity identification. The first strategy aims at stimulating knowledge and skills regarding idea generating techniques. Cognitive processes in opportunity identification show a great resemblance to creativity cognition (Corbett, 2005; Plesk, 1997), meaning that knowledge of techniques and heuristics for generating novel ideas can help improve opportunity identification. Scott, Leritz and Mumford (2004) reported that encouraging and developing divergent thinking was a consistent element in most efforts to increase creativity, and divergent thinking is underpinned by the use of idea generating techniques. Therefore students should acquire skills in idea generation techniques and have knowledge of heuristics behind these techniques, which can be achieved by practising, and reflection.

The second strategy underlines that students should be stimulated to conceptualize their experiences in opportunity identification, thereby developing and extending their mental schemas, and connecting these schemas with knowledge of science and of markets in order to combine these with new business opportunities. In addition, evaluating opportunities and developing criteria will contribute to an understanding of the concepts behind opportunity identification, which can be applied later on.

A third strategy aims at letting students actively apply concepts and heuristics in new realistic experiences and assessments, in order to promote transfer. Simons (1999) argued that for the stimulation of transfer, concepts and heuristics should be applied in professional tasks and in a professional context. Meta-cognitive knowledge, such as heuristics and problem-solving skills, determines whether knowledge and skills will be transferred.

In the prior evaluation study (Nab et al., accepted 2011), it was suggested to complement these findings with two strategies. It appeared that students' needs to apply heuristics and knowledge regarding opportunity identification should be provoked more profoundly *by means of assignments, tasks and assessment*. Students should experience a need to obtain specific concepts and heuristics to solve relevant problems. This can be achieved by defining clear criteria to be met, by metacognitive activities and by assessment criteria (Simons, 1999). This leads to the fourth strategy for fostering opportunity identification in this study.

A fifth strategy was recommended in order to challenge students out of routine thinking patterns, in order to come to new solutions. In the evaluation students did not feel challenged very strongly, however. Students can be challenged by complex and interdisciplinary and open-ended problems, by giving them realistic and relevant tasks, giving them autonomy, and through the perspective that their business ideas will be exploited in reality.

Laying aside, temporarily, a problem on which one is not making progress, is a simple technique to enhance creative productivity. This phenomenon has led to the idea that creative work typically involves a period of incubation (Wallas, 1926/1945, in Nickerson, 1999, p. 417) during which one is not consciously thinking on the task. Ceasing to think about the problem can take away fixations, and consequently gives access to knowledge that can lead to a solution (Finke, Ward & Smith, 1992). This has led to a sixth strategy that aims at prolonging the time span for identification and incubation of the business idea. This strategy implies that students will be admitted to the course only when they bring in a promising business idea. It is suggested that they will start earlier in searching for ideas, and have a substantial period for incubation and refinement, which consequently will contribute to the quality of business ideas at the beginning of the course. The process of iterative refinement of the idea and incubation periods can be enhanced by intermediate feedback by the teacher on students' business ideas.

In summary, six strategies for fostering competence in opportunity identification have been given:

1. Stimulate the use of idea generation techniques and knowledge of heuristics on these techniques
2. Let students conceptualize business opportunities and let them develop criteria for identifying business opportunities
3. Lets students apply concepts and heuristics in entrepreneurial experiences and assessments.
4. Create a need to know and apply knowledge, concepts and heuristics

5. Challenge students to abandon routine thinking patterns and find new solutions
6. Provide students with a period of incubation for identification and development of their business idea

It should be noted from the strategies above that knowledge acquisition and knowledge construction play a crucial role in opportunity identification. Knowledge is either specific domain knowledge, or knowledge of markets and industries, and much of this knowledge has to be acquired from the entrepreneur's social context. Therefore the entrepreneur's context should have a substantial role in developing competence in opportunity identification. This is confirmed in definitions of competences where knowledge, skills and attitude are related to the context of performance. The importance of context in learning was first addressed in the theory of situated learning, which was defined by Brown, Collins and Duguid (1989) as: "The notion of learning knowledge and skills in contexts that reflect the way the knowledge will be used in real life". This theory was further elaborated on in the theory of authentic learning.

3.3 Learning in authentic contexts

Professional contexts, in which entrepreneurs operate, are characterized by complexity, time-pressure, deadlines, uncertainty, performing various roles, and working on multidisciplinary, open-ended, unstructured, hidden and undefined problems, and ambiguous conditions. The development of the small business owner is characterized by learning from peers, learning by doing, learning from feedback, learning by copying, learning by experiment, learning by problem solving and opportunity taking and learning from mistakes (Gibb, 1997). In these circumstances entrepreneurs learn from collaborating with a diversity of persons in their professional and personal environment: clients, suppliers, competitors, family and friends, bankers and many others. Entrepreneurs learn in multiple, overlapping communities of knowledge and practice, in which they participate. Cope (2005) describes critical incidents in the professional life of the entrepreneur which evoke high-order learning. Non-routine situations force the entrepreneur to question their taken-for-granted beliefs and assumptions and to reframe their mental frameworks, changing the management of their enterprise, as well as personal beliefs and feelings. Deep reflection is essential for learning from critical incidents. The impact of the context in the development of personal competences of entrepreneurs was demonstrated by Lans, Biemans, Verstegen and Mulder (2008) who showed that support and guidance, external interactions, internal communications and task characteristics were seen as essential in the competence development of entrepreneurs.

Many of these aspects from the complex and uncertain context of entrepreneurship are not available in default educational circumstances in entrepreneurship education at universities. The emphasis in this education has traditionally been on theory, on extracting essential principles, concepts, and facts, and teaching them in a rather decontextualized form (Resnick, 1987). Educating university students in entrepreneurship might be enhanced by introducing a context and activities that provoke the type of learning as in the practical life of entrepreneurs. Snowman and Biehler (2003, p.306) state that learning will be more meaningful if students are placed in authentic and/or realistic learning environments. It is the challenge for entrepreneurship education to create a learning environment that has the characteristics of the entrepreneurial context in such a way that cognitive activities and learning of students are directed in a similar way as in entrepreneurship.

Herrington and Oliver (2000) identified critical characteristics of a situated learning model from an extensive body of literature, and their theory of authentic learning

suggests that the intended learning outcomes are best gained in a learning environment that features the following nine dimensions or contextual strategies:

1. Provide a physical and social *context* that reflects the way knowledge will be used in real life.
2. Provide *authentic activities*, which are ill-defined, complex and open-ended, and have real-world relevance. Students should be working on a single task for a sustained period of time. The task should provide the opportunity to organize their work, and provoke the detection of relevant versus irrelevant information.
3. Provide access to expert performances and the modelling of processes.
4. Provide multiple roles and perspectives, which provide students with different perspectives on topics, and offer the opportunity to express their points of view through collaboration.
5. Support collaborative construction of knowledge. Tasks should be addressed to a group rather than an individual, and an appropriate incentive structure for whole-group achievement must be handled.
6. Promote reflection to enable abstractions to be formed.
7. Promote articulation to enable tacit knowledge to be made explicit.
8. Provide coaching and support via the teacher at critical episodes.
9. Provide authentic assessment. Students must be able to demonstrate their acquired knowledge, skills and attitudes in products and performances. Assessment should be integrated with the activity that students work on, and criteria for assessment must be reliable and valid for profession. Assessments must consist of complex, ill-defined challenges that require judgments and a full array of tasks.

The basic rationale behind learning in authentic contexts is its similarity to the professional situation in all essential dimensions; it is a practical situation that is adapted to the learning of the junior professional. Authentic learning does not simply imply that real life must be brought into the classroom, but a learning context/practice must be designed that evokes key cognitive activities as in entrepreneurship. Herrington, Reeves and Oliver (2007) found that in simulations in the classroom the “physical fidelity” of the simulation is less important than the simulation of realistic problem solving process which the author describes as the “cognitive realism” of the task. Stanton (1996) makes a difference between physical fidelity and functional fidelity in simulations, where functional fidelity is vital for the transfer of skills to the operational environment, whereas perfect physical fidelity is not required for those aspects that are not important for task execution.

Authentic learning does not occur through implementing one isolated component of education, but the interactions of components proved to be relevant for designing an authentic learning environment (Barab, Squire, & Dueber, 2000). It implies that authentic learning cannot be achieved by one single intervention, but a coherent complexity of combined design elements has to be implemented to achieve authentic learning.

Nab et al. (2010) reported design strategies specifically focusing on authenticity in entrepreneurship education for computer science students. Seven strategies were drawn from an entrepreneurship course that proved successful in learning outcomes, the number of start-ups after the course as well in students’ evaluations. Their findings are congruent with dimensions reported by Herrington and Oliver (2000). The strategies by Nab et al. (2010) refer to the context of learning as in a starting company, students’ roles as problem solvers, multiple roles of students, types of tasks and activities, the teacher’s role, facilities and infrastructure, and authentic assessment.

It can be conjectured that strategies which strengthen authenticity of the context will foster students' competence. Therefore the research question for this study is:

- To what extent does authentic learning in entrepreneurship education contribute to the fostering of science students' competence in identifying business opportunities?

Therefore three sub-questions have to be answered:

1. Can a coherent course design be formulated based on the strategies for opportunity identification and for authentic learning?
2. How feasible is the course design that complies with strategies that promote opportunity identification and with strategies on authentic learning?
3. How effective is learning in a course design that complies with strategies that promote opportunity identification and strategies on authentic learning?

4. Methods

In design, research strategies are deduced from literature, prior experiments, and from experience of teachers and designers. Design strategies are the intermediate formulation between a visionary curriculum and implementation in practice, and can assist teachers and designers in the development of entrepreneurship education. Strategies as deduced in the theory section were used for synthesizing a course design as described in section 5.1 which deals with research question 1. The course design is implemented, and then used as the vehicle to evaluate the feasibility of the course design (research question 2) and its effectiveness (research question 3). The feasibility of the course design is determined by evaluating the degree of implementation of the course and by investigating students' perceptions. The effectiveness of the course design was determined by analysing students' products with regard to opportunity identification.

4.1 Participants

The ICT Entrepreneurship course is an elective part of the masters programme in Business Informatics at Utrecht University in the Netherlands. When 31 students were asked at the start of the course, 71% of the students stated that they had plans to start a business, and 32% of them to do so within 5 years. 58% of the students reported some entrepreneurial experience with family or friends, and 29% owned a company at the time of the course. Students worked in ten self-selected groups of 3 to 5 students during the course, and the proportion of females was 6.5%. The perceived competence of students in opportunity identification was measured by a questionnaire, using a 5-point Likert scale (see Section 4.3.4). A pre- and post-test questionnaire was filled in by 96% and 77% of participants respectively. No significant differences were detected on any scales between pre- and post-test, and therefore the means of both tests are used here to characterize the student participants. Means were high for Divergent Thinking (3.65), Intrinsic Motivation (3.62), Working Style (3.64), Problem Solving Style (3.88) and Self-efficacy (3.68). The scale mean for Distraction by Extrinsic factors was average.

4.2 Determining the feasibility of the course design

4.2.1 Determining the intended course design

In order to determine the intended course design, course descriptions as well as study guides were collected from the Internet or as hard copy. Likewise preliminary reports and publications were used as a source. These documents were analysed using the framework of Herrington and Oliver (2000), as described in the theoretical section. Also teachers were interviewed before the start of the course. The interview was audiotaped and transcribed verbatim.

4.2.2 Determining the degree of implementation

In order to determine the degree of implementation of the strategies, all meetings, lessons, and classroom activities related to opportunity identification were observed and videotaped. Relevant video fragments were transcribed verbatim and coded. In analysis the strategies for authentic learning and for fostering opportunity identification were used as an analytical framework.

4.2.3 Determining students' perception of the course

In order to determine students' perception of the learning environment with regard to stimulating opportunity identification and authenticity, data were collected by means of a questionnaire and by individual interviews with students.

The questionnaire consisted of six sub-scales: encouragement by education, encouragement by teacher, autonomy, pressures, peer support, and climate. This questionnaire consisted of 33 items and was completed by students during the final meeting of both courses. The items in the questionnaire used a 5-point Likert scale from "strongly disagree" to "strongly agree". For determination of homogeneity of scales 44 of the questionnaires were collected from two entrepreneurship courses. Six scales had a Cronbach's Alpha above 0.70: the scales on Autonomy, Climate, Encouragement by Education, Peer Support, Pressure, and Encouragement by Teacher. In earlier studies these scales proved to be reliable (Nab, Oost, Pilot, & Keulen, 2008). Means of scales were calculated using SPSS.

For determining students' perception of the course, five volunteer students were interviewed individually. The interviews were semi-structured, with a list of items deduced from the two design principles. Interviews were audiotaped and transcribed verbatim and then coded. Results from the questionnaire and the interviews were mirrored to see whether results confirmed each other.

4.2.4 Determining students' perception of their competence

Students' perception of their competence in identifying business opportunities was measured by means of a questionnaire, which was filled in by 25 students in the last session of the course. The questionnaire had four scales, each scale correlating with creativity or opportunity identification (Nab et al., 2008): use of idea generating techniques, intrinsic motivation, divergent thinking and self-efficacy. Homogeneity of scales was determined with SPSS, using the results of 95 students from various entrepreneurship courses for science students. Scales had a Cronbach's Alpha above 0.70: Use of Idea Generating Techniques, Divergent thinking, Self-efficacy and Intrinsic Motivation. In earlier studies these scales proved to be reliable (Nab et al., 2008). Items were added to the questionnaire to determine students' prior experiences of entrepreneurship.

4.2.5 Calculating the degree of implementation.

Observations as well as questionnaires and interviews were used in triangulation to determine the degree of implementation. For this research question, strategies form the units of investigation. The degree of implementation of each strategy was scored in a rubric: not realized, partially realized or fully realized. If a strategy was scored between 0 – 25%, it was considered as 'not realized'. A percentage implementation

between 25 -75% was scored as 'partially realized', and in between 75% - 100% was scored as 'fully realized'. There was a deliberate choice to make the category 'partially realized' quite large, because in this category lies the potential for further improvement of the course design.

4.3 Determining the effectiveness of the course design

The implemented course was used as a vehicle to achieve learning outcomes with respect to opportunity identification. The effectiveness of this process (research question 3) was investigated by analysing marks and success rates, students' learning outcomes with regard to opportunity identification, and statements of experienced entrepreneurs who assessed students' products.

Students' marks were available at the end of the course, and were used for calculating means and ranges. Business plans and their presentations in the end review were assessed by the supervisory board consisting of entrepreneurs, investors, venture capitalists and an IT journalist. The assessors used a form (Nab et al., accepted 2011 with two scales: innovativeness and market potential, both from -5 to +5. Business ideas, as depicted in the business plans received a score on both scales. Supervisors also used the form to give written feedback on specific issues. The forms were collected and analysed and means of scores by supervisors per business plan were calculated. The entrepreneurs evaluated the instrument during the mid-course review and the results in this paper are scored with the readjusted version of the instrument.

In addition, all presentations of all business plans for the board of supervisors were videotaped and analysed in order to collect feedback and statements of external professionals (supervisors) on business plans and education. After the final meeting five students were interviewed on the perception of the course. Interviews were videotaped and transcribed verbatim.

5. Results

5.1 Results with respect to feasibility: course design and setting

The course design is both instrument and outcome in this study. This section gives an extensive description of the course design, as an outcome of applying six strategies on fostering opportunity identification and nine strategies on authentic learning. The course description is restricted to specific details that should establish authenticity and on interventions that should foster opportunity identification.

For this study we selected an existing course, the ICT Entrepreneurship course, to elaborate on. During exploratory meetings with the teachers it was indicated that strategies for teaching opportunity identification were implemented in this course, as were characteristics of authentic learning (Nab et al., 2010). Specifications of this course are presented in Table 1.

Table 1: Specifications of courses in this study

Duration	10 weeks, 50% of time
Study load	7.5 ECTS ¹
Programmes and Institutes	Course ICT Entrepreneurship as part of masters programme in Business Informatics at Utrecht University
Main pedagogical	Pedagogy: mainly experiential learning. Student groups work on development of business plan and

¹ ECTS = European Credit Transfer System where 1 ECTS equals 28 hours of study load.

formats	prototype for start-up. Students have staff roles in horizontal teams in a virtual holding company. Just in time lectures.
Assessment	Formative assessment by the board of supervisors (investors and entrepreneurs) in the mid review and summative assessment of business plan presentations in the end review

The ICT Entrepreneurship course focuses on a team-based project. Professional tasks in combination with a professional context are key features of the project. Students start with their own idea for a software product and form teams to develop a small company around this product. Teams identify an IT product or IT service, and evaluate and refine this business idea as in a starting company. Several deliverables such as product definition, prototype and business plan have to be produced within strict time limits. Furthermore, students take part in one of the staff departments or so-called horizontal teams of a virtual holding company Netherware (www.netherware.nl). By the development of their own company students should get a thorough orientation on the activities that are relevant to develop and exploit a product software company. Activities in the horizontal teams on the other hand let students experience work in an IT firm. The course aims at stimulating entrepreneurship in students through this experience.

The course was developed and refined in iterative cycles during the last decade. During evaluation of the course in 2007 the board of supervisors claimed that the level of innovation in students' business ideas was limited and emphasis should be placed on innovation, creativity and techniques to generate new ideas. In 2010 the teachers introduced another strategy to improve the quality of business ideas. Handing in a business idea in the domain of informatics in advance of the course was made compulsory and was conditional for admittance to the course, thereby creating a longer period of incubation and refinement of ideas.

Teachers on this course have much experience of leading the course. They have the role of CEO of the holding company and take the role of a coach rather than that of an expert. Entrepreneurs and investors who were involved in education, as guest speakers or as members of the board of supervisors during the mid- and end of course review, all had a thorough background in IT Entrepreneurship.

The strategies on teaching and learning opportunity identification were elaborated into interventions and activities for students as presented in Table 2.

Table 2: Elaboration of strategies to foster competence in opportunity identification.

Strategies	Elaboration by interventions / activities
<i>A1. Stimulate knowledge and skills on idea generation techniques</i>	<ul style="list-style-type: none"> • Schedule a workshop on creativity, innovation and idea generating techniques in entrepreneurship. • Organize presentations and discussions on successful innovations and firms • Let students apply idea generation techniques in solving entrepreneurial problems.
<i>A2. Let students conceptualize their experience in opportunity identification and let students discover criteria</i>	<ul style="list-style-type: none"> • Organize activities that promote conceptualization of business opportunities in an "authentic" way, e.g., as in entrepreneurship. • Let students extract criteria for "successful" business ideas. • Organize formative and summative assessment by professionals who use entrepreneurial criteria.

<p><i>A3. Let students actively apply opportunity identification concepts and criteria in new entrepreneurial experiences and assessments</i></p>	<ul style="list-style-type: none"> • Let students apply concepts and criteria in the improvement and tuning of business ideas according to examples of peers, and to feedback of peers, teachers and assessors. • Let students perform realistic tasks in a starting company • Use innovation and creativity as criteria in assessment of the business idea.
<p><i>A4. Give students activities that provoke the need to know and the need to apply concepts on opportunity identification</i></p>	<ul style="list-style-type: none"> • Give students the responsibility for finding their own solutions in all activities and let them find out what is necessary to solve problems. • Let students draw criteria for opportunity identification, in order to meet these in the mid- and end of course review.
<p><i>A5. Challenge students to abandon routine thinking and find new solutions</i></p>	<ul style="list-style-type: none"> • Organize long-lasting, open-ended, complex and interdisciplinary activities for students • Give students autonomy, responsibility and initiative in start-ups and in horizontal teams • Create intergroup competition • Create a possibility to exploit the business idea in a real market
<p><i>A6. Provide students with a period of incubation for identification and development of their business idea</i></p>	<ul style="list-style-type: none"> • Demand a promising business opportunity in the IT domain as a criterion for admittance to the course. • Let the teacher give formative feedback on these ideas, so students can use this to improve or reject opportunities.

Strategies on authentic learning (Herrington & Oliver, 2000), as a new condition to be investigated in this study, were also assimilated in the course design. Strategies on authentic learning were elaborated into interventions and activities as presented in Table 3.

Table 3: Elaboration of strategies for authentic learning.

Strategies	Elaboration by interventions / activities
<p><i>B1. Provide authentic contexts that reflect the way the knowledge will be used in real life.</i></p>	<ul style="list-style-type: none"> • Deliverables have to be submitted within strict deadlines. • Create conditions for the development of an informal atmosphere as in a start-up • Organize a physical working space where students can work during company working hours. • Make students the owners of their business ideas • Let students select the teams themselves • Give students autonomy and responsibility for the project and learning.
<p><i>B2. Provide authentic tasks and activities</i></p>	<ul style="list-style-type: none"> • Let students work together on extensive, complex, and open-ended tasks and activities (objects) as in a starting company. • Let all tasks and activities contribute to one final main task (the business presentation). • Let students use real-life resources and tools. • Demand deliverables common to entrepreneurship (such as product definition, prototype, and business plan) • Create students' need to gather information, models and theory.

<i>B3. Provide access to expert performances and modelling of processes</i>	<ul style="list-style-type: none"> • Provide role modelling by entrepreneurs and teachers • Provide process modelling on OI by teacher, and examples given by teacher.
<i>B4. Provide multiple roles and perspectives</i>	<ul style="list-style-type: none"> • Put students in the role of business starter to stimulate them to perform roles such as general manager, IT worker, developer, and marketing manager. • Give students specific staff roles in the horizontal teams of the virtual holding company.
<i>B5. Support collaborative construction of knowledge</i>	<ul style="list-style-type: none"> • Create a common team commitment by addressing them as such • Give students a common responsibility for group processes, work planning, product quality and other tasks. • Stimulate discussions on all tasks and activities in and between teams • Assess groups as a team. Grades must mainly be based on group activities and products.
<i>B6. Promote reflection to enable abstractions to be formed</i>	<ul style="list-style-type: none"> • Let students develop concepts and criteria out of their experiences • Create a need to understand mechanisms and concepts for students by provoking activities.
<i>B7. Promote articulation to enable tacit knowledge to be made explicit</i>	<ul style="list-style-type: none"> • Let students create, share and clarify knowledge and ideas in horizontal teams • Let students articulate their intermediate results to peers and teacher(s) • Let students present and discuss conceptual business ideas and business plans within teams and between teams. • Let students present the final product (business plan) to an external board of supervisors during mid- and end of course review.
<i>B8. Provide coaching and scaffolding by the teacher at critical times</i>	<ul style="list-style-type: none"> • Let the teacher take the role of coach/mentor and of CEO of the holding company, rather than an expert. • Teacher supplies formative and summative feedback on process and on activities & deliverables. • Teacher gives feedback on students' ideas and asks critical questions. • Stimulate students to improve their business ideas
<i>B9. Provide authentic assessment by learning within the tasks</i>	<ul style="list-style-type: none"> • Summative co-assessment of the business plan presentation is performed by professionals (entrepreneurs and investors) and by the teachers. • Assess students in a formative way on products as used in entrepreneurship (deliverables). These products must directly contribute to the start-up, or to the virtual holding company. • Stimulate real exploitation of the business ideas • Objective as well as intuitive criteria to be used as in entrepreneurship practice.

The course design in this section shows that a coherent course design complying with strategies to foster opportunity identification and authentic learning can be created. Thereby the first research question can be answered in a positive way.

5.2 Results with respect to feasibility: implementation of the course in practice

In this section the feasibility of the learning environment that complies with the strategies that promote opportunity identification and strategies on authentic learning is described. Data were analysed to determine to what extent design strategies on teaching and learning opportunity identification were implemented. These findings are presented in 5.2.1, and summarized in Table 4. Subsequently the implementation of the strategies on authentic learning is reported in 5.2.2, and the results are summarized in Table 5.

5.2.1 Evaluation of strategies to foster competence in opportunity identification.

Strategy A1: Stimulate knowledge and skills on idea generation techniques
Supportive as well as non-supportive data were found for this strategy, and therefore it can be concluded that this strategy was partially implemented.

Table 4: Summary of the degrees of implementation of strategies for teaching and learning opportunity identification

Strategies	Degree of implementation
<i>A1. Stimulate knowledge and skills on idea generation techniques</i>	Partially
<i>A2. Let students conceptualize their experience in opportunity identification and let students discover criteria</i>	Fully
<i>A3. Let students actively apply opportunity identification concepts and criteria in new entrepreneurial experiences and assessments</i>	Fully
<i>A4. Give students activities that provoke the need to know and the need to apply concepts on opportunity identification</i>	Fully
<i>A5. Challenge students to abandon routine thinking and find new solutions</i>	Partially
<i>A6. Provide students with a period of incubation for identification and development of their business idea</i>	Fully

It was observed that a workshop on innovation and creativity was scheduled in week 2, dedicated to creativity and idea generating techniques in entrepreneurship and opportunity identification. Several successful examples of creativity in IT entrepreneurship were presented. Students applied creativity in solving an authentic problem, as an exercise. Later in the course students had to use creativity in solving specific problems related to the start-up process. Data from the questionnaire supported that the implementation of this strategy was as intended. At the end of the course students felt somewhat familiar with the techniques used to generate new ideas (3.38). Also students felt slightly stimulated in learning to generate new ideas (3.39), and the teacher was perceived as stimulating creativity (3.71). On the Divergent Thinking scale students scored positively (scale mean: 3.68). However other findings did not support that the implementation of the strategy was as intended.

It was observed that the creativity meeting was scheduled after the first business ideas and after the product definition phase, with the result that techniques were difficult to apply in the identification of a business idea. Also there was little time for practising of techniques and reflection on idea generating techniques, which was confirmed by the questionnaire with an average score of 3.05 for the use of idea generation techniques. Data from the questionnaires also showed that students did

not use idea generation techniques to find their business idea (2.24) and did not use these techniques in general (2.18).

Strategy A2: Let students conceptualize their experience in opportunity identification and let students discover criteria

Data support the conclusion that this strategy was fully implemented.

From observations it appeared that guest speakers and teachers presented successful innovations and firms that were discussed by students.

Essential concepts of business opportunities (such as customer value, market potential, innovativeness, profitability) were deduced implicitly and explicitly from students' experiences, by comparing their own business ideas with those of others and by studying successful firms and entrepreneurs (role modelling). Conceptualization was also promoted by spontaneous collaborative discussions with peers, teachers, and stakeholders. From interviews it appeared that students also discussed their ideas with outsiders, which contributed to further elaboration.

Data from questionnaires support that peers, teacher and entrepreneurs extracted concepts from their own experiences and from formative feedback criteria for good business ideas. Students felt stimulated by peers (3.88) and by the teacher (3.71). In interviews students valued the formative and summative assessment by entrepreneurs and investors that helped to elucidate entrepreneurial criteria (innovativeness and market potential). Students felt directed by feedback from assessors and teachers which resulted in a change of their plans. Students learned the essentials of a business opportunity from writing a business plan.

Strategy A3: Let students actively apply opportunity identification concepts and criteria in new realistic experiences and assessments

For this strategy it can be concluded that this was fully implemented.

Observation data showed that the main task for students was the start-up of a company, and most activities were related to this main task. In this process students had to apply concepts and criteria for opportunity identification. Feedback of peers, teachers and assessors generated new concepts and criteria that had to be applied in the refinement of business ideas. Because innovation and creativity of the business idea was an important criterion in assessment, students were stimulated to rethink their ideas on this criterion.

In interviews students particularly appreciated the mid- and end of course review, and these helped them to some degree to get an impression of their competence in recognizing business opportunities (3.30). Also the course helped them to gain insight into their skills at discovering business opportunities (3.46). Students reported that they felt stimulated to come up with new ideas; they felt safe in expressing ideas. There was an open atmosphere, and expressing one's own opinion was appreciated. Students stated that new ideas were discussed in a fair and constructive way (4.09). At the end of the course students knew what to do to discover new business opportunities (3.52), which imply that in their perception they have knowledge of concepts and criteria.

Strategy A4: Give students activities that provoke the need to know and the need to apply concepts on opportunity identification

Taking the data into account, it can be concluded that this strategy was fully implemented.

Observations proved that students largely had to find and decide on their own solutions and information for solving questions. For the project students had to find specific tools, methods, concepts, criteria and resources. Information was very project-specific because every start-up was unique in its needs for information, and only those involved can decide on what is needed. Besides, information on specific subjects (e.g., business models) was presented in just in time lectures. Students felt the need to collect data on markets, from clients, on business models etc. for the creation of their start-up.

Limited and little specified criteria for deliverables such as a business plan were given by the teachers, and students were stimulated to draw concepts and criteria regarding opportunities and other subjects in order to meet these criteria in assessments. The questionnaire showed that students could see some relevance of tasks and deliverables (3.36). In interviews it became clear that the need to know was mainly directed by the start-up and less by the horizontal team activities.

Strategy A5: Challenge students to abandon routine thinking / problem solving strategies in order to stimulate creativity

The results show that this strategy was partially implemented.

In the course two kinds of tasks could be distinguished: tasks concerning the start-up of their own company and tasks relating to the horizontal teams in the virtual company. It was shown by interviews and observations that the start-up activities were experienced as challenging in getting away from routine thinking strategies, whereas the horizontal activities were felt to be less challenging. Students were challenged by activities related to the start-up of their company: tasks, autonomy and responsibility, and intergroup competition.

For their start-up student teams produced a business plan which was an open-ended, complex and interdisciplinary task over the length of the course, where many elements had to be integrated. Activities arose from the needs that are experienced by students. On the other hand students had smaller tasks and had to make deliverables for the holding company within strict deadlines. Data from the questionnaire reveal that, in general, students felt stimulated by the tasks and problems they were working on (3.56). In addition student teams experienced a high degree of autonomy (mean 3.61 on Autonomy Scale), responsibility and initiative in the start-up process. Also some intergroup competition was experienced in the business start-ups, because at the end one team was acclaimed as the best team and could win virtual capital. As observed, the public presentation of the business plans to the board of supervisors challenged the students to perform. Students knew that after the end of course review teams could be invited by one of the assessing investors that are interested in investing in promising start-ups, and this was a challenge for some to excel. Questionnaires show that students felt stimulated by fellow students (3.52) and supported by peers (3.96), because the teacher was enthusiastic about their ideas (3.71), and because students experienced an energetic atmosphere (3.65). For the start-up activities it can be concluded that these were challenging tasks for students.

However the activities for their staff roles in the horizontal teams were experienced as being less challenging. Students did not find these activities very instructive, and experienced less autonomy in this part of their activities. This was confirmed by the questionnaire: students did not feel challenged by the work of the horizontal teams (2.76). From the interviews it appeared that the production of deliverables for the holding company was not always experienced as feasible.

Strategy A6: Admit students based on the quality /potential of their business idea
This strategy was fully implemented as will be shown below.

Interviews showed that in an introductory meeting two months before the course students were asked to hand in a business idea in IT in advance. From interviews with students it appeared that ideas came from personal interests and skills, from the environment (social media, prior work, partners' activities), and from conversations with friends and brainstorming with their peers. Most interviewed students stated that they shared their ideas immediately with peers and with others. Also students stated that they felt stimulated or even forced in a positive way by the request to find an idea before the start of the course. The teacher gave feedback by mail or in person on the ideas, and students used the feedback to improve or reject opportunities. Students found the feedback of the teacher helpful (3.71). Finally all student groups were admitted with a solid business idea.

To summarize, the results with regard to the design principle on teaching and learning opportunity identification show that four out of six strategies were fully implemented and two were partially implemented. This brings us to the conclusion that the design principle was largely implemented as intended.

5.2.2 Evaluation of strategies for authentic learning

The degree of implementation of authenticity in the course was analysed using nine strategies of the framework for authentic learning by Herrington and Oliver (2000) as an analytical framework. The results are presented below and a summary of the results is given in Table 5.

Table 5: Summary of the degree of implementation of strategies for authentic learning

Strategies	Degree of implementation
1. Provide authentic contexts that reflect the way the knowledge will be used in real life.	Fully
2. Provide authentic tasks and activities	Fully
3. Provide access to expert performances and the modelling of processes	Fully
4. Provide multiple roles and perspectives	Partially
5. Support collaborative construction of knowledge	Fully
6. Promote reflection to enable abstractions to be formed	Partially
7. Promote articulation to enable tacit knowledge to be made explicit	Fully
8. Provide coaching and support via the teacher at critical times	Fully
9. Provide authentic assessment by learning within the tasks	Fully

Strategy B1: Provide authentic contexts that reflect the way the knowledge will be used in real life.

Data show that this strategy was fully realized.

We observed that a safe social atmosphere as in a start-up was emphasized by the teachers. Students formed a team around a business idea, and were autonomous in forming the start-up team; teachers did not interfere in this process. This stimulated students to organize social activities, such as coffee breaks, collaborative lunches, drinks and dinner. Teachers participated at these activities which had an informal atmosphere. In questionnaires students confirmed the open atmosphere during the course (4.32), and felt safe in expressing new ideas (4.08). Also the chance to express one's own opinion was appreciated (3.88).

Students experienced ownership of their business ideas. To underline this, the students had full intellectual rights, and were free to exploit their business ideas. Responsibility was in the hands of the students: they felt in charge of their work (3.64), and felt responsible for the production of deliverables (3.84). In interviews with teachers it was stated that students had to be present during working hours as in a larger company, and were monitored by one of the horizontal student teams. In interviews this was perceived by students as being less authentic for the start-up process.

Strategy B2: Provide authentic tasks and activities

This strategy was fully implemented.

We observed that the major task that the students were working on was the production of the business plan. This was a complex, multidisciplinary task for the duration of the course which required the integration of expertise from various domains. Tasks were open-ended and at the start it was unknown what the outcome would be, and every outcome was unique. Because during the course this process was condensed into ten weeks, it was perceived as intensive by students.

As observed, start-up teams had to produce intermediary products (product definition, marketing plan, business model, etc) that contribute to the final products (business plan and prototype). These intermediary products are commonly in use in entrepreneurship, in start-ups and in firms, and therefore resembled reality. In preparing prototypes of their products, students used domain specific tools from the IT domain, as well as from entrepreneurship. Students had to find the resources by themselves. Questionnaires showed that students found it stimulating to look up the appropriate information themselves (3.65).

Strategy B3: Provide access to expert performances and the modelling of processes

The results show that this strategy was fully realized.

In interviews it appeared that students felt inspired by guest speakers who tell stories about their start-up process, their successes and downfalls, and discussed these afterwards. Also students were inspired by the board of supervisors, and the chance to contact them personally. The teacher presented successful examples of IT business opportunities. However in the questionnaire students consider the teacher to be an average example of finding opportunities (3.17).

Strategy B4: Provide multiple roles and perspectives

This strategy was implemented partially.

From the course design and observation it was clear that two major roles could be distinguished: being a member of a start-up team and being a member of a horizontal

team. In interviews students stated that the roles were not felt to be meaningful by students.

During the start-up process students were confronted with various roles, and students sought their preferences for roles (team manager, communication, etc). Students were motivated by this role. In addition, students had a role in the horizontal teams. Although all activities and products of the horizontal teams contributed to the success of the virtual holding company, the students did not feel stimulated by this work (2.76). This was confirmed in the interviews:

“Horizontal teams must be removed from the course. I hear many students agree on this.”

“The horizontal teams are often redundant.”

Strategy B5: Support collaborative construction of knowledge

This strategy was fully implemented.

Questionnaires revealed that students felt supported by their peers in the start-up team and by peers from other teams (mean of 3.85 on peer support scale). They appreciated discussing business ideas with other students (3.52), and new ideas were discussed in a fair and constructive way (4.09). Students also appreciated the ideas of others because they enriched their own ideas (4.08).

All decisions on products and process had to be taken as a team, and students felt positive about it. Communications with peer students in the start-up teams was experienced as being free and open (4.20).

Strategy B6: Promote reflection to enable abstractions to be formed

This strategy was partially implemented.

We observed that during this course conceptualization is realized implicitly and explicitly in discussions on experiences, between team members, with other teams, and with teachers and assessors.

“The course helped us in certain aspects on how to create documents, and this helped us in making the decision on whether or not to proceed.”

Entrepreneurial problems that they faced evoked the need to deduce general concepts and criteria in order to improve their business idea, and meet the criteria in the end review. However, few explicit discussions were observed on students' conceptualizations in an authentic way. The learning of individual students could not be monitored. Therefore this strategy should be strengthened.

Strategy B7: Promote articulation to enable tacit knowledge to be made explicit

This strategy was fully implemented.

We observed many formal and informal opportunities to elaborate on business ideas and other activities, by writing and speaking. Start-up teams discussed their business ideas, intermediate products and deliverables. Questionnaires showed that students enjoyed discussing business opportunities with others (4.10). It was observed that articulation was also provoked in the mid- and end of course reviews and in the reports that had to be written. One or more members of the start-up team presented the plan for the board of supervisors, and often tasks were divided. Students took the presentation seriously, which was illustrated by spontaneously organized try-outs and discussions to improve the presentations.

Strategy B8: Provide coaching and support via the teacher at critical times
This strategy was fully implemented.

As observed, the prominent teacher role was that of coach/mentor and making students enthusiastic, giving feedback and hints. Teachers were in the working environment and were asked for advice. Teachers also took the role of CEO in the virtual holding company, and this role was informal and not hierarchical.

Teachers gave feedback on initial business ideas and on intermediate products, on feasibility, market potential, and gave hints for improvement (observation). From questionnaires it was shown that the teacher's feedback was seen as helpful by students (3.71). Students were already working on a business idea before the start of the course, and the teacher gave feedback on the first business ideas and later on improvement of ideas. Students were positive about the teacher's role. They perceived that the teacher encouraged students to persevere with work (3.83), and the teacher supported students in finding new ideas (3.46).

Strategy B9: Provide authentic assessment by learning within the tasks.
Results show that this strategy was fully implemented.

As observed, students were assessed on the presentation of the business plan by the board of entrepreneurs that used professional criteria. These criteria were formalized by the use of a standardized form which gave scoring on innovation and market potential. Entrepreneurs from the board of supervisors emphasized the business models proposed by teams, feasibility of plans and competition. The assessors also gave hints for contacts and markets (observation). In interviews students were positive about the feedback of the board:

"Feedback from the board is very instructive for improving our idea."

Students are also assessed by teachers on their roles/work in the horizontal teams. Rewards were given at the end of the course for special fulfilment of roles. Students felt stimulated by invitations from real investors to discuss financing of business ideas.

To summarize, the results with regard to the design principle on authentic learning show that seven out of nine strategies were fully implemented, and two strategies were partially implemented. This leads to the conclusion that the design principle on authentic learning was largely implemented as intended.

5.3 Results with respect to effectiveness of the course design

The effectiveness was determined by analysing (1) the pass rate of the course, (2) students' learning outcomes in identifying business opportunities, and (3) qualitative remarks on the business ideas by entrepreneurs at the end of the course.

Pass rate

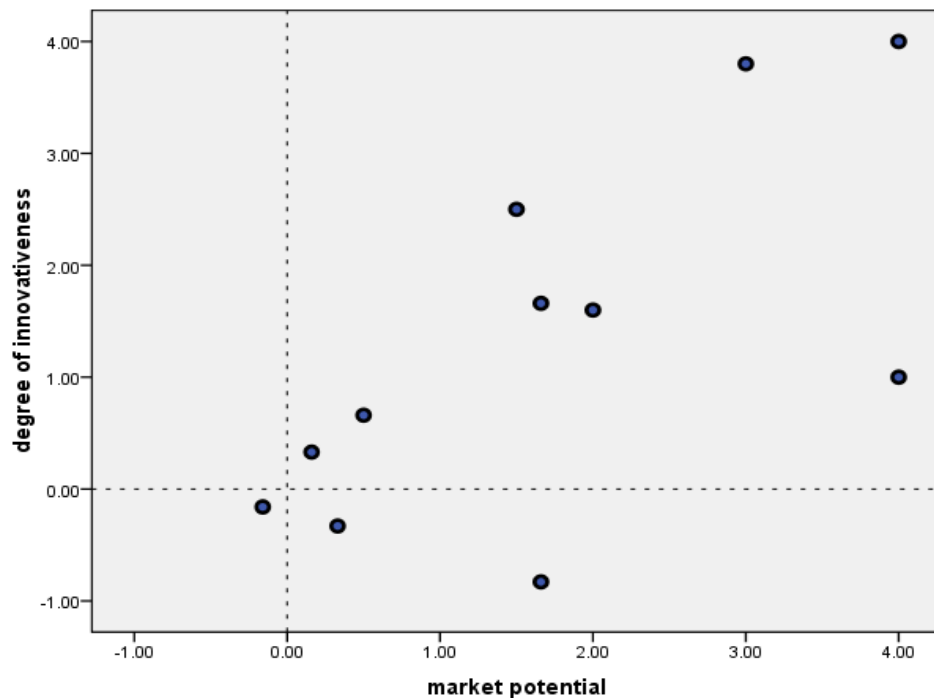
Students received marks that were composed of the scores for various deliverables, the prototype and the business plan. Business plans were assessed as team products by a board of supervisors; all students in a team got the same mark. All 10 start-up teams passed the assessment of the business plan and its presentation. The average score for the business plan was 7.0 on a scale from 0-10, with scores ranging from 5.9 -7.7. Final individual marks for the course, based on team work and

individual work, ranged between 6.6 and 7.7, meaning that all students were successful in passing the course.

Business ideas as assessed by teachers and professional entrepreneurs

A board of supervisors assessed business ideas, business plan and presentations by scoring in two areas: innovativeness and market potential. Supervisors read the business plan before the presentation. For scheduling reasons six board members were divided over two sessions, meaning that the number of assessors per business plan varied during the day. Ten presentations were assessed by two or more board members, and one plan was assessed by one board member. In a final session where the most promising business ideas as pre-selected by the teachers were presented, all board members were present and gave their scores. Scores per team are presented in Figure 1.

Figure 1: Scatter plot of score means of 11 team business plans as assessed by entrepreneurs. Y-axis: degree of innovativeness and X-axis: market potential.



In assessment by the board of supervisors 8 out of 11 teams scored positively on innovativeness as well as on market potential (73%), which can be considered as an acceptable score (standard distribution). Two teams (18%) scored negatively on one of the scales, and one team (9%) scored slightly negatively on both scales. Two teams scored highly on both scales (> 3.0).

It can be concluded that the majority of student teams was able to identify a business opportunity that was technically innovative and had market potential in the opinion of entrepreneurs and investors.

Statements by board of supervisors.

Recordings of feedback by the board of supervisors in the end review and interviews of teachers were analysed for comments on the quality of presented business plans

and ideas. As compared to previous years the level of business ideas was considered to be higher, although improvements were still possible.

“We were impressed by the overall quality of ideas. It has grown dramatically over the last few years. With that we are able to raise the bar, and finally give some serious criticism.”

“For the innovative part: yes, I see innovation growing, if I compare it with five years ago when I was already working on this project. Then I only saw variety on the same theme. Today I do see some real innovations. I would say to go the extra mile. There is a lot of potential in terms of innovations. We saw nice examples, but finish it, and push a little harder. It is not enough yet.”

Every year one to three start-ups from the course do actually enter the market. The numbers of start-ups from this course has not yet been evaluated, because start-ups need more time before such results can be reported.

6. Conclusion and discussion

The overall outcome of this study is that a learning environment can be designed which complies with the design strategies on opportunity identification and on authentic learning, and which is feasible and effective in stimulating the competence of opportunity identification in informatics students at university.

The *first research question* was: can a coherent course design be developed that is based on strategies for teaching opportunity identification and for authentic learning? Interventions were scheduled in a logical and logistic order, and the course design should be perceived by users as a natural order of activities. This study showed that all strategies could be elaborated into a coherent set of learning activities, which is one of the criteria of a robust course design (McKenney, Nieveen & Van den Akker, 2006).

The *second research question* concerns the implementation of strategies in practice. This study shows that the design principle for stimulating opportunity identification was largely implemented. Two strategies of this design principle appeared partially implemented:

1. The strategy (A1) to stimulate knowledge and skills on idea generation techniques was not fully realized. Although students felt stimulated in their creativity and idea generation by the teacher and peers, and perceived their divergent thinking to be high, students rarely used idea generation techniques to find business ideas. This may be due to the fact that the lecture / workshop on idea generation was planned after the phase of idea generation in the process of opportunity identification.
2. A second strategy (A5) on challenging students to abandon their routine way of thinking was partially implemented. Students felt challenged by tasks for the business start-up, by perceived autonomy, by peers and by the teachers. They experienced an energetic atmosphere. However they did not feel challenged by their tasks and activities for the staff roles in the horizontal teams. Students did not perceive these roles as instructive and did not experience a need to know for their activities in the horizontal teams. Students had a clear preference for their activities in the start-up process of their company, and felt motivated by it.

In addition the design principle on authentic learning was largely implemented, but two strategies appeared partially implemented:

1. The strategy (B6) to promote reflection to enable abstractions to be formed was partially implemented. There was little explicit emphasis on conceptualization, which is necessary to create cognitive prototypes and schemas that can be used in similar situations. Because students proved to be able to apply concepts and criteria in assessments, it can be assumed that conceptualization occurred implicitly, and prototypes and criteria were developed. More explicit reflection might improve the learning.

2. Also the strategy (B4) to provide students with multiple roles and perspectives was partially realized. Students experienced various roles in their start-up activities to be instructive, but their role as staff member in the horizontal teams for the virtual holding company was felt to be not very meaningful. Therefore this part of the strategy on staff roles in the virtual company should be reconsidered in subsequent course designs.

For the second research question, it can be concluded that it is feasible to design a learning environment that complies with the strategies for opportunity identification and for authentic learning.

Subsequently the *third research question* on the effectiveness of the learning environment in stimulating students in opportunity identification was evaluated. The majority of the student teams was able to identify a business opportunity that had a sufficient degree of innovation in the IT domain and had commercial potential in the eyes of entrepreneurs and investors. Therefore it can be concluded that the learning environment was effective in stimulating opportunity identification in students.

In summary, the coherent course design complying with design strategies for opportunity identification and for authentic learning was feasible and was effective in fostering students' competence in opportunity identification. It can be concluded that design strategies of authentic learning contribute to fostering students' competence.

New strategy on incubation of ideas

In this study a new effective design strategy (A6) was introduced which aimed at providing students with an incubation period for their business ideas. It was implemented by admitting students based on the potential of their business idea which had to be identified in advance of the course. Such pre-selection of students is a proven way of achieving better learning results in education and its effects can be explained by several mechanisms. By introducing this strategy students had a prolonged period for finding their business idea. It is generally accepted that ideas have to mature after the first spark of discovery or creation, and the idea matures in cycles of evaluation and refinement. In earlier versions of the course students had one or two weeks for finding opportunities. In fact such a short time period is limited and induced a pressure to deliver the business idea. In literature the phenomenon of incubation was described (Amabile, 1996, p101; Nickerson, 199, p 417) as periods where one is not explicitly thinking of the idea, but on a subconscious level one proceeds with cognitive activities that contribute to the maturation of the ideas. This strategy might have expanded the incubation time, and thereby have contributed to the quality of business ideas. At the end the quality of business ideas had improved sharply in comparison to previous years, as reported by the assessors in the end of course review, and this strategy may have been a contributory factor. Another consequence of this strategy is that students feel proud to be selected, and have

proved themselves able to identify a promising opportunity. Such positive feedback may have influenced students' self-efficacy which in turn will positively influence their competence in opportunity identification (Krueger, 2000).

Challenging students to abandon routine thinking

The strategy (A5) to challenge students to abandon their routine thinking proved to be partially realized. Challenging students to abandon routine thinking is essential in learning, especially in teaching opportunity identification. Because something innovative is created and brought to the market, students must be stimulated to step out of routine problem solving scripts. Therefore students must be faced with problems that cannot be solved with established strategies and heuristics, but new ways of solving problems have to be discovered. Students can be challenged in various ways: by the content, by the sort of problems they are faced with (open ended, complex), by giving students self-regulation, and by assessment. Students feel challenged if their expectations do not match the demands of education, which provokes degrees of frustration at not having enough capability. This situation is similar to entrepreneurship circumstances where one has to be innovative in finding resources, new markets, etc. Vermunt and Verloop (1999) described "constructive friction" in learning where students' competence and demands from education do not match. This is not always a problem but can be a stimulus for learning if students are convinced that they are able to bridge the distance between demands and competence. Such a constructive friction can deliberately be created by supplying an authentic learning context. Although challenge can be achieved in various ways, it should be aimed at provoking the essential mental activities for opportunity identification.

In this study challenge was successfully achieved in the start-up activities but was not stimulated by activities for the horizontal teams. Start-up activities were experienced as meaningful and thereby motivating, and teachers expressed high expectations of students. Apparently students experienced a constrictive friction in these activities. On the other hand, activities in the horizontal teams did not provoke this perception in students. In further design for education on opportunity identification more emphasis should be given to introducing sufficient challenge in activities for horizontal teams to get students out of routine thinking strategies.

Also the various roles (strategy B4) connected to horizontal activities were experienced as not stimulating. If students do not perceive one of their roles as meaningful, motivation will decrease and thereby learning will too. In a forthcoming course design emphasis must be given to making the roles in the horizontal teams more meaningful and motivating. It is suggested that this will enhance learning.

Creativity and opportunity identification

Theory suggests that stimulating creativity and divergent thinking will stimulate opportunity identification (Corbett, 2005; Plesk, 1997; Scott et al., 2004). From this study it is difficult to confirm this relation, due to improper scheduling of the workshop on this subject. In fact this strategy (A1) was not implemented properly, and as a consequence students could not easily use idea generation techniques in finding opportunities, which was scheduled before the start of the course. This finding underpins the importance of a design principle that describes the sequence of interventions in a course design (Prins, 2010). It is also advisable to add such a principle in forthcoming studies. In developing complex competences such as opportunity identification, the precise timing of training in specific techniques is crucial (Van Merriënboer, 1997), and this should also be kept in mind when offering idea generation techniques during the process of opportunity identification.

Stimulating reflection

From this study it appears that the strategy on reflection (B6) was partially implemented, and reflection occurred in an implicit way. From cognitive theory on opportunity identification (Baron & Enslay, 2006) it can be assumed that conceptualization is essential. Students must develop complex mental schemata and prototypes / scripts that help them in identifying information patterns that may lead to opportunity identification. Concepts of opportunities are related with innovativeness, commercialization and market potential. These concepts are unique for individuals and depend on their prior education and knowledge of the domain / industry and of clients' needs. In this study students were able to conceptualize as was shown in the learning outcomes. It is not clear whether this knowledge is implicit or explicit. In terms of entrepreneurs: is it tacit/intuitive knowledge and can it be rationalized? Learning from experiences is strongly stimulated by explicit reflection, and cognitive prototypes may develop out of this (Simons, 1999; Cope, 2003). This in turn can strengthen the learning outcomes and must be emphasized in further experiments. However reflection is often difficult to implement and in an authentic learning environment, reflection must be stimulated in an authentic way, for example by introducing peer feedback or by the development of common criteria for future projects.

Instruction strategies

In this study we used constructivist as well as cognitive approach instruction theories to design education. In the strategies on opportunity identification cognitive learning is an important perspective. For identifying opportunities one needs specific information. Gathering knowledge underlies the creative process of OI, and cannot only be gathered in school because essential information is restricted to the market place. Information comes from industry networks, mentors and professional forums (Ardichvilli, Cardozo & Ray, 2003). The entrepreneurial community can be considered as a learning community where knowledge is created, and information can only be obtained by participating in this community. Therefore in the design of OI education, a social constructivist instruction model should be used next to cognitive instruction theories.

Coherence of strategies

Considering the results it would be interesting to know which strategies are the most effective in OI teaching and learning. The strategies for this purpose were implemented to a large extent, although some strategies need improvement in the implementation, as stated above. The course design is a synthesis of all strategies, and forms a coherent framework of intertwined strategies. This makes it difficult to distinguish the effects of individual strategies and determine what the key strategies to be further investigated are. It is hard to identify the key strategy. But the more strategies are successfully implemented, the more robust the course design will be. It can be suggested that all interventions must provoke those cognitive activities in students that help them in developing their competence. Because students were able to apply their concepts and criteria in practice, it can be concluded that cognitive stimulation was effective. It is however important how students perceive the learning environment. If students see the learning activities as relevant and meaningful this is important for motivation and learning effects and this can be assumed to be more effective than creating a simulation of a start-up atmosphere. From this study it cannot be concluded which strategies for authentic learning are the most essential in stimulating the proper cognitive activities.

Teaching in an academic setting

Understanding the theory and concepts of opportunity identification might help in identifying opportunities, but there are also many components in opportunity identification such as social networks, domain knowledge, and market knowledge,

which are difficult to obtain in the classroom. The dilemma of teaching entrepreneurship in an academic setting which emphasizes theory building, is to comply with sufficient theoretical profundity as well as with enough practical knowledge. Focusing on theories can easily result in a lack of practical and tacit knowledge while a mainly practical approach might result in a lack of conceptualization. This study focuses on the learning of the cognitive / conceptualization side of opportunity identification, in an authentic environment that complies with essential elements of the learning environment of entrepreneurship, and stimulates the cognitive activities that are essential in opportunity identification. The course design in this study thereby combines demands from the academic community and from entrepreneurial practice.

Design principles

The findings of this study lead to an empirical underpinned design principle for the fostering of competence in identifying business opportunities in an authentic learning environment.

If you want to design education with the aim of fostering science students' competence to identify business opportunities, this can best be achieved by strategies which:

- a. *Stimulate knowledge and skills on idea generation techniques*
- b. *Let students conceptualize their experiences with OI and let them discover criteria*
- c. *Let students actively apply opportunity identification concepts and criteria in new entrepreneurial experiences and assessments*
- d. *Give students activities that provoke the need to know and the need to apply concepts of OI*
- e. *Challenge students to abandon routine thinking and find new solutions*
- f. *Provide students with a period of incubation for identification and development of their business idea*

And do that in an authentic learning environment that is characterized by strategies which:

- g. *Provide a context that reflects the way knowledge will be used in real life*
- h. *Provide authentic tasks and activities*
- i. *Provide access to expert performances and the modelling of processes*
- j. *Provide multiple roles and perspectives*
- k. *Support collaborative construction of knowledge*
- l. *Promote reflection to enable abstractions to be formed*
- m. *Promote articulation to enable tacit knowledge to be made explicit*
- n. *Provide coaching and support via the teacher at critical times*
- o. *Provide authentic assessment by learning within the tasks*

Limitations

This study evaluated the combination of two design principles, which together proved feasible and effective. Considering the complexity of educational settings, and the

many factors that may influence the outcomes, this pilot study cannot be viewed as conclusive on this subject. This pilot study aimed at evaluating a set of design strategies, and it is a first step in finding validated design strategies. But there are some limitations to this study. To begin with, the conclusions in this paper were drawn from one study with a small number of participants, and need to be verified in new experiments with larger numbers of participants. Also the teachers in this study had extensive experience of entrepreneurship education and this may have influenced the study in a positive way. It is interesting to investigate if less experienced teachers can gain the same results using the design strategies. Because the course in this study is an elective course there might be self-selection of the participants. In this way a population is created that is highly motivated for this type of education, and can see the relevance of learning activities. Results from such a population cannot directly be generalized towards other populations. In addition, opportunity identification is a creative process and the results are unique for the moment of creation. Innovativeness is time dependent. What is new now will not be new tomorrow, and therefore the effectiveness of the learning outcomes is also time dependent and relative, and is difficult to reproduce. As a consequence of these limitations the results of this study cannot be fully generalized to a broader context than the informatics domain. However it can be expected that the strategies will have value in other domains, but the implementation in other domains will differ profoundly, because every domain has its specific authentic context.

A challenging task for further research is the evaluation of the design principles in learning environments with various degrees of authentic learning, in semi-experimental settings and with greater numbers of students, in order to determine more qualitatively the effects of combinations of strategies. The practical value of opportunities should be determined after exploitation in real markets and therefore a more longitudinal study for effects in the market can further validate our findings. In future these findings will contribute to the teaching and learning of a competence that is crucial for entrepreneurship and for society.

References

- Alvarez, S. A. (2005). Theories of entrepreneurship: Alternative assumptions and the study of entrepreneurial action. *Foundations and Trends in Entrepreneurship*, 1(3), 105-148.
- Amabile, T. M. (1996). *Creativity in context*. Oxford: Westview Press.
- Ansoff, I.H. (1968). *Corporate Strategy*. London: Penguin Books.
- Ardichvilli, A., Cardozo, R., & Ray, S. (2003). A theory of entrepreneurial opportunity identification and development. *Journal of Business Venturing*, 18(1), 105-123.
- Barab, S. A., Squire, K., & Dueber, B. (2000). Supporting authenticity through participatory learning. *Educational Technology Research and Development*, 48(2), 37-62.
- Baron, B.A., & Enslay, M.A. (2006). Opportunity recognition as the detection of meaningful patterns: Evidence from comparisons of novice and experienced entrepreneurs. *Management Science*, 52(9), 1331-1344.
- Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18 (1), 32-42.

- Christensen, P., Madsen, O., & Peterson, R. (1994). Conceptualizing entrepreneurial opportunity identification. In G. E. Hills (Ed.), *Marketing and entrepreneurship: Research ideas and opportunities*. London: Quorum Books.
- Cope, J. (2003). Entrepreneurial learning and critical reflection. Discontinuous events as triggers for higher level learning. *Management Learning*, 34(4), 429-450.
- Cope, J. (2005). Toward a dynamic learning perspective of entrepreneurship. *Entrepreneurship Theory and Practice*, 29(4), 373-397.
- Companys, Y.E., & McMullen, J.S. (2007). Strategic entrepreneurs at work: The nature, discovery and exploitation of entrepreneurial opportunities. *Small Business Economics*, 28 (4), 301-322.
- Corbett, A. C. (2005). Experiential learning within the process of opportunity identification and exploitation. *Entrepreneurship Theory and Practice*, 29(4), 473-491.
- DeTienne, D. R., & Chandler, G. N. (2004). Opportunity identification and its role in the entrepreneurial classroom: A pedagogical approach and empirical test. *Academy of Management Learning & Education*, 3(3), 242-257.
- European-Commission. (2006). The OSLO agenda for entrepreneurship education in Europe. (Online). Available from: http://ec.europa.eu/enterprise/policies/sme/files/support_measures/training_education/doc/oslo_agenda_final_en.pdf (Accessed 19th of May 2011).
- Finke, R. A., Ward, T. B., & Smith, S. M. (1992) *Creative cognition; Theory, research and applications*. Cambridge, MA: MIT Press.
- Gibb, A. A. (1997). Small firms' training and competitiveness: Building on small business as a learning organization. *International Small Business Journal*, 15 (3), pp.13-29.
- Gibb, A. A. (2002). Creating conducive environments for learning and entrepreneurship. *Industry & Higher Education*, 16(3), 135-148.
- Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development*, 48(3), 23-48.
- Herrington, J., Reeves, T.C., & Oliver, R. (2007). Immersive learning technologies: Realism and online authentic learning. *Journal of Computing in Higher Education*, 19 (1), 80-99.
- Hills, G. E., Shrader, R. C., & Lumpkin, G. T. (1999). Opportunity recognition as a creative process. In W.D. Bygrave et al. (Eds.). *Frontiers in Entrepreneurship Research*, Babson Park, MA, Babson College Press, 216-227.
- Hulbert, B., Brown, R. B., & Adams, S. (1997). Towards an understanding of opportunity. *Marketing Education Review*, 7 (3), 67.
- Kickul, J. (2006). Pathways to new business opportunities: Innovations and strategies for the entrepreneurial classroom. In H. Klandt & A. Fayolle (Eds.),

International entrepreneurship education (pp. 168-188; 10). Cheltenham, UK / Northampton, MA. USA: Edward Elgar Publishing Limited.

Kickul, J., Gundry, L. K., Barbosa, S. D., & Whitcanack, L. (2009). Intuition versus analysis? Testing differential models of cognitive style on entrepreneurial self-efficacy and the new venture creation process. *Entrepreneurship Theory and Practice*, 33(2), 439-453.

Kirzner, I., (1979). *Perception, Opportunity, and Profit*. Chicago: University of Chicago Press.

Krueger, N. F. (2000). The cognitive infrastructure of opportunity emergence. *Entrepreneurship Theory and Practice*, 24(3), 5-23.

Lans, T. (2009). Entrepreneurial competence in agriculture. Characterization, identification, development and the role of the work environment. (Wageningen University, PhD thesis.)

Lans, T., Biemans, H., Versteegen, J., & Mulder, M. (2008). The influence of the work environment on entrepreneurial learning of small business owners. *Management Learning*, 39(5), 597-613.

Man, T. W. Y. (2006). Exploring the behavioural patterns of entrepreneurial learning: A competency approach. *Education + Training*, 48(5), 309-321.

McKenney, S., Nieveen, N., & Akker, J. van den. (2006). Design research from a curricular perspective. In J. van den Akker, K. Gravemeijer, S. McKenney and N. Nieveen (Eds), *Educational design research* (pp. 67-90). London and New York: Routledge.

Muzychenko, O. (2008). Cross-cultural entrepreneurial competence in identifying international business opportunities. *European Management Journal*, 26, 366-377.

Nab, J., Oost, H. A., Pilot, A., & Keulen, H. v. (2008). *Measurement of the ability of science students to recognize business opportunities*. Paper presented at the European Conference for Entrepreneurship and Education, Winchester, UK.

Nab, J., Bulte, A. M. W., & Pilot, A. (accepted for publication). Fostering the competence of science students in identifying business opportunities. A design approach. *International Journal of Entrepreneurial Venturing*.

Nab, J., Pilot, A., Brinkkemper, S., & Ten Berge, H. (2010). Authentic competence-based learning in university education in entrepreneurship. *International Journal of Entrepreneurship and Small Business*, 9(1), 20-35.

Nickerson, R. S. (1999). Enhancing creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 392-430). Cambridge: Cambridge University Press.

Nixdorff, J., & Solomon, G. (2007). *Role of opportunity recognition in teaching entrepreneurship*, March 22-24. Paper presented at the NCIIA, 11th Annual Meeting, Tampa, FL.

Onstenk, J. (2003). Entrepreneurship and vocational education. *European Educational Research Journal*, 2(1), 74-89.

- Plesk, P. E. (1997). *Creativity, innovation and quality*. Milwaukee: ASQC Quality Press.
- Prins, G. T. (2010). Teaching and Learning of modelling chemistry education. Authentic practices as contexts for learning. PhD Thesis, Utrecht University.
- Resnick, L. (1987). Learning in school and out. *Educational Researcher*, 16(9), 13-20.
- Saks, N., & Gaglio, C. M. (2002). Can opportunity identification be taught? *Journal of Enterprising Culture*, 10(4), 313-348.
- Sarasvathy, S.D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, 26(2), 243-264.
- Scott, G., Leritz, L., & Mumford, M. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal*, 16(4), 361-388.
- Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *The Academy of Management Review*, 25(1), 217-226.
- Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science*, 11(4), 448-469.
- Shook, C. L., Priem, R. L., & McGee, J. E. (2003). Venture creation and the enterprising individual: A review and synthesis. *Journal of Management*, 29(3), 379-399.
- Simons, P. R. J. (1999). Transfer of learning: Paradoxes for learners. *International Journal of Educational Research*, 31, 577-589.
- Snowman, J., & Biehler, R. (2003). *Psychology applied to teaching*. Boston/ New York: Houghton Mifflin Company.
- Stanton, N. (1996). Simulators: A review of research and practice. In N. Stanton (Ed.), *Human Factors in Nuclear Safety* (pp. 117-141). Southampton: Taylor & Francis.
- Van Merriënboer, J. J. G. (1997). *Training complex cognitive skills: A four-component instructional design model for technical training*. Englewood Cliffs, New Jersey: Educational Technology Publications.
- Vermunt, J. D., & Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Individual Differences*, 9, 257-280.
- Vygotsky, L. (1978). *Mind in society*. London: Harvard University Press.
- Wallas, G. (1945). *The art of thought*. London: C.A. Watts.