Teaching science students to identify entrepreneurial opportunities

Jan Nab

Onderwijs in het herkennen van ondernemerskansen voor bètastudenten

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Chapter 1

Introduction and overview

This research aims to elucidate how competence in identifying entrepreneurial opportunities by science students in higher education can be taught and learned. This research provides a set of piloted design principles and strategies for the design and development of such teaching.

Entrepreneurship brings economic growth, innovations, and new jobs, and raises employment levels (Shane & Venkataraman, 2000; Van Praag & Versloot, 2007), and therefore entrepreneurship has become an important economic and social topic as well as a well-known research topic (Fayolle & Gailly, 2008). International and national governments stress the importance of entrepreneurship and have developed policies to stimulate individuals to start a career as an entrepreneur (European Commission, 2004), and this has resulted in the stimulation of entrepreneurship education programmes (European Commission, 2005, 2008, 2011). As a consequence, the number and status of entrepreneurship programmes at all school levels, and specifically at colleges and universities, has increased considerably (Finkle & Deeds, 2001; Kurakto, 2005). Besides this, the popularity of entrepreneurship courses has increased among both graduate and undergraduate students.

Historically, entrepreneurship education was the domain of business and business economics teachers, but in the last decades other domains like life-sciences, engineering, IT, medicine and health also acknowledge the value of fostering entrepreneurial competencies among their students (Defillippi & Arthur, 1994; Gou, 2009; Gurău, 2006). It means that more students with different backgrounds and ambitions have to be educated in entrepreneurship (Taatila, 2010), and therefore a need exists for new entrepreneurial programmes within higher education institutions.

Identification of business opportunities is a central and unique component of entrepreneurship (Ardichvili, Cardozo, & Ray, 2003; Eckhardt & Shane, 2003; Man, Lau & Chan, 2002; McMullen, Plummer, &Acs, 2007; Shane & Venkataraman, 2000), and is considered to be the first stage of the entrepreneurial process (Christensen, Madsen, & Peterson, 1994). Actually, without the identification of an opportunity there is no entrepreneurship (Short, Ketchen, Shook, & Ireland, 2010). Gaglio & Katz (2001) have defined opportunity identification as being the most distinctive entrepreneurial competence that distinguishes entrepreneurs from employees. This explains why opportunity identification has become the subject of entrepreneurship scholarly research. There has been considerable interest in studying the factors, processes, and dynamics that influence opportunity identification (Ardichvilli et al., 2003; Gregoire, Barr & Shepherd, 2010). These studies have been devoted to understanding why, when and how some people discover, create and take

advantages of the opportunities provided and others simply don't (Shane & Venkataraman, 2000).

Because opportunity identification is at the heart of entrepreneurship and is considered as a core competence for entrepreneurs, concepts and competences related to it should have substantial emphasis in entrepreneurship education (Fiet, 2000; Saks & Galio, 2002). However, despite the growing amount of published work focusing on entrepreneurial opportunities, little empirical exploration or investigation is available on how competence in opportunity identification can be fostered in educational settings (Nixdorff & Solomon, 2007).

Few publications report pedagogical formats that aim at fostering students' competence in identifying opportunities (Corbett, 2005; DeTienne & Chandler, 2004; Jones, 2007; Muzychenko, 2008; Saks & Gaglio, 2002), and heuristics for the design and development of courses on opportunity identification are hard to deduce from these studies, and a pedagogical model for fostering students' competence in identifying opportunities has not or only partly been defined in such a way that teachers can use it for the design and development of their courses.

From these findings, it can be concluded that a pressing demand exists for design rules for developers and teachers that aim to set up new entrepreneurship programmes with an emphasis on opportunity identification.

This research was focused on science students in higher education, because science students possess specific knowledge of science and technology that can be used to identify entrepreneurial opportunities. Therefore, this research aims to provide an answer to the question, how science students' competence in identifying business opportunities can be fostered in higher education. The aim is to provide a set of piloted design principles and strategies for the design and development of such teaching. In this way the study will contribute to the development of practice in entrepreneurship education, but also to a broader elucidation of the mechanisms involved, and thereby contribute to the theory of entrepreneurship education.

The main research question of this research is, therefore:

- *What are design principles for education that aims at fostering the competence of science students in identifying business opportunities?*

NURTURE OR NATURE

Researchers as well as laymen have long disagreed on whether or not entrepreneurship can be learned. The discussion 'nature or nurture' concentrated on whether entrepreneurial competences, such as risk taking and opportunity identification, can be learned, or whether these are personality traits, which are in-born or established at an early age (Henry, Hill, & Leitch, 2005a, 2005b; Sexton & Upton, 1987; Van der Sijde & Tilburg, 1998). Many empirical studies in this field state that entrepreneurship can be learned and that education can foster specific aspects of entrepreneurship, for instance Gatewood and colleagues (Gatewood, Shaver, Powers, & Gartner, 2002) addressed the influence of feedback on the motivation for start-ups. Gorman, Hanlon, & King (1977) conducted a survey of entrepreneurship education research between 1985 and 1994, and came to the conclusion

that entrepreneurship can be taught. Also Chilosi (2001) established a positive relationship between education and the success of start-ups and self-employment. A correlation between the level of the entrepreneur's education and the level of performance of his / her venture was reported by Van der Sluis and colleagues (Van der Sluis, van Praag, & Vijverberg, 2005). In their study on senior graduates, Mayhew and colleagues (Mayhew, Simonoff, Baumal, Wiesenfield, & Klein, 2012) showed that taking an entrepreneurial course influenced the innovation intentions of students, as did assessments that encouraged students to take innovative approaches to problem-solving, and assessments that encouraged students to develop arguments. Innovation intention is considered as a key factor in predicting the entrepreneurship of students. These authors also reported other factors that positively influence innovation intentions, such as specific scores on the Big Five by Costa and McCrae (1985) (extraversion, agreeableness, consciousness, neuroticism, openness), and self-identification. Also a low socioeconomic status, family exposure to entrepreneurship, low grade point average, and conservative political preference are influencing innovation intentions. It seems however that there are some factors related to personality that cannot be learned. White, Thornhill and Hampson (2006) found that biological factors of individuals correlate positively with risk-taking behaviour, dominance seeking and status seeking (Apicella et al., 2008; Mazur and Booth, 1998; Ronay & Von Hippel, 2009) which are all related to entrepreneurial behaviour (White et al., 2006).

Particularly in opportunity identification research, many studies in the 50s and 60s focused on the role of personality traits of entrepreneurs. Although this psychometric test searching for distinctive traits was unable to identify differences in most traits between entrepreneurs and other groups (Shaver and Scott, 1991), two personality traits did prove to be positively related to successful opportunity recognition. The first is entrepreneurial optimism that proved to be related to higher opportunity identification. Optimism is related to self-efficacy beliefs (Krueger & Brazeal, 1994; Krueger & Dickson, 1994). The second personality trait that is related to opportunity identification is creativity. Here, it must be noted that creativity is considered as an individual trait as well as a competence that can be developed. Winslow & Solomon (1993,) argue that creativity and entrepreneurship are strongly related. Hills, Lumpkin, & Singh (1997) found that 90% of respondents found creativity very important in opportunity identification. But in general, the person-centric approach has been largely unsuccessful in explaining entrepreneurship (Gartner, 1990), in part because entrepreneurial activity is occurring at usually irregular intervals, making it unlikely to be explained by factors that influence human action in the same way all of the time. Therefore it can be concluded that entrepreneurship is a personality trait as well as a competence that can be learned and taught (Mayhew et al., 2012).

Despite this on-going debate on nature or nurture, the focus of this research is specifically on the part of entrepreneurship that can be developed and fostered by education: cognition, skills and attitudes, despite the fact that students have a specific personality or talent. Specifically, opportunity identification has elements of skills, knowledge and cognition, as will be illustrated later in this introduction.

THEORETICAL PERSPECTIVES OF THIS RESEARCH

The following section summarizes the theoretical perspectives and argumentation for this research. First, definitions of the major concepts in this research are provided, and the process model for opportunity identification in entrepreneurship is described. Then, the main theories of opportunity identification are provided, and the relation of these theories to learning theories is described. Next, creativity as a relevant factor for teaching and learning opportunity identification is elaborated. Then, an overview is given of studies on education on opportunity identification. And finally, the terms of entrepreneurship, entrepreneurship education and competence as used in this research, are defined.

Definition of entrepreneurship

Entrepreneurship is the subject of education in this research and therefore it is necessary to clarify what is meant by entrepreneurship. Reviews of entrepreneurship research have indicated a lack of an agreement upon the definition of entrepreneurship (Gartner, 1990; Bull & Willard, 1993; Shane & Venkataraman, 2000; Mars & Rios-Aguilar, 2010; Gedeon, 2010). Such an agreement is complicated because entrepreneurship is a multifaceted phenomenon that crosses many disciplinary boundaries (Low & MacMillan, 1988). Moreover, the phenomenon of entrepreneurship can be explained from several theoretical viewpoints e.g. risk theory, profit theory, dynamic theory, traits and behaviour theories, etc. (Gedeon, 2010). One of the first people to define entrepreneurship was Cantillon (1755), and the debate about this issue still has not come to an end. More recently, the prevalent and compelling views of entrepreneurship focus on the perception of new economic opportunities and the subsequent introduction of new ideas in the market. While a variety of definitions of the term entrepreneurship have been suggested, this research will use the widely accepted definition by Stevenson and Jarillo (1990:23):

"*entrepreneurship is the process by which individuals – either on their own or inside organizations – pursue opportunities without regard to the resources they currently control*".

Actually, without the identification of an opportunity there is no entrepreneurship (Short, Ketchen, Shook, & Ireland, 2010). Because entrepreneurs are pursuing a novel opportunity while lacking access to required resources, they face considerable risks (with regard to demands, technology, execution and financing). This definition of Stevenson and Jarillo (1990) is still current, as demonstrated in a more recent view by Venkataraman (1997) who defined entrepreneurship as the process of 'discovery, evaluation exploitation of opportunities to create future goods and services'.

Shane & Venkataraman (2000) argue that entrepreneurship does not require, but can include, the creation of a new organization. Entrepreneurs have a managerial role but routine management of an on-going operation is not considered to be entrepreneurship. If individuals within organizations pursue the exploitation of opportunities, they can be classified as entrepreneurs, or better, intrapreneurs.

The focus of entrepreneurship education, in this thesis, is generally on the first stages of

opportunity identification: discovery/creation and evaluation of opportunities. For universities it is difficult to let students fully exploit opportunities and create an organization, because of time and financial constraints, and also because caution must be taken with regard to risk taking by students.

Entrepreneurship education

It must be emphasised that various types of entrepreneurship education (EE) have been distinguished (Bechard & Gregoire, 2007; Blenker, Korsgaard, Neergaard & Thrane, 2011; Gibb, 2002; Honig, 2004; Korhonen et al., 2012). As described by Fayolle & Gailly (2008), three dominant approaches to EE can be discerned, each with different views on learning outcomes, pedagogy and the role of the teacher:

• *Making students more entrepreneurial*. This type of education typically has a focus on values, beliefs and attitudes associated with entrepreneurship. Concepts such as an entrepreneurial mind-set, entrepreneurialism, an entrepreneurial spirit and attitude characterise the discourse of this type of entrepreneurship education. In practice, this means that one should have an eye for opportunities and networking, be proactive, risk-taking, creative, and self-directed. This conception of EE also has strong connections with modern views of work, employment and learning.

• *Stimulating students to create new firms*. This type of entrepreneurship education focuses on initiating actions: venturing, turning ideas into 'gestation' activities, and firm formation processes. The fundamental outcome of these processes is the new organisation itself (Gartner, Carter, Reynolds, Acs & Audretsch, 2010). Examples of such activities are: development of a business model, prototyping the product, talking to clients, defining a market for the product, and organising a start-up team (Gartner et al., 2010). These activities typically lead to a business plan, and start-up activities.

• *Learning about entrepreneurship*. In this type of education the focus is on conceptual and theoretical understanding of entrepreneurship. It involves theoretical and empirical research about entrepreneurship that has its roots in economics, management, sociology and (personality) psychology; this is usually the focus in departments of economics and management as well as in business schools.

These three approaches to EE are not mutually exclusive but can be seen as a natural progression in entrepreneurship teaching (Blenker et al., 2011). The student can mature from a stage with a focus on the acquisition of knowledge, through the development of an entrepreneurial attitude, to being a nascent entrepreneur and firm founder. In many entrepreneurship programmes two or more of these approaches can be seen.

In the last decades the focus in higher education has predominantly been on stimulating students to start new firms, with the business plan as the central activity in education (Gibb, 2005). But nowadays there is a trend to make students more entrepreneurial, which is a necessary competence in a changing world with more project work and limited access to life-long jobs. Every academic should value the ability to identify new opportunities and to develop an

entrepreneurial competence profile, in order to generate life-long income. It is assumed that entrepreneurial skills have value for everybody, while the specific competences for firm start-up or for scholarship in entrepreneurship suit a smaller group of students.

In the case studies of this thesis, the focus is on writing a business plan as a way to elaborate and evaluate an entrepreneurial opportunity, and on stimulating students to become more entrepreneurial.

Definition of opportunity identification

Several definitions of opportunity exist. The Concise Oxford English Dictionary (Soanes & Stevenson, 2004, p.1003) defines an opportunity as 'a favourable time or set of circumstances for doing something', while in the Oxford Advanced Learners Dictionary (Hornby, 2004, p.890) an opportunity is defined as 'a time when a particular situation makes it possible to do or achieve something'. Both are definitions of opportunities in a generic sense. In entrepreneurship research specific definitions of opportunities are commonly used. Kirzner (1979) defines an opportunity as the special knowledge an entrepreneur needs to possess about goods and/or services sold in new markets which can be sold at a profit. According to Kirzner, ideas become an opportunity when their commercial value is recognised. A business opportunity is a chance to meet an unsatisfied need that is potentially profitable (Hulbert, Brown & Adams, 1997). More recent formulations can be found in entrepreneurship research for example by Shane & Venkataraman (2000, p.220) who define an opportunity as 'those situations in which new goods, services, raw materials and organizing methods can be introduced and sold at greater than their cost of production'. Shane (2003, p. 18) defines an entrepreneurial opportunity as 'a situation in which a person can create a new means-ends framework for recombining resources that the entrepreneur believes will yield a profit'. Central to all definitions of opportunity recognition is the creation and/or discovery of something novel that is of some value to the client, and/or society, and makes a profit for the entrepreneur.

According to Stevenson and Jarillo (1990:23) an opportunity may entail: pioneering a truly innovative product, devising a new business model, creating a better or cheaper version of an existing product or targeting an existing product to new sets of customers. Opportunities can be recognised as new products or services, new ways of production, new markets, new resources, or new ways of distribution.

For this research, we use the following definition of opportunity identification:

'Opportunity identification is the creation and/or discovery of something novel that has some value to the customer and/or society, and has profit for the entrepreneur'.

In addition, the opportunity research literature provides various terminologies with regard to the concept of opportunity. The terms 'recognition' and 'creation' are commonly used, and are connected to specific theories (as will be discussed in the following sections). Therefore in this research we prefer the more neutral terminology of opportunity identification, which is inclusive and means that none of the 'opportunity' theories are excluded in this research. Although in

the domain of entrepreneurship 'opportunity' is a clear concept, in other disciplines such as educational sciences, it has a much broader meaning. If in this dissertation we use the concept of opportunity, we refer to an 'entrepreneurial opportunity' (McMullen, Plummer & Acs, 2007) or a 'business opportunity'. Some examples of entrepreneurial opportunities by informatics students are described in Chapter 5 (p. 132).

Process model of opportunity identification

Shane and Venkataraman (2000) proposed a model for the process of opportunity identification, consisting of three stages: opportunity search, opportunity evaluation, and opportunity exploitation. Ray and Cardozo (1996) proposed a preceding phase of heightened alertness to information. This entrepreneurial alertness was defined as 'a propensity to notice and be sensitive to information about objects, incidents, and patterns of behaviour in the environment, with special sensitivity to maker and user problems, unmet needs and interests, and novel combinations of resources'. Also Shook, Priem and McGee (2003) proposed a preceding stage of entrepreneurial intention. These scholars include in their model psychological factors, characteristics (i.e., education and past experiences) and cognitions in the process of venture creation and opportunity recognition.

Opportunity identification describes a range of phenomena that begin unformed and become more developed in time (Ardichvilli et al., 2003). They may begin as simple concepts and become more developed by the entrepreneur. It starts with some form of recognition, discovery, creation, search or serendipity that leads to the first spark of an entrepreneurial opportunity. In its most elemental form, an 'opportunity' may appear as an imprecisely defined market need, or un- or under-employed resources or capabilities (Kirzner, 1979). As the market needs become more precisely defined in terms of benefits and value sought by particular use, and resources become more precisely defined in terms of potential use, the opportunity progresses from its elemental form and a business concept begins to emerge (Ardichvilli et al., 2003). The opportunity process then proceeds to the stage of evaluation (Shane and Venkataraman, 2000) where the product or service is evaluated in the context of markets, resources, supply chain and feasibility.

In our research the focus was on the stages of opportunity identification and evaluation in education. These two stages of opportunity identification can be organised and experienced in the school system, to offer students the possibility of developing their competences in opportunity identification.

During the last stage of opportunity exploitation, serious organisation is needed to bring an idea to the market, which is difficult to manage within the boundaries of the school system. However, initiatives to promote the exploitation of student companies by providing incubator facilities have been reported (Van der Sijde & Ridder, 2008).

Theories of opportunity identification

In this section the main theories of opportunity identification will be discussed: the discovery theory, the creation theory and the theory of effectuation. Also the relationship of the theories of

opportunity identification to learning theories will be elaborated.

According to the **discovery theory,** opportunities exist in the environment, independent of the individuals who discover them (Alvarez, 2005; Kirzner, 1973; McMullen et al., 2007; Shane, 2003). An advantage in knowledge means that some individuals discover opportunities and others do not. Every price, invention and piece of information has within it objective opportunities (Alvarez, 2005). The discovery theory is, from the learning perspective, mainly built on knowledge acquisition. According to Shane (2000) entrepreneurs discover opportunities related to the information they already possess: prior knowledge of markets, prior knowledge of ways to serve markets, and prior knowledge of customer problems. The entrepreneur with knowledge of market disequilibria has an advantage over others, and having such knowledge is a primary competitive advantage. The discovery theory departs from causation thinking, where rational decision-making is assumed possible and desirable with the focus on a predefined plan, complete information, as well as an overview of ways to maximise profits. In this theory, a predominantly linear process of opportunity identification is assumed, however in practice the sequence of steps is passed iteratively. In this view opportunity recognition seems to be largely an individual cognitive process of scanning the market for disequilibria, and finding new ways to exploit these by applying industry or domain knowledge. Relevant knowledge is constructed through dialogue and participation. The discovery theory has elements of the cognitive learning theory that is characterised by the development of mental schemas and scripts, and according to this theory, instruction theories should focus on activating pre-knowledge, elaborating and combining knowledge, applying this knowledge in various contexts, and structuring and developing heuristics (Valcke, 2007). In entrepreneurship, the market context functions as a source of information and is the nucleus for the entrepreneur's learning process. Also parallels exist between the discovery theory and the social constructivism learning theory. In this theory learning is mainly concerned with the interrelationship between individual entrepreneurs and their cultural, social and structural environment. Knowledge is constructed through dialogue, and the sharing and developing of information with others is essential. Entrepreneurs' networks are important to opportunity identification (Hills et al., 1997; McGrath, 1996). Entrepreneurs with extended networks identify significantly more opportunities than solo entrepreneurs (Hills et al., 1997). De Koning (2003) showed that entrepreneurs evolve opportunities by information gathering, thinking through talking, and resource assessing, in general through active interaction with an extensive network of people.

According to the **creation theory** opportunities are created through hypothesis testing and learning by the entrepreneur (Alvarez, 2005; McMullan et al., 2007; Schumpeter, 1934). In this theory, the individual shapes an innovation that did not exist before, and an opportunity is created by the entrepreneur through the recombination of existing information and cooperation on common goals and tasks. Creation theory implies reorganisation and reconnecting mental schemas and the formation of new prototypes by individuals. Ward (2004) distinguishes three mechanisms in creation: conceptual, combination and analogical reasoning. Reconstruction of knowledge

implies that the entrepreneur has knowledge of various kinds, such as domain, market or industry knowledge. This was confirmed by Baron and Enslay (2006), who found that the mental prototypes of experienced entrepreneurs were more clearly defined, richer in content, and more concerned with factors and conditions related to actually starting and running a new venture than the prototypes of novice entrepreneurs. Alsos and Kaikkonen (2004) found that 'created' opportunities are often related to business experiences, employed work, and hobbies. Prior knowledge can also have been obtained through education. Created opportunities proved to be more innovative than those gained by discovery.

Parallels exist between the creation theory of opportunity identification and the cognitivist learning theory. This theory is dominated by concepts such as mental schemas, and declarative and procedural knowledge. According to the creation theory the learner is a (re)constructor of knowledge, of existing mental schemas, and learning is reconstructing knowledge from experience (Merrill, 1991). The creation theory of opportunity identification also bears elements of social constructivist learning theory, which states that new knowledge is created through the collaborative construction of participants in a community with a common interest (Vygotsky, 1978).

The effectuation theory is an alternative to the causal and linear way of thinking in entrepreneurship research. The effectuation theory breaks with the assumption of pre-existing opportunities, markets, etc. and instead focuses on how entrepreneurs deal with the on-going challenge when limited means are available, the situation is unpredictable and pre-existing goals are absent. It takes as its starting point a set of individual-related given means: 'Entrepreneurs begin with three categories of "means": they know who they are, what they know, and whom they know—their own traits, tastes, and abilities; the knowledge corridor they are in; and the social networks they are a part of' (Sarasvathy, 2001, p. 250). Given these means the entrepreneur asks: What can I do with these means? (Sarasvathy, 2008), and from there starts a process of improvisation and change. Small steps are taken in which the actor cooperates with others to gain access to resources that are out of his control. From here new goals arise that give the actor a new perspective on what he can do, as well as new means that affect the actor's perceptions of 'who, what and whom I know'. Iterative cycles of step-wise effectuation will follow.

Imaginative rethinking of possibilities and continual transformation of targets characterise the process of effectuation (Sarasvathy & Dew, 2005). Effectuation has the premise that the future is at least partially created by wilful participating agents. The process of effectuation is iterative in nature. Because creativity as well as cooperation in a community are both crucial factors, effectuation implies elements of both the cognitivist and the social constructivist theory of learning.

Prior knowledge is a key element in opportunity identification. According to Alsos and Kaikkonen (2004) opportunities may be the result of serendipity or deliberate research, and may be objectively discovered or subjectively created. These authors combined these two axes and came to four types of opportunity identification: opportunity discovery, opportunity search, opportunity creation and

opportunity occurrence. These authors showed that prior knowledge plays a role in all types of opportunity identification, but this role differs depending on the type of process.

All three theories of opportunity identification assume learning in the sense of retrieving, processing information and recombining information, as well as participation and cooperation in a community. Therefore both cognitivism and social constructivism are relevant in designing an education that aims at fostering competence in opportunity identification, and this implies that instruction strategies from both theories can be used for educational design (Gravemeijer & Cobb, 2006). This will be further elaborated in Chapter 3 of this research.

Having knowledge of domain and markets is important in learning, because new knowledge is built upon existing knowledge. However, science students in general have limited knowledge of markets, of ways to serve markets or of customer problems. Starting from this specific, industry- or market-related knowledge is a difficult approach to teaching. In this research the creation perspective is therefore emphasised, because here an extensive knowledge base is relevant, and it may be assumed that science students do possess specific knowledge. As a conclusion, the main theories of opportunity identification can be connected with existing learning theories: cognitivism and social constructivism. It means that teaching the fostering of students' competence in opportunity identification can use instructional design models of both learning theories.

Creativity and opportunity identification in education

Opportunity identification is a multi-factor phenomenon, and several authors have discussed the factors that influence the process of opportunity identification (Ardichvilli et al., 2003; Corbett, 2007). In this section, one of the factors that seem relevant for education is briefly discussed: creativity.

Research supports the assumption that the process models of creativity and opportunity identification show similarities and that creativity, cognition and opportunity recognition are correlated (Hills, Shrader & Lumpkin, 1999; Corbett, 2005; Ward, 2004). Therefore theories and models of creativity research may be useful in the development of education on opportunity identification. Wallas (1926) was the first researcher to describe a model for creativity consisting of four stages: preparation, incubation, insight and evaluation. Later this model was extended with a fifth element: elaboration (Csikszentmihalyi, 1996). Amabile (1983) described a componential framework of creativity composed of five stages: 1) problem or task presentation, 2) preparation, 3) response generation, 4) response validation and 5) outcome. Hills, Shrader, & Lumpkin (1999) showed empirically that the recognition of business opportunities is a context-specific form of creativity in entrepreneurship. The authors argue for a creativity-based approach to opportunity recognition and developed a five-stage model for the opportunity recognition process, which is based on Csikszentmihalyi's model. A comparison of models for creativity with the process model of opportunity identification shows that many similarities exist between these models. It can be assumed that opportunity identification may be considered as a domain-specific form of creativity in the context of entrepreneurship, which implies that process models for enhancing

creativity can be of value in the fostering of students' competence to identify opportunities. Several authors have described experiential approaches in education with the aim to enhance creativity abilities in students (Gundry & Kickul, 1996; Dewett & Gruys, 2007). Ward (2004) gave attention to the role of knowledge that can either enhance or inhibit creativity, where new ideas are built on a person's knowledge of a specific domain. Also Amabile (1983) developed a three-component framework for the enhancement of creativity.

Other resemblances between creativity and opportunity identification can be distinguished in the cognitive processes underlying both (Corbett, 2005). Gregoire, Barr & Shepherd (2010) developed a model of opportunity identification as a cognitive process of structural alignment, prior knowledge and mental connections. Corbett (2007) ascertained a relation between general knowledge, specific knowledge, ways of information retrieval and information processing on one side, and opportunity discovery on the other side. Baron (2004) stated that people who recognise opportunities have a more developed alertness schema, which is based on previously built cognitive structures. This author also described opportunity recognition as a form of pattern recognition (Baron, 2006). The elements of cognitive learning mentioned above have also been described as playing a role in creativity models (Amabile, 1983; Ward, 2004; Ward, Smith, & Finke, 2007).

Therefore, it can be concluded that resemblances exist between the process model, cognition and methods for enhancing creativity and methods for fostering the competence to identify opportunity identification. Experiential activities are generally accepted for the enhancement of creativity, and several authors advocate the use of creativity techniques. These findings from creativity research can help in the design of entrepreneurship education, and can be applied in instructional design aimed at the fostering of competency in opportunity identification.

Competence

Students' competence is a central concept in this research, and therefore a need exists to be explicit about exactly what is meant by competence. Competence is an ill-defined concept, crossing different disciplines and levels of analysis, and therefore various definitions of competence have been reported for various purposes (Onderwijsraad, 2002). For this research a comprehensive, educational approach to competence is desired. Competence from this perspective is considered a personal characteristic someone needs for successful task performance and problem solving with respect to real-world entrepreneurial problems, challenges and opportunities on an individual level (Mulder et al., 2009). The concept of competences as it has been developed in vocational education, and now is accepted in higher education, integrates the personality and behavioural perspectives, the context as the learning environment and the cognitive approach of entrepreneurship; it is the synthesis of knowledge, (cognitive) skills, attitudes and personal qualities for the performance of specific, professional tasks (Lathi, 1999; Mulder et al, 2009).

Cognitive skills are an important element of competences. They are associated with the mental operations that process information. Such cognitive skills all refer to mental processes while using,

transforming or supplementing available knowledge. Furthermore, cognitive skills are associated with higher-order activities like problem solving, reasoning, thinking, assessing, concluding, and include the mental processes of analysis, synthesis and evaluation (Bloom et al. 1956) to produce a re-ordering or extension of someone's existing cognitive structure (Westera, 2010). Such is the case in the mental process of opportunity identification.

In contrast with knowledge, cognitive skills are difficult to assess directly, and this has consequences for assessment of competences. The only way to assess the mastery of a cognitive skill is to provoke observational behaviour that can directly be linked to the skill.

Some elements have been found frequently in various definitions of competences (Onderwijsraad, 2002). Competences are bound to specific contexts, are coherent clusters of skills, knowledge, attitudes and traits, are changeable in time, are connected to activities or tasks, and learning and development are conditional for the acquisition of competences. Competences are abilities of persons or teams, to make satisfactory and effective decisions in a specific setting or situation (Barnett, 1994; Kirschner et al., 1997).

This brings us to a working definition for this research. A competence is:

The synthesis of related knowledge, skills, attitude and personal qualities that enables a person to act effectively in an entrepreneurial task or situation.

Competence is considered to be conditional for behaviour. Competences cannot be observed directly, but the behaviour and artefacts that results from it, are. To a certain degree, competences are transferable from one situation to another.

Teaching students to identify opportunities

In this section an overview is presented of what has been found in the literature on fostering competence in identifying opportunities in education, and it concludes with the aim of this research.

A literature search on the teaching of opportunity identification resulted in only a few publications. Attempts to teach opportunity identification were studied by several scholars (Corbett, 2005, 2007; DeTienne and Chandler, 2004; Gaglio and Katz, 2001; Jones, 2007; Muzychenko, 2008; Nixdorff and Solomon, 2007; Saks and Gaglio, 2002). Saks and Gaglio (2002) examined how entrepreneurship educator-practitioners from fourteen top masters-level entrepreneurship programmes in the USA conceptualise and teach the opportunity identification process. The results show that most teachers focus on the evaluation stage in the opportunity identification process, and less on finding an opportunity. In another study, Gaglio and Katz (2001) suggest the training of students in advanced counterfactual thinking techniques to increase their ability to identify opportunities. DeTienne and Chandler (2004) empirically ascertained a series of interventions on stimulating opportunity recognition by students. In this SEEC training (securing, expanding, exposing and challenging), the authors were successful in improving both the number of ideas generated and the innovativeness of those ideas. Corbett (2005) coupled opportunity recognition with the stages in experiential learning and learning styles associated

with these stages, and gives recommendations for actions needed by students at each stage of opportunity recognition. Muzychenko (2008) focused on international opportunity identification and advocated a competence-based approach for teaching. This approach not only focused on opportunity identification itself, but also on strengthening the self-perceived task competence (self-efficacy) of the entrepreneur, since self-efficacy and opportunity recognition are strongly linked (Krueger, 2000). Nixdorff and Solomon (2007) reviewed the literature on competences for entrepreneurship education and found that creativity and opportunity recognition were cited most often. The authors also advocate the use of creativity in the fostering of opportunity recognition. Jones (2007) described the pedagogy of student-centred learning in the teaching of opportunity recognition, thereby strengthening entrepreneurial skills and abilities, such as risk taking, self-esteem, creativity and taking responsibility. Corbett (2007) developed the concept of learning asymmetries in learning to identify entrepreneurial opportunities. The concept is based on how individuals differ in acquiring and transforming information and experience (i.e., learning) in order to identify opportunities. This concept was implemented in experiential learning as a pedagogical model.

Although a few publications reported pedagogical formats that aim at fostering students' competence in identifying opportunities, heuristics for the design and development of such an education are hard to deduce from these studies, and a pedagogical model for fostering students' competence in identifying opportunities has not or only partly been defined in such a way that teachers can use it for the design and development of their courses. Therefore, it can be concluded that a pressing demand exists for design rules for developers and teachers who aim to set up new entrepreneurship programmes with an emphasis on opportunity identification. The aim of this research is to describe a set of design principles and strategies for the design and development of such teaching. This research will contribute to the development of practice in entrepreneurship education, but also to a broader elucidation of the mechanisms involved, and thereby contribute to the theory of opportunity identification.

RESEARCH QUESTION

This research aims to provide an answer to the question, how science students' competence in identifying business opportunities can be fostered in higher education. Despite theories and many studies on the phenomenon of opportunity identification, design rules to systematically develop an education that aims at fostering students' competence in identifying opportunities, hardly exist. Therefore, the central research question for this research is:

- What are design principles for an education that aims at fostering the competence of science students in identifying business opportunities?

In order to give an answer to the main research question, several sub-questions will be

answered in five separate sections of this dissertation:

1 What design strategies can contribute to the creation of an authentic learning environment in entrepreneurship education, and how can these strategies be optimized, based on an evaluation of a successful entrepreneurship course? (Chapter 2)
2 What design strategies for the fostering of science students' competence in opportunity identification can be developed from theories of opportunity identification and of learning? And based on an evaluation of a course that was designed with these strategies, what is the level of implementation of strategies, and do the students show the expected outcomes of the strategies? (Chapter 3)
3 Do expert teachers in entrepreneurship education report to apply these design strategies, and how do report to they implement these strategies? What additional strategies do expert teachers in entrepreneurship education report to apply in teaching opportunity identification, and how do they apply these additional strategies? (Chapter 4)
4 To what extent can design strategies for authentic learning and for fostering students' competence in opportunity identification be integrated in a single course design? (Chapter 5)

In answering these research questions, this research aims to provide an understanding of the fostering of science students' competence in identifying opportunities. The research will provide a set of design principles and corresponding strategies for such education. Thereby, it will contribute to the development of practice in education, but also to a deeper understanding of the theories and arguments involved.

RESEARCH METHODS

Educational design research

Many factors influence the process of opportunity identification by individuals: the entrepreneurs' personality traits, social networks, prior knowledge, creativity, entrepreneurial alertness, and other factors that vary with the stages of opportunity identification (Ardichvilli et al., 2003). Therefore, it can be characterised as a multi-factorial and complex process.

Teaching and learning processes are also characterised as complex and multi-factorial, where many factors may also influence students' achievements (Valcke, 2007). This makes the design and development of an education that aims at fostering students' competence in identifying business opportunities, a complicated and complex task for educators and for researchers, and a multidimensional view for this is advocated by Chell & Allman (2003).

We chose educational design research (EDR) as a research approach because it complies with the complexity and practicality of our research question (Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006).

> *'Educational design research is a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understanding that can inform the work of others'* (McKenney & Reeves, 2012).

EDR can produce practical solutions and theoretical insights simultaneously, in the real-world context of the classroom, and in collaboration with stakeholders. EDR produces design principles for the design and development of education, that are descriptions and characteristics of evaluated teaching and learning strategies that aim to acquire certain learning outcomes in students (Plomp & Nieveen, 2007). EDR also advances the knowledge that underlies these principles. This approach focuses on the development of generic solutions for field problems (Van Aken & Andriessen, 2011).

Reeves (2006) described the process of educational design research and the first step is to identify and analyse problems in a real classroom setting. Educational problems for which no or only a few validated strategies ('how to do' guidelines or heuristics) exist, are the starting point for design research, to structure and support the design and development. Next, prototype solutions are developed based on state of the art theory, existing design principles, and practical knowledge and technological innovations. This step is followed by iterative cycles of testing and refinement of strategies in practice, where each of the iterations is a micro-cycle of research. These iterations also result in a set of implemented interventions in the classroom(s) as the first result of this type of research. The process of EDR is completed with reflection in order to produce a better theoretical understanding and broadly applicable design principles as guidelines for implementation in practice.

EDR is a research approach that may include several research methods, often used in triangulation. In our studies we used multiple methods to study the phenomenon of fostering university students' competence in identifying business opportunities. Case studies were done to explore the design strategies of good practice (Chapter 2), and to study the implementation of design strategies in the context of entrepreneurship education (Chapter 5). An educational design study was used in Chapter 3, where we describe an iterative cycle of testing and refinement of design strategies to foster the students' competence in identifying opportunities. In this study a mix of methods was used: interviews with students and teachers, observations of teamwork and presentations of students, questionnaires, students' artefacts, and assessment forms used by external assessors. A qualitative study with expert teachers was performed to examine these empirically established design strategies from a previous study in a broader context (Chapter 4).

At this point, some elaboration on levels of evidential value of intervention studies is needed. For educational design research, four levels of evidential value of strategies and interventions are distinguished (Weber, Ropes, & Andriessen, 2011; Van Yperen, Veerman & Bijl, 2013).

On the lowest level the evidential value is 'descriptive'. In this type of studies a description is given of the strategy, the context in which the strategy can be used and the expected outcome(s). This type of design research can at best claim that the strategy has potential, and outcomes are unknown.

On a second level the evidential value of the research is also 'theoretically supported'. On top of a description of the strategy, theoretical substantiating is provided for example through mechanisms or theories that are applied in the strategy. The interventions have then theoretical support in addition to potential. Types of research connected with this level are meta-analysis, and literature research.

On a third level, the evidential value of the research is 'indicative'. In addition to description and theoretical support of the strategy, the expected outcomes have been achieved. If the intended outcome in students' performance is determined by a pre- and post-test, the expected outcome is achieved. On this level, functionality can be claimed. However, a causal relation cannot be claimed as for example in randomized control trials, and rival explanations for achieving the outcomes cannot be excluded.

On level four, the evidential value of research is 'causal'. The study then shows that the positive results are caused by the strategies, and not by something else. On this level, effectiveness can be claimed. Types of research connected with this level are (quasi-) experimental research and repeated case studies. Randomized control trials are considered as the most valid and reliable method to determine causality of a strategy.

In educational design research it is often impossible to determine a causal relation, because this type of research operates in complex situations in reality. Therefore, this research aims at the determination of the indicative functionality of design strategies. This level of evidence provides adequate guidelines for the development of education.

When, as in our studies, students' performance is only measured at the end of the course, then the expected outcome might be observed, but because only a post-test has been administered we only know to what degree students at the end of the course show the expected outcomes. We do not yet know if they have achieved this during the course. An alternative explanation might be that the students were competent already upon entering the course. This research can claim that there is an indication for functionality ('indicative') of a strategy or combination of strategies, meaning that at the end of the course students' products show their performance, but without claiming a causal relation, and without the exclusion of rival explanations. This level of evidence provides a theoretically and empirically supported indication that the strategy or combination of strategies might work and is therefore situated at the beginning of the third level described above.

In this research, we also use the **robustness** of a course design as an added criterion for evidential value. *'We need robust designs - ones that produce impressive results, not only under ideal conditions, but also under severe realistic constraints, and we want sustainable designs that thrive and improve with time, not ones that slide downhill every year'* (Walker, 2006, p. 13). To establish the degree of robustness of a design, repeated case studies can be used. If in repeated cases the functionality is shown and some rival explanations can be excluded (for example if the strategies have been executed by different teachers), evidence will increase that the strategies work. If in

this research, design strategies prove feasible and show an indicative functionality under several conditions, it can be claimed that the strategies are robust, which supports their generalization and their value in other circumstances.

As stated above, EDR can provide a functional and feasible solution for an educational problem, together with a set of empirically supported design principles as a contribution to theory. In line with McKenney, Nieveen & Van den Akker (2006) and Denyer, Trenfield & Van Aken (2008) we use the following format for a *design principle* for education:

In an educational Context C Strategies Sa….z will lead to/is expected to result in Expected outcome(s) O1…n because of Arguments A I…X.

The basic elements of a design principle are defined in Table 1. 1

Table 1.1: Elements of an educational design principle

Context	Describes the problem in its context. The context gives a description of everything outside the borders of the strategy (those elements that are not part of the strategy).
Strategy	A 'strategy' describes the (process or sequence of) planned activities, interventions and means, as they should be implemented in the classroom in a designed teaching and learning process.
Arguments	Arguments provide the explanation why the strategy has the intended and expected outcome. Arguments are based on theory or mechanisms in learning and teaching that are supported with empirical evidence and experiences in practice.
Expected Outcomes	Students 'performance that might be expected from the mechanisms that were built in the strategy, in a specific context. If expected student performance is achieved (as shown in pre- post test) or observed in a post-test, this indicates the functionality of the design strategy.

In our research, a design principle can be composed of one or more strategies, can have one or more expected outcomes and is based on one or more arguments explaining the expected outcomes. This research focuses on finding design strategies, and therefore this concept of (design) strategies is used in the individual chapters. In the final chapter, if several design strategies prove to contribute to the same goal, the strategies are brought together into a design principle.

Design principles and strategies are not intended as guaranteed recipes for success, but to help teachers and developers to select and apply the most appropriate substantive and procedural knowledge for a specific design and for the development of tasks in a specific setting.

Setting of this research

The research for this thesis was predominantly undertaken in The Netherlands, more specifically at Utrecht University and was conducted in the years 2006-2013.
Two case studies (Chapter 2 and 5), and a design study (Chapter 3) were conducted at Utrecht University. In an evaluation study (Chapter 4) expert teachers from universities and universities of applied sciences in The Netherlands (7), Belgium (1) and France (1), were interviewed.

Selection of cases

This research focused on entrepreneurship education for science students in higher education in the Netherlands, and therefore this was an important inclusion criterion for case selection.

The design strategies in Chapter 2 were distracted from a course on entrepreneurship for ICT students at Utrecht University. This case study started as a consultancy project for the faculty of science, and this project aimed at distracting characteristics of successful education for other courses of the faculty. This case was considered appropriate for this study because it proved to be successful over years in terms of numbers of start-ups that came into being from this course. In the last decade, this course produced several successful companies per year, each company providing sveral jobs. In this way, the course produced at least 100 jobs in the last decade. This case was accessible for the researcher, and it was expected that relevant processes, interventions and interactions could be studied properly. Besides, the long history of iterative development and refinement of this course was documented and available for analysis. The researcher and teachers considered this case as good practice and the case was expected to provide guidelines that can be used by teachers.

Chapter 3 aims at the development and evaluation of design strategies for fostering students' competence in opportunity identification. This case at Utrecht University was selected because this course had to be designed from scratch, and it offered the possibility to develop design strategies, to integrate these in the course design, to evaluate the degree of implementation of the strategies, and to evaluate the degree of functionality of the course design. The case offered the possibility to create the course together with the teacher, as a form of co-design. The proximity of the course for the researcher gave many possibilities to study the development, implementation and evaluation of the course (design) in detail.

Chapter 4 aimed at evaluating the previously found design strategies by expert entrepreneurship teachers. The selection started with known good practices in entrepreneurship education in the Netherlands. Expert teachers were selected that have at least three years of experience in EE for science students. Next, more expert teachers were detected by the snowball method: each interviewed expert was asked to name one or two other teachers in the field. To begin with, expert teachers for programs for non-technical students were selected. Later a teacher of a programme for technical students was included. Finally, expert teachers from Flanders as well as from a French university were included. Selection of expert teachers continued until saturation in results occurred.

The case in Chapter 5 was selected because it offered the possibility to study a course where design strategies for opportunity identification as well as for the creation of an authentic learning environment were implemented in a single course. This made it possible to examine the design strategies of this course design, their feasibility, and their indicative functionality. This case also meets other selection criteria: entrepreneurship education for science students, and successful in generating start-up firms. The course was easy accessible for observations, interviews, distribution of questionnaires, and videotaping of lessons.

Units of analysis

In Chapters 2, 3, 4 and 5 educational design strategies are evaluated with data from multiple units of analysis: course descriptions and documents, and artefacts from students, teachers, and assessors. In three case studies (Chapters 2, 3 and 5) data are collected from students by observations of presentations, interviews, and products such as business plans. Questionnaires are used to measure the students' perception of opportunity identification competences, and their perception of the learning environment.

Course descriptions were studied and the rationale of the course design was discussed with teachers. Teachers in the classroom and informal meetings with students were observed and also teachers were interviewed. External assessors were interviewed and observed, and their scores and comments on students' business ideas were used as data. In the evaluation study (Chapter 4) expert teachers in entrepreneurship education at various universities and universities of applied sciences were interviewed.

Characterisation of participating students

All students in Chapters 2, 3 and 5 had a bachelor science degree in biology, chemistry, biomedical science, physics, informatics, information science, or pharmacy. Some of the participating students had previously finished an applied science master at one of the Dutch universities of applied sciences, and then continued in a business and science master at university level. All students in these studies were in their final year before graduation.

A degree in science meant that all participating students had knowledge of the science domain that can be applied in the identification of opportunities. As Shane (2000) postulated, entrepreneurs will identify opportunities because prior knowledge triggers recognition of the value of information. He maintains that an entrepreneur will only discover opportunities that are related to his or her prior knowledge. Because students had a proven knowledge of science, they could apply this knowledge to discovering or creating new entrepreneurial opportunities. All students in these studies had chosen a master programme in Entrepreneurship or Business, meaning that they were motivated for entrepreneurship or a business career. Their motivation for entrepreneurship was also measured by means of questionnaires in two of our studies. 52% of the students in the study reported in Chapter 3 stated that they had plans to become an entrepreneur in the future, and 56% had some form of experience in entrepreneurship with family, friends or active participation.

In the study reported in Chapter 5, 71% of the students had plans to start a business, where 58% had some prior experience in entrepreneurship with family or friends, and 29% owned a company while participating in this study. Having future plans for entrepreneurship, or having past or current experience in entrepreneurship may have a positive effect on motivating students to take an entrepreneurship course. The gender proportion differed in the student population of the courses. In two studies the participation of females was low (< 10%) in Chapters 2 and 5, whereas in one study (Chapter 3) female and male participation was more in balance (43.4 % females). In general the degree of participation of females in science studies is low in The Netherlands.

Questionnaires with a 5-point scale were used to characterise the students in Chapter 5. The mean scores of students prove to be high (mean + 1 SD) for the scales Divergent Thinking (3.65), Intrinsic Motivation (3.62), Working Style (3.64), Problem Solving Style (3.88), and Self-Efficacy (3.68). In general science students can be characterised by analytical and critical thinking due to their training in solving scientific problems, and it can be assumed that they have a more analytical than intuitive style in terms of opportunity identification (Kickul, Gundry, Barbosa, & Whitcanack, 2009). Also one might expect that these students have a limited match between their cognitive styles and the divergent thinking skills that are necessary to identify opportunities (Wolf & Kolb, 1984), and therefore extra emphasis must be given to the teaching of these skills. An overview of participating students in our studies is given in Table 1.2.

Characterisation of the selected courses

In two studies (Chapter 2 and 5) the course under investigation was an elective, and in one case (Chapter 3) the course was a mandatory part of the master programme. All three courses in this research were part of master programmes on 'science and business' or 'science and entrepreneurship'. This can be relevant for the motivation of students, as it is well known that the motivation of students in electives is higher than in mandatory courses.

All three courses were provided in an academic context at universities, which implies that the courses must have, from a legal perspective, a focus on theorisation and on research as a method of gaining knowledge, besides the focus on starting a business, which has many practical implications. The courses consisted of both experiential learning elements, and theoretical elements with a focus on conceptualisation and argumentation. The proportion of both varied within the courses. An overview of courses that were studied in this dissertation is presented in Table 1.2.

Participating teachers

In all studies teachers played an important role. In the studies in Chapters 2 and 5 the teachers took a role that matched the project-based and experiential pedagogy of the course. Besides being a teacher, they were also the CEO of a virtual company, and took the role of an entrepreneur, co-worker and manager (Chapter 2). The teacher avoided taking the role of knowledge provider. The teachers in these studies were experienced and had a long history of development of entrepreneurship education and had proved to be successful in stimulating new start-ups.

In Chapter 3 the teachers had less experience, but had a role in the design, development and implementation of the course. These teachers departed and were replaced by others during the cycles of development. The focus of these teachers was on theorisation as well as being a coach in the process of start-ups. The expert teachers in Chapter 4 were selected because of their well-known expertise in entrepreneurship education for science students. None of these teachers were trained to be an entrepreneurship teacher, but they had acquired their competence through experience. In one case (Chapter 3) the teacher's competence was built up during the course. An overview of participating teachers in all studies is presented in Table 1.2.

Table 1.2: Summary of the characterisation of courses in this research and their participants

Chapter	Course characteristics and participants
2	• Elective Graduate course on ICT and Entrepreneurship (Netherware) at Utrecht University for students in the Master Business Informatics. • 57 participating students, over 90% male. • Teachers with entrepreneurship background and a long experience in entrepreneurship education and a proven success rate in stimulating new start-ups over the years.
3	• A mandatory entrepreneurship course as part of the master's degree in Science and Business at Utrecht University. • 23 participating students, with 43.4% females. • Course in the third cycle of development, and teachers varying each year. • 52 % of the students plan to become entrepreneurs. 56% had some form of experience in entrepreneurship
4	• Teachers from universities and universities of applied sciences in The Netherlands, Belgium and France. Expert teachers with at least three years of experience in entrepreneurship education for science students were selected, based on their well-known expertise in teaching entrepreneurship. • All selected teachers were involved in bachelor or master programmes for science/agricultural studies, other technical studies.
5	• Elective graduate course on ICT and Entrepreneurship at Utrecht University for students in Business Informatics. • 31 participating students with 6% females. • 71% had plans to start a business. 58% had some prior experience in entrepreneurship with family or friends, 29% owned a company. • Students had high scores for Divergent Thinking, Intrinsic Motivation, Working Style, Problem Solving, and Self-Efficacy. • Experienced teachers with a long and sustained history of development and a course successful in stimulating new start-ups.

OVERVIEW OF THE THESIS

The empirical research for this dissertation can be divided into four chapters that are preceded by an Introduction and are concluded with a Discussion.

Chapter 1 of this dissertation (Introduction) presents the relevance of this research, and then elaborates on the relevant concepts and theories from entrepreneurship and from educational science. Then the central research question of this research is presented:

- *What are design principles for education that aims at fostering the competence of science students in identifying entrepreneurial opportunities?*

Educational design research that is used as a design approach in this dissertation is elucidated, and the selection and setting of the various studies is clarified. Finally an overview is given of the aim of the individual studies.

Chapter 2 describes an explorative case study on characteristics of successful education in entrepreneurship. The conceptual design of an entrepreneurship course that has proved to be successful in producing start-ups in the IT domain is explored. Design strategies for an authentic entrepreneurial learning environment are drafted from literature, and the strategies are then evaluated in a case study.

Next, two chapters focus on revealing educational design strategies that foster science students' competence in identifying business opportunities.

Chapter 3 describes an educational design study for the fostering of science students' competence in identifying opportunities, and aims at piloting design strategies for this type of education. From theory and practical evidence of teachers three strategies are developed. The strategies are integrated into a course design and then the course design and the individual strategies are implemented in the classroom and evaluated in practice.

Chapter 4 presents a further evaluation of three design strategies from the previous study (Chapter 3). In this qualitative study expert entrepreneurship teachers are interviewed to determine whether they use the previously described strategies in their teaching, and how they implement these strategies. Then it is examined whether they use additional strategies with the same objective, and how these additional strategies are implemented. Nine expert teachers in entrepreneurship education at nine different universities are interviewed.

Chapter 5 of this research evaluates the synthesis of two sets of design strategies from the preceding studies, in a single course in practice. The first set of strategies is on fostering science students' competence in opportunity identification, while the second set of design strategies is on

the authentic learning environment. All strategies are combined into a single course design.
It will be studied if these strategies are applied coherently, and how they are applied. Then, the degree of realization of each strategy is determined. The indicative functionality of the course with regard to opportunity identification is determined by assessment of students' products by external experts.

Chapter 6 presents the conclusions with regard to the central research question of this thesis, and reflections on the research. This research provides two design principles. The first is a concept principle that consists of six design strategies for handling the subject of opportunity identification. The second is the learning context principle that consists of strategies for the creation of an authentic learning context for opportunity identification. This chapter concludes with a reflection on this dissertation as a whole, and provides suggestions for practice in entrepreneurship education, for higher education in general, and discusses the implications of this research for further educational research. Finally, an overall presentation of all design strategies from this research is provided.

The chapters of this research are schematically presented in Figure 1.1. This figure is used as an organizer for this dissertation.

Figure 1.1: Organiser for this research

	Educational Context	***Content Opportunity Identification***
Relevance and theory	*Chapter 1* *Introduction*	
Exploratory case study	*Chapter 2* *Case study on characteristics of successful entrepreneurship education*	
Pioting design strategies		*Chapter 3* *Development and evaluation of design strategies on fostering opportunity identification*
Evaluating design strategies in other contexts, and finding new strategies		*Chapter 4* *Evaluation of design strategies on opportunity identification by expert entrepreneurship teachers in science education*
Evaluation of integrated design strategies	*Chapter 5* *Evaluation of design strategies on fostering opportunity identification and on an authentic learning context in a single course design*	
Reflection on this thesis	*Chapter 6* *Conclusions and Discussion*	

Chapter 2

Authentic competence-based learning in university education in entrepreneurship[1]

ABSTRACT

This explorative study aims to explore the characteristics of successful entrepreneurship education for science students. For this purpose, the concept of authentic learning as an integrated part of competence-based learning is introduced as a perspective for entrepreneurship education.

Design strategies for authentic learning were drafted from prior studies and evaluated in an entrepreneurship course for informatics students that have proven to be successful in stimulating new start-ups. Based on the evaluation results, five design strategies are presented that characterize the circumstances in a start-up. These design strategies for authentic learning in entrepreneurship education are: the working atmosphere as in a start-up, students in autonomous roles of problem solver, working on realistic tasks and activities, the role that the teacher should have, and on assessment as in entrepreneurship.

Next, recommendations are provided for improvement of some strategies, and suggestions are made for the introduction of additional strategies for the stimulation of collaboration, multiple roles for students, and role modelling by entrepreneurs.

The findings of this study can enhance the development of entrepreneurship education in forthcoming curriculum projects.

[1] *This chapter is an adapted version of 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.*

INTRODUCTION

Entrepreneurship brings economic growth, and innovations, and creates new jobs (Shane & Venkataraman, 2000): therefore much emphasis is given to entrepreneurship education (EE) as a means to prepare a new generation of entrepreneurs. In Europe for example, the number of positions and courses in EE has increased in the last decade, in business as well as non-business studies (European Commission, 2008), for example in Denmark, Germany and the Netherlands. In particular, domains like life-sciences, engineering, IT, medicine and health increasingly acknowledge the added value of fostering entrepreneurial competences among their students in the light of new career paradigms, lifelong learning, globalization, employability and innovation (Defillippi & Arthur, 1994; Guo, 2009; Gurău, 2006).

For entrepreneurs the context plays an important role in the process of learning, and it can be expected that the introduction of relevant context elements from entrepreneurship can contribute to the development of entrepreneurship education. Therefore, this study takes the learning context of entrepreneurs as the perspective for the development of entrepreneurship education.

Entrepreneurial contexts are characterized by complexity, deadlines, uncertainty, various roles, multidisciplinary and open-ended tasks, lack of structure, and ambiguous conditions. The learning of the small business owner is characterized by learning by doing, by trying, by copying and by mistakes (Gibb, 1997). In these circumstances entrepreneurs learn from collaborating with a diversity of persons in their professional and personal environments, in multiple communities of practice. Rae (2000) considered entrepreneurship as a contextual process of becoming an entrepreneur, in which the entrepreneur is permanently learning and developing in relation to himself/herself and his/her environment.

In education, the learning context is strongly defined by the pedagogical approach that is chosen. For entrepreneurship education, experiential learning (Kolb, 1984) is often reported as a successful pedagogical approach (Corbett, 2005; Hannon, McBride, & Burns, 2004; Heinonen & Poikkijoki, 2006; Kickul et al., 2010; Pittaway & Cope, 2007).

However, in literature a clear description of the contexts in which students should have entrepreneurial experiences is seldom given. Moreover, entrepreneurship education is located within the school system that by default is not an enterprise. It can be expected that higher education is lacking several if not many characteristics of an entrepreneurial context. So, if the entrepreneurial context is conditional for learning in entrepreneurship education, it means that relevant elements of this context must be brought into the classroom.

Therefore we first introduce the concepts of authentic learning in this study. Authentic learning is derived from situated learning (Brown, Collins & Duguid, 1989). According to this paradigm, learning is domain specific as well as context specific, and learning should therefore be contextualized (Brown et al., 1989; Carlson et al, 1990). The learning environment should be designed to evoke the key cognitive activities of entrepreneurship.

Several scholars from the entrepreneurship domain have argued for the introduction of authentic elements in entrepreneurship education (Gibb, 1993; Pittaway & Cope, 2007; Taatila, 2007; Vincett & Farlow, 2008). An authentic learning environment should be functional, realistic, activating and inviting to learn. Such a learning environment can be designed with the aid of the theory of authentic learning. Strategies for developing authentic learning in other domains were defined by several authors (Herrington & Oliver, 2000; Renzulli, Gentry & Reis, 2004; Rule, 2006), and these strategies from other learning contexts can contribute to entrepreneurship education.

The authenticity of tasks refers to the degree of similarity between the tasks used in an educational setting and the tasks in a real professional setting (types of problems, constraints, information, materials and other resources), or the extent to which they require (cognitive) processes and activities similar to those in a real setting, with similar time frames (Ten Berge et al., 2005b).

This study aims to draft and optimize a set of design strategies for an authentic entrepreneurial learning environment in higher education. Guidelines for the design of education are usually presented in the format of design principles and strategies (McKenney et al., 2006). Design principles are composed of context, strategy, argumentations on the mechanism involved and expected outcome, and can be seen as a coherent description (see section Method).

The design strategies of authentic learning in this paper are derived from prior studies, and course documents. The strategies are evaluated in a master course in ICT entrepreneurship at Utrecht University in the Netherlands. Data from various sources and stakeholders were analysed, and based on the results, adjustments will be proposed in order to improve the set of strategies. Together these strategies will provide a design principle for the creation of an authentic learning environment in entrepreneurship education.

THEORY

The learning context of entrepreneurs

The professional contexts in which entrepreneurs operate are characterized by complexity, time pressure, deadlines, uncertainty, multiple roles to be taken, ambiguous conditions and multidisciplinary, open-ended, ill-structured, hidden and ill-defined problems. The learning 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). Lans et al. (2008) showed the impact of the entrepreneurial context for the learning of entrepreneurs. Entrepreneurs experienced support and guidance, external interactions, internal communications and task characteristics as essential in their environment. In these circumstances entrepreneurs learn from collaborating with a diversity of persons in their professional and personal environments.

Learning from others in the professional and private environments is one of the characteristics of the learning of entrepreneurs. Entrepreneurs learn in the multiple, overlapping communities of

knowledge and practice in which they participate.

Baron (1998) has outlined the working situation of entrepreneurs as having high levels of uncertainty, novelty, emotion and time pressure. The cognitive processes of the entrepreneur will be influenced by various forms of bias and error if an overload of information occurs, and high degrees of uncertainty if new situations occur, in which the entrepreneur cannot fall back on existing mental frameworks. Besides that, emotions run high, and often a high time pressure exists. These factors from the professional context of the business owners influence their cognitive functions and will cause errors in decision-making. Cope (2005) on the other hand, states that especially critical incidents in the professional life of the entrepreneur evoke high-order learning. Emotions intensify the effects of critical incidents. Non-routine situations force entrepreneurs to question their taken-for-granted beliefs and assumptions, to reframe their mental frameworks and change the management of their enterprise, as well as their personal beliefs and feelings. Essential for learning from critical incidents is deep reflection. Volberda (2004) uses the concept of turbulence – ranging from stable to extreme competition – when analysing the dynamics, complexity and difficult to unpredictability of the market in which entrepreneurs operate. The context of entrepreneurship is complex and difficult to predict, and many aspects of this context are not available in current educational circumstances at universities.

Competences of entrepreneurs

Abilities of entrepreneurs and students to make satisfactory and effective decisions in a specific professional setting or situation can be described as a competence (Barnett, 1994; Kirschner et al., 1997). Competence is an ill-defined concept, crossing different disciplines and levels of analysis, and therefore various definitions have been reported for various purposes (Onderwijsraad, 2002). Competences combine several elements: motives and intentions, attributes, self-concept (attitudes), knowledge and skills (Spencer & Spencer, 1993). These elements aim at the performance of specific professional tasks, which take place in specified contexts. It is accepted that knowledge and skills can be learned and can be taught; the self-concept is changeable, but only with large efforts; and attributes are open to change and can be changed by educators by influencing thoughts, feelings and behavioural intentions (Florin et al., 2007). Motives and intentions are linked to the personality of the student, but can be influenced by the ecology of learning, such as the kind and relevance of tasks and the role of the teacher. In competence-based learning all these elements are considered as part of a whole and as necessary for performing a professional task. Competences are changeable and learnable, and interventions in terms of education can contribute to the process of learning.

Motives and intentions select and direct the behaviour towards specific goals. Hornaday (1982) was the first to study the motives of entrepreneurs for starting a venture. It is supposed that motivation is part of the personality of an individual, and motives can be manifested by external factors and can stimulate the individual to action (Boekaarts & Simons, 1995). Driessen (2005) distinguished internal and external factors in the motivation of entrepreneurs. Internal factors

are the need for autonomy, the need for achievement and the need for power (McClelland, 1961). External factors are unemployment, seeing a niche in the market, a desire to perform the profession or the certainty of having clients. The external factors are in accordance with the definition of entrepreneurship by Bull and Willard (1993).

In the literature, many *attributes* of entrepreneurs have been mentioned: endurance, creativity, risk- taking propensity, autonomy, internal locus of control, self-belief and self-confidence (Caird, 1993; Gibb, 2002). Other attributes are the identification and seizing of opportunities, and the entrepreneurial drive. These attributes may add to the success of the entrepreneur.

The self-concept consists of the set of attitudes, values and convictions of a person. An attitude is generally understood as a learned predisposition to respond in a predictable manner with respect to the object of that attitude (Azjen, 1991). Entrepreneurs show a preference for learning through action. A preference for innovation, nonconformity, proactive disposition, self-efficacy and achievement motivation were given as attitudinal dimensions of the entrepreneurial drive (Florin et al., 2007).

The *knowledge goals of* entrepreneurship education programmes were analysed by Béchard and Toulouse (1998). They described eight groups of specific teaching objectives for entrepreneurship education, and distinguished content, skill and situational levels, where the situational level mostly approaches the definition of competences. For entrepreneurial academics, research objectives should be added to this list.

Cognitive skills are an important element of competences. They are associated with the mental processing of knowledge, and are associated with higher-order activities. Specific entrepreneurial *skills* are negotiation, persuasion, selling, proposing, project management, time management, strategy formulation and creative problem solving (Gibb, 2002). In case of academic entrepreneurs, academic skills should also be added to this list. The five elements above can be combined in logical clusters of competences, directed by the specific professional tasks of the entrepreneur.
Summarizing the elements that were elaborated above, this leads to a working definition of competence for this study:

> "*The synthesis of related knowledge, (cognitive) skills, attitudes and personal qualities that enables a person to act effectively in an entrepreneurial task or situation*" (see Chapter 1).

A similar definition was used by Man et al. (2002), who proposed a set of competences that entrepreneurs must attain to deal with the specific context of entrepreneurial life. Students should develop one or more of these competences depending on the type of entrepreneurship education (see Chapter 1).
Entrepreneurial competences, as proposed by Man et al. (2002) are:

- opportunity competences: identifying and developing market opportunities through various means
- relationship competences: person-to-person-based or individual-to-group-based interactions, e.g., building a context of cooperation and trust, using contacts and connections, persuasive ability, communication and interpersonal skills

- conceptual competences: different conceptual abilities which are reflected in the behaviour of the entrepreneur, e.g., decision skills, absorbing and understanding complex information, risk taking and innovativeness. This also includes domain knowledge, for example of science.
- organizing competences: the organisation of different internal and external human, physical, financial and technological resources, including team building, leading of employees, training and controlling
- strategic competences: setting, evaluating and implementing the strategies of the firm
- commitment competences: the entrepreneurial drive to move ahead with business.

Authentic learning

The challenge is to create a learning environment that has the relevant characteristics of the entrepreneurial profession in order to encourage students to develop entrepreneurial competences. The application of an authentic learning environment in entrepreneurship education may help to simulate the professional situation and create a learning environment that focuses on the relevant competences.

Projects, cases, and problems have frequently been used in higher education as a starting point for learning. A real problem coupled with a professional situation and context is the key feature of an 'authentic' problem (Gobert & Pallant, 2004). Authentic tasks aim at engaging students in that same sort of problem solving, reasoning and decision-making processes that are characteristic of professional practice. According to the situated cognition paradigm, it is important that learning is contextualised: problem solving is a domain- and context-specific task (Kirsh, D., 2009). Problem solving requires domain-specific knowledge, both declarative and procedural (Shin et al., 2003). The knowledge is general and explicit (concepts, models, principles, methods and procedures). Also, tacit knowledge is involved in problem solving, often specific for a group of problems or contexts.

Jonassen (2004) identified the critical features of tasks for higher-order learning: the type of problem, the degree of complexity and the structure. Authentic elements often add to the complexity of the task, and the level of complexity can be adjusted to an adequate level of competence in the learning process of the students. Furthermore, the challenge involved in the task appears to be an important factor which influences the students' approach to the task, where the authenticity of the task can contribute to this challenge (Cumming and Maxwell, 1999). Schön (1987) notes that "*problems in the real world do not present themselves to practitioners as well-formed structures but as messy, indeterminate situations*". Ten Berge et al. (2006) summarise the characteristics of the authentic task as related to the degree of complexity, structure, authenticity and challenge.

In an authentic learning environment, students can acquire specific knowledge and skills that are related to the tasks performed. By working on meaningful and multidisciplinary tasks, students learn to integrate skills and knowledge from more than one domain. An authentic learning environment gives the student the opportunity to participate in the discourse of entrepreneurs, and thereby become familiar with the culture and language of entrepreneurial life. By working on real-life problems, students will construct knowledge themselves instead of reproducing knowledge.

They are part of a community of practice, where knowledge and meaning are constructed together with others as they express and discuss their ideas. Students also learn to recognise resources and use them in an authentic way. We can suppose that they also acquire relevant tacit knowledge as a result of their experiences in realistic situations.

It must be emphasized however, that students cannot be exposed to 'too risky and unsafe' conditions, and the authenticity of certain tasks may have to be reduced to prevent students from (financial) risks that they cannot bear responsibility for and from situations that they are not yet able to handle.

Ten Berge and others (Ten Berge et al., 2005a; Ten Berge et al., 2005b) analysed which aspects of authenticity influence students' learning about entrepreneurship in the development of product software. Based on a review of the literature, these authors found that an authentic learning environment can be described as design features. They found that by introducing elements of an *authentic working atmosphere*, students learn to work in circumstances that they will encounter in practice and thereby develop an effective attitude. Students must be brought in *the role of problem solver*. They should have a role in activities comparable to that in professional situations. This means that they get enough autonomy and responsibility to accomplish the task. Also, students should work on *real and meaningful tasks and problems* as they occur in the professional life of the entrepreneur. Problems derived from daily practice in the domain should be transformed into instructionally feasible tasks. Ten Berge et al (2005) considered assessment of business plans by entrepreneurs that use criteria from the market, as one of the realistic tasks. For this study, *assessment as in the market* is considered as a separate strategy, because assessment is strongly steering students' attention and learning. A high degree of similarity between the *assessment* of students' tasks and the conditions for success in practice is important, and this directs the students' learning.

The *teachers' way of tutoring* has strong influence on the learning of the student. This refers to the role of the teachers within the authenticity of the community of practice of student start-ups. *Facilities and infrastructure* have to be available for students, in accordance with what is needed for the execution of the entrepreneurial tasks and for achieving the learning effects. In relation with this, Herrington, Reeves & Oliver (2007) described the physical fidelity of the working environment, meaning the degree of simulation of relevant environmental factors.

Ten Berge et al. (2005a, 2005b) provided a thick description of the features and processes in the classroom of an entrepreneurship course that can be used as an analytical framework in this study. In educational design research, guidelines for the development of education are usually described as design principles (McKenney, Nieveen & Van den Akker, 2006), and therefore we will describe the features from Ten Berge et al. (2005a, 2005b) as such. Design strategies are not intended as recipes for success, but to help others to select and apply the most appropriate substantive and procedural knowledge for specific design and development tasks in a specific setting.

In line with McKenney, Nieveen, and Van den Akker (2006) and Denyer, Trenfield and Van Aken (2008) the following format for an educational design principle is used:

In an educational context (C) strategies ($S_{a...z}$) will lead to/are expected to result in Expected Outcomes ($EO_{1...n}$) because of Arguments (A_{1-x}).

A design principle can be composed of one or more strategies, can have one or more expected outcomes and is based on one or more arguments or mechanisms, explaining the expected outcomes. If the features of Ten Berge et al. (2005a, 2005b) are converted into the format of design principles above, this will result in a formulation as presented in Table 2.1.

Table 2.1: Description of design strategies for the creation of an authentic learning environment, drafted from literature (S = strategy, A = Argumentation, and EO = Expected Outcomes)

Strategy name	**Description**
1. Working atmosphere	*(S) Create a working atmosphere that resembles* the culture in a small ICT company, with much autonomy and responsibility for participants and high expectations of their achievements, because (A) if students perceive ownership, cooperate informally with others, and experience time pressure, (EO) they will learn the domain language, culture and tacit knowledge of entrepreneurship, and acquire commitment competences.
2. Student as problem solver	*(S) Bring the student into the position of problem solver of real-life problems,* because (A) if students work and decide autonomously about products and procedures for solving the problem, and in teams of shared responsibility, (EO) this will enable the development and understanding of problem-solving capabilities, the acquisition of domain-specific knowledge and skills and the obtainment of conceptual and relational competencies, and will positively influence motivation.
3. Realistic tasks and activities	*(S) Provide students with realistic tasks and activities* because if tasks (A) are realistic in their demands of the market, complexity, structure, challenge, the degree of being open ended and being dependent on others' expertise, because (EO) of positive effects this will have on motivation, and the transfer to later professional situations in entrepreneurship, on the development of effective entrepreneurial behaviour and on competences for opportunity identification, strategy and relationship.

4.	Teacher's role	*(S) Let the teacher's behaviour resemble that of a professional entrepreneur* because (A) as the teacher takes the role of co-worker or manager, focusing on coaching students, this will have a learning effect by means of role modelling, and (EO) it is expected that students will acquire commitment and relational and organising competences.
5.	Facilities and infrastructure	*(S) Provide facilities and infrastructure that are comparable with professional situations,* because (A) by using professional information systems, software, resources and accommodation, networks, and so on, (EO) that students will learn to recognise and use the resources available and acquire opportunity competences
6.	Assessment	(S) Assess students and their start-ups with the same criteria and by the same persons as in an entrepreneurial setting, because (A) providing (peer) feedback and assessment by clients, bankers, entrepreneurs, that use criteria from the market, financing and competition, has an expected outcome (EO) on relational competencies, such as negotiation and presentation, and on the learning process and motivation.

In this study, these strategies will be evaluated in an existing entrepreneurship course that has proven to be successful in the stimulation of new start-ups in informatics, in order to study and optimize the strategies. This leads to the research question for this study:

- *What design strategies can contribute to the creation of an authentic learning environment in entrepreneurship education, and how can these strategies be optimized, based on an evaluation of a successful entrepreneurship course?*

The framework derived from the features of Ten Berge et al. (2005a, 2005b) will be used as an analytical framework in this study.

METHOD

This is an explorative case study that can be considered as a first step in the cycle of educational design research (McKenney & Reeves, 2012, p.77) as applied in this thesis. This case study provides an analysis of the learning context in an entrepreneurship course, with the aim to draft, evaluate and adjust a set of design strategies for the creation of an authentic learning

environment. Educational design research is based on an iterative cycle of making a design (based on theoretical arguments), doing experiments on aspects of the design, and then analysing and interpreting the results (in the light of the theoretical arguments for the design) and reflecting on them, and thus gaining more insight into problems and solutions. With each cycle the design of the subject under study can be improved (McKenney et al., 2006). Outcomes of the design study can be a set of (adjusted) design strategies, theoretical insights, products (learning materials, a syllabus, software, tasks, cases, etc.) and professional development of teachers and developers.

Case selection

A case study was chosen as a pragmatic method for answering the research question. The selected course on Entrepreneurship in ICT was considered appropriate for this study because it proved to be successful over years in terms of numbers of start-ups that came into being from it. In the last decade, this course produced at least 100 jobs. In this particular course, nine out of seventeen start-ups had plans to enter the market, and continued their activities in an incubator facility.

Moreover, this course on entrepreneurship had a long history of iterative development and refinement that was documented and available for analysis.

The entrepreneurship course at Utrecht University was evaluated in 2005 and 2006, using the features for authentic learning environments from Ten Berge et al. (2005a, 2005b) as a framework for analysis.

This study started as a consultancy project for the Faculty of Science, and this project aimed at finding characteristics of successful education to apply in other courses. Besides, the case was accessible for the researcher, and it was assumed that relevant processes, interventions and interactions could be studied properly.

Data collection and analysis

In this study, course documents, student manuals, and project papers on this course were studied in order to analyse the course design of this case. Students' perception of the design was measured by using questionnaires with questions related to the perceived learning effects and the course design. The items used a 5-point Likert-scale from 'strongly disagree' to 'strongly agree', and additionally open questions were used. Data were collected during and at the end of the course. Interviews were held with focus groups of students at the end the course. Lectures and group work meetings were observed, and these observations were discussed in interviews with the teachers during the course.

Mid reviews and end reviews that were held by external entrepreneurs using criteria as in entrepreneurship, were videotaped; interviews and also the focus group meetings were audiotaped. Data from observations were divided into relevant fragments that were coded, and subsequently the codes were clustered, using the framework of Ten Berge et al. (2005a, 2005b) as an analytical framework. The outcomes of analysis were discussed with the main teacher and several

recommendations for the improvement of the strategies were developed, based on arguments from the theoretical framework.

RESULTS

Course description

The case that was studied is a 7,5 ECTS ICT Entrepreneurship master course for informatics students at Utrecht University. In the course, various elements were implemented which are in line with professional practice of the IT entrepreneur. The teaching method of the course can be described as a team-based project, where students perform professional tasks in a professional context. Students form start-up teams, identify an idea for a software product or service, and evaluate and refine this idea as in a start-up process. A product definition, a prototype, and a business plan have to be produced within strict time limits. A team of entrepreneurs and investors assessed these artefacts. Furthermore, the students have staff roles in a virtual holding company of the participating start-ups (www.netherware.nl). Their tasks for the virtual holding may concern work in departments of human resource management, technology, marketing, investor relations, finance, or in the project office. In this course, the students should gain a thorough understanding of the development and exploitation of a product software company, and in this way experience what it is to work in an IT firm. The course aims to stimulate entrepreneurship through these challenging experiences.

Initially, the course was developed for approximately 15 students at the maximum. Because the number of attendants had increased to more than 50, and because of the number of teachers available, the participants were divided over three business units within the virtual holding company Netherware. Each business unit consisted of five or six teams, each pursuing a start-up around a product or service in ICT. The effects of this scaling up were reported previously (Nab et al., 2006).

The course and the outcomes (starting enterprises, perceived learning effects and perception of the course by students) were evaluated and analysed. The relevance of the course, as perceived by the respondents (67% of 57 participants), was high (4.21 on a five-point Likert scale). Ninety percent of the attending students successfully finished the course, which implies they showed entrepreneurial competences at an acceptable level. In the course for 2005 – 2006, 9 out of 17 start-ups had plans to enter the market, and continued in an incubator facility that was offered after the course.

Evaluation results

By analysis of multiple data, the design strategies for entrepreneurial education were drafted and evaluated. The findings for each strategy are presented here.

Working atmosphere

Activities to create the working atmosphere of a starting IT company were highly appreciated by students, in particular the social activities such as a business dinner and drinks (questionnaire). These social activities were reported to contribute to the students' cooperation. Moreover, the presentation of the virtual holding at an innovation fair was perceived as stimulating. Less appreciated in the design of the course was the large number of deadlines and deliverables obligated by the holding (data from focus group), which decreased the reported feeling of autonomy and ownership. Letting students organize the processes of start-up and learning, for example make students responsible for just-in-time information gathering can further stimulate autonomy and responsibility by students.

From questionnaires as well as from interviews, it appeared that working in the virtual holding did not give the students the impression of working in a real software company, and they could not see the relevance of the activities for the holding. Some students perceived that much had to be organized by them (focus group). A rather 'unorganised' context that requires a lot of self-regulation and autonomy of students was built in deliberately (teacher interview), as most start-up ventures act in an unorganised manner, but not all students could appreciate the pedagogical meaning of it. Besides, the working atmosphere of the holding (deadlines and deliverables) did not seem to match the informality and autonomy of working when starting a business. As a conclusion it seems that the social part of the design strategy (the working atmosphere) was appreciated, where the work assigned by the virtual holding was not positively evaluated. From these findings it appears that this design strategy should be maintained, however, its implementation needs to be improved.

Students in the role of problem solver

During the course, students performed various roles in the start-up as well as in the virtual holding (data from course documents). Deliberately, students were given various roles, because it stimulates them to view concepts of entrepreneurship from different perspectives, with the aim to enrich their knowledge. In interviews, students clearly articulated their priorities for their role in the start-up. The students reported to be strongly motivated by working on their own product and start-up, where they were making their own decisions. But (in the questionnaires) some activities were perceived as obligatory by the holding. Here a discrepancy was noticed between the activities for the starting company and for the holding. The functions for the start-up and the virtual holding were competing for time and attention, and therefore the tasks for the holding were perceived as second priority, and were felt as disruptive.

It can be concluded that this strategy to put students in the role of problem solver is perceived by the students to be functional for learning, and should be maintained for reasons of motivation and learning. However emphasis must be given to the various roles of students in the start-ups and in the virtual holding. Multiple roles should all be perceived as authentic and useful in order to contribute to the learning process.

Realistic tasks and activities

In focus group interviews and in questionnaires, the elements of the course that were valued most by the students were the tasks and activities of the students. Students reported (in the focus groups) that they learned the most of thinking about the key issues of their product while writing the business plan, of the software production and of the presentation of their business plan for a board of entrepreneurs and venture capitalists. In interviews as well as in questionnaires, tasks for the virtual holding company were less appreciated, unless these tasks contributed directly to their own start-up. Students preferred to focus on their own product and business. The textbook used (Cusumano, 2004) was reported not to be very relevant for their activities (questionnaires), where lectures were perceived to be just in time and relevant for the tasks of that moment.

Students reported in focus group interviews that learning from other teams and business units were not stimulated by the course design. In interviews with teachers it was concluded that the focus of students should be on their central activities for the start-ups. Besides, students' ownership of tasks for the virtual holding can be improved. This can be achieved if activities of the holding make a clear contribution to the start-ups.

Teachers and assessors (in interviews) reported that students' activities could be made more market driven, because this can increase the feeling of reality and commitment to activities.

Students did not feel an 'authentic' need, derived from the tasks, to have contact with other start-ups and units. In the interviews with teachers it was concluded to increase the involvement and communication between start-up teams, because students can learn from receiving and providing feedback from peers. An 'authentic' way of stimulating collaboration between students is desired, and therefore an *additional strategy* to stimulate collaboration between students was recommended.

As a conclusion, the students appreciated all activities related to the nascence of their own business start-up, and the tasks and activities for the holding should be adjusted in order to improve the perceived relevance and ownership of the strategy. These findings argue for maintenance of the design strategy on tasks and activities,

Role of the teacher(s)

In interviews students positively evaluated the roles of teachers and CEO of the virtual company, but teachers were not considered to be good role models for entrepreneurship. Students often consulted the CEO/teacher for advice. In focus group interviews it appears that teachers should stick to the role that is expected, e.g., being an educator. Teachers should have a an educational role, by coaching, being a co-worker, but also in providing tasks, demands, feedback, and giving advice, and in organization.

On the contrary, students experienced the entrepreneurs in the course, as guest speakers and assessors, as relevant and good role models. From them the students learned what it meant to be an entrepreneur. Apparently, only real entrepreneurs can supply the entrepreneurial role model. Entrepreneurs are perceived as good role models for solving problems and entrepreneurial

behaviour. It was concluded in interviews that the involvement of entrepreneurs could be increased, for example in coaching.

Summarizing, both the roles of teachers and entrepreneurs cannot, in the perception of students, be fulfilled by one person. This has implications for the description of strategies. It implies that the strategy of the role of teacher should be maintained, and an *additional strategy* on role modelling by entrepreneurs was proposed.

Facilities and infrastructure

Rooms for the business units were not accessible to the students all day, and could not be locked, so the students did not perceive the rooms as their start-up space where they can work when they want (questionnaires). However, changing rooms in between meetings was not considered to be a problem.

In addition, the holding company had the possibility to purchase specific software if necessary (teacher interviews). Students were working in classrooms with IT infrastructure, and this facilitated the exchange of knowledge.

It may be concluded that facilities and infrastructure as in entrepreneurship, have to be available, but little importance should be attributed to the physical fidelity of the working environment. However, we do not know what the effect of this design strategy would have been on student collaboration and community building, if properly implemented.

Assessment

Students perceived the assessment by external entrepreneurs and investors as realistic and strongly motivating. The students prepared themselves very well for the end review and took this presentation very seriously. Criteria from the market were used in assessment and in formative feedback. Serious business contacts emerged out of these meetings. The feedback of the panel of entrepreneurs was considered valuable, but the students desired more time for consultation. These findings argue for more involvement and other roles of entrepreneurs in the course, besides assessment. In interviews students reported little involvement in the plans, products and presentations of other start-up teams during assessment. Students perceived this design strategy on assessment supportive for learning. This strategy should be maintained, but the findings suggest adjustments with regard to the involvement of peers in assessment, and coaching by entrepreneurs.

CONCLUSIONS

From prior studies strategies for the creation of an authentic learning environment were drafted, and evaluated in a case study. These strategies relate to a working atmosphere as in a start-up, students in the autonomous role of problem solver, working on realistic tasks and activities, the role of the teacher, facilities and infrastructure and assessment as in entrepreneurship. The stakeholders of this course (teachers and students) perceived five of these strategies as functional

for learning, meaning that these strategies should be maintained. The strategy on facilities and infrastructure could not be evaluated. In addition, recommendations were made to improve the elaboration of some of the strategies.

The elaboration of the strategy to simulate a working atmosphere as in a start-up should be adapted in a way that the activities for the virtual holding better support the activities of the start-ups and thereby the learning process.

The strategy on realistic tasks and activities should be made more market driven, to stimulate the involvement and communication between the start-up teams, and by improvement of perceived relevance and ownership of tasks and activities for the virtual holding. In assessment students should be involved more explicitly, for example by giving peer feedback and assessment.

Students perceived the guest entrepreneurs in the course as good role models for entrepreneurship, but not the teachers. The roles of teachers and entrepreneurs are difficult to be realized by one person, and distinct persons should therefore fulfil this role. The result of this study is that an additional strategy on role modelling and coaching by entrepreneurs has to be developed and studied in further studies.

With regard to the design strategy for facilities and infrastructure, no conclusions can be drawn, because this strategy was not implemented as intended for logistic reasons and therefore this could not be evaluated.

The overall conclusion is that five design strategies for the design principle on the creation of an authentic learning environment were confirmed in this study, whereas one strategy was not implemented and could not be evaluated. Recommendations for three *additional strategies* were made on: collaborative learning, multiple roles and role modelling by entrepreneurs. This will be elaborated in the discussion.

DISCUSSION

In the literature, numerous publications on entrepreneurship programmes can be found, and experiential learning is most often presented as an effective teaching approach (Corbett, 2005; Hannon, McBride & Burns, 2004; Heinonen & Poikkijoki, 2006; Pittaway & Cope, 2007). Other scholars argued for the introduction of authentic elements in entrepreneurship education (Gibb, 1993; Pittaway & Cope, 2007; Taatila, 2007; Vincett & Farlow, 2008). Despite this, few descriptions can be found on how the learning environment in entrepreneurship education should be designed. This study provides a description of an authentic learning context for entrepreneurship education. From prior publications on authentic learning in entrepreneurship education, six strategies for the design of such a learning context were drafted and evaluated.

Five design strategies for the creation of authentic learning environment comply with previous findings (Ten Berge et al, 2005a, 2005b): working atmosphere, students as problem solver, realistic tasks and activities, teacher's role and assessment as in entrepreneurship. The strategy on facilities and infrastructure could not be investigated. In another study these strategies will be adapted

where relevant, and evaluated (Chapter 5).

The reported design strategies may also be extended with strategies derived from the recommendations: the stimulation of collaborative learning by students, of multiple roles by students and of role modelling by entrepreneurs.

In the application of the design strategies, an authentic learning environment with real-life experiences can be created that will stimulate the acquisition of entrepreneurship competences, and can add to the motivation of the students, because they will be the owners of the project they work on, and will easily notice the relevance of the tasks. Ownership has proven to be essential in motivating students and providing an authentic need-to-know that stimulates relevant learning activities. Also, authentic tasks will prepare students for the profession of entrepreneurship.

Reflection on strategies

Strategy on facilities and infrastructure

The design strategy on facilities and infrastructure could not be evaluated because it was not implemented as intended. The physical fidelity of the simulated learning environment is one of the elements of this strategy, and it was argued that the physical fidelity is less relevant for learning than is the fidelity of the cognitive processes (Gulikers, Bastiaens & Kirschner, 2004; Herrington, Reeves & Oliver, 2007). In the case study, the relevant cognitive processes are comprehensively provided by the other strategies of this principle. So, although this strategy was not implemented as intended, it can be assumed this will probably not strongly affect the learning environment.

Multiple roles.

Students were stimulated to perform multiple roles, as occurs in a start-up, or in working at different levels in the organisation of the virtual holding company. In this way students learn to work in several and sometimes conflicting roles. By doing so they will develop different perspectives on a topic from various points of view (Bransford, Sherwood, et al., 1990; Lave & Wenger, 1990) and they will develop organisational and relational competences. If students take multiple roles, it can also contribute to a natural reflection of their activities that may assist learning.

Students in this case did not always perceive their multiple roles as functional for learning, which is a condition for authentic learning (Gulikers, 2006). Having multiple roles seemed to interfere with some of the other strategies; for example students' work for the virtual holding seemed to affect the start-up process, and thereby the activities and tasks strategy were influenced. Only if the activities for the holding contributed directly to the start-up process, students perceived it to stimulate learning. Giving students multiple roles should therefore stronger be emphasized in future course designs, and this argues for an additional strategy on multiple roles: (S) *Let students perform various roles as in entrepreneurship*, because (A) by having different perspectives on a topic and reflecting on it (EO) students will develop a deeper understanding of concepts, and of contextual influences on the topic.

Collaboration

Based on the findings of the evaluation, one of the recommendations of these study pleas for an additional design strategy for the stimulation of communication and involvement between students and between start-up teams. Although some students worked alone, most of them collaborated in start-up teams, however the data showed that the collaboration between start-up teams was not fully exploited. Students reported that they often just divided the roles within their start-up team. Also, students reported that there was little exchange of information and collaboration between start-up teams, and between the different holdings.

Students can learn from others, from others' feedback and by cooperating with and giving feedback to others (Hattie & Timperley, 2007). By doing so, they will develop a feel for the quality and feasibility of plans and products. Also, some competition between business units may increase the involvement in each other's products and activities.

According to theories of collaborative learning (Vygotsky, 1978), collaboration provokes articulation of (tacit) knowledge and concepts and stimulates mental processes. In a review study Johnson and Johnson (1996, p. 1021) reported the positive impact of collaborative learning on knowledge construction, a positive motivation and learning attitude, and the development of social and metacognitive skills. It can be assumed that collaborative learning contributes to development of entrepreneurial competences (Man, Lau & Chan, 2002). This argues for an additional strategy on collaboration and articulation of students in and between start-up teams, in the creation of an entrepreneurial learning context.

The following description of a strategy for collaboration can then be derived:
(S) *Stimulate the collaborative construction of knowledge,* because (A) if students work together on tasks and articulate their knowledge, this (EO) will promote knowledge construction, a positive motivation and learning attitude, and the development of social and metacognitive skills,

Roles of teachers and guest entrepreneurs

Our findings plea for an elaboration of the strategy on the role of the teacher. The students perceive differences in the roles of teachers and 'guest entrepreneurs with a role in education'. The last were perceived as role models for learning of behaviour and process modelling (how to do things), where the teachers in their role of CEO of the virtual holding were not perceived as such. In the eyes of students, the teachers have other functions in the course such as giving advice, feedback and being an educator.

The dominant function of a role model is 'learning by example', although 'learning by support', 'increasing entrepreneurial self-efficacy' and 'inspiration/motivation' are also important (perceived) functions of role models (Bosma, Hessels, Schutjens, Van Praag & Verheul, 2012). This is consistent with both the social learning theory (Bandura, 1977) and role identification theory (Gibson, 2004).

Our findings suggest that the roles of teachers and guest entrepreneurs should be separated. This can best be achieved by making an additional strategy for the role of the guest entrepreneurs and an adjustment of the strategy for the teacher. In further studies these strategies can be elaborated.

The design strategy on role modelling can be expressed as:
(S) *Involve entrepreneurs as role models in entrepreneurship education*, because (A) if students learn by observing and imitating entrepreneurs behaviour and ways they perform tasks and handle processes, (EO) this will increase students' tacit knowledge and skills on entrepreneurial tasks and processes, self-efficacy, and inspiration and motivation.

Further research

This study is a first step in the development and empirical support of design strategies for the creation of an authentic learning context in entrepreneurship education. It is a single case study to draft design strategies with this purpose, that must be followed by further qualitative research and experimental studies. If the set of design strategies is further investigated with a broader population of students from different disciplines, this can contribute to the refinement of strategies, and support generalisation. Moreover, strategies for authentic learning from other domains can supplement the strategies from this study.

In this explorative study, five strategies were drafted and evaluated. Because alternative explanations cannot be excluded in this study, caution must be taken with regard to generalizations. Additional studies have to be done in order to come to generalization of the strategies.
In this study the authentic learning environment in entrepreneurship education was considered.
In future, other aspects of the designs have to be studied. For example, emphasis must be given to the measurements of learning effects in an authentic learning environment. Such can be achieved by analysing students' artefacts. Findings of such studies can contribute to establishing causal relations between design strategies and learning effects. In order to determine the long-term learning effects of entrepreneurial programs, longitudinal studies have to be performed, measuring the success rates of start-up companies.

Organiser for this research

	Educational Context	***Content Opportunity Identification***
Relevance and theory	*Chapter 1* *Introduction*	
Exploratory case study	*Chapter 2* *Case study on characteristics of successful entrepreneurship education*	
Pioting design strategies		*Chapter 3* *Development and evaluation of design strategies on fostering opportunity identification*
Evaluating design strategies in other contexts, and finding new strategies		*Chapter 4* *Evaluation of design strategies on opportunity identification by expert entrepreneurship teachers in science education*
Evaluation of integrated design strategies	*Chapter 5* *Evaluation of design strategies on fostering opportunity identification and on an authentic learning context in a single course design*	
Reflection on this thesis	*Chapter 6* *Conclusions and Discussion*	

Chapter 3

Fostering the competence of science students in identifying business opportunities: a design research approach[2]

ABSTRACT

A pedagogical model for teaching opportunity identification has not yet been defined, and therefore design strategies for 'fostering science students' competence in opportunity identification' were developed, based on theoretical and empirical findings. Three design strategies were developed, and subsequently implemented in an entrepreneurship course for science students. Evaluation showed that all strategies were largely implemented as intended. Next, the outcomes were determined as these can be expected from the theoretical and conceptual models underlying the strategies.

The expected outcomes of the strategy aiming at enabling students to conceptualise opportunity identification were fully realized in this case. The expected outcomes of a strategy that aimed to enable students to apply techniques for the generation of ideas in opportunity identification were partially realized, as were the outcomes of the third strategy that aimed to help students to apply the concepts and criteria of opportunity identification in authentic tasks. These findings comply with the mechanisms underlying these strategies.

Analysis of students' products showed that the students were able to identify business opportunities and to create business opportunities based on their own knowledge and skills. It can be concluded that the course design based on three design strategies showed an indication of functionality as expected, although a causal relation between strategies and students competence in opportunity identification has yet to be determined. Finally, adjustments and refinements to the strategies are proposed.

[2] *This chapter is an adaptated version of Nab, J., Bulte, A.M.W., & Pilot, A. (2013). Fostering the competence of science students in identifying business opportunities: a design research approach. International Journal of Entrepreneurial Venturing, 5 (1), 28-47.*

INTRODUCTION

European and national policies (European Commission, 2005, 2008) are driving students in higher education to become entrepreneurs or to become entrepreneurial, with the aim of stimulating the economy and the creation of jobs. Initiatives have been created to encourage students in higher education to gain competences that will prepare them for entrepreneurship. As the identification of business opportunities is considered to be a core competence for entrepreneurs (Man et al., 2002; Stevenson et al., 1985), this competence should be part of education in entrepreneurship. Opportunity identification plays an important role in entrepreneurship education, e.g., when students write business plans or participate in start-ups or business plan competitions, but explicit emphasis is rarely given on how to identify business opportunities. A business opportunity is defined as the creation and/or discovery of something novel that has some value for the customer and/or society, which is feasible and which can be exploited in a profitable way by the entrepreneur (Gaglio and Katz, 2001; Shane and Venkataraman, 2000). Little research exists regarding the education in the specific competence of opportunity identification, and even less of this research is empirical in nature (Saks and Gaglio, 2002). From the perspective of the educational designer few studies have addressed pedagogical strategies for teaching opportunity identification in such a way that it could assist others.

The aim of the present study is to develop and evaluate design strategies for education that aims at fostering science students' competence in identifying business opportunities. The concept of opportunity identification has been widely studied in various economic and social domains, and theories on opportunity identification in entrepreneurship (Ardichvilli et al., 2003; Shane and Venkataraman, 2000) can be used for the design of education. Due to the fact that creativity plays a crucial role in opportunity identification, models for the stimulation of creativity should be applied, and teaching and learning theories may also contribute to the design of education in opportunity identification. This study will contribute to an understanding of teaching opportunity identification, and to the development of pedagogy. Opportunity identification is a complex concept (Ardichvilli et al., 2003), and studying this in the context of education makes research even more complex. Educational design research offers the opportunity to study a complex educational situation in naturalistic settings (Reeves et al., 2006) and has therefore been chosen as the research approach for this study. Educational design research has design principles as an output and its merits are measured, in part, by its practicality for users in real educational contexts, and by its contribution to the development of a local theory. Design research aims at optimising and empirically underpinning design strategies through cycles of design, formative evaluation and revision, grounded on literature and empirical findings (Nieveen et al., 2006, p.78).

In this study, we will use the concept of a design principle, which can include one or more design strategies, can have a number of outcomes, and bases each strategy on at least one underlying argument or mechanism. Strategies include all activities, interventions and means that are organised in the classroom to stimulate students' learning. Arguments are based on well-

grounded theories, or may describe a mechanism that can be confirmed by experiments. Design strategies are context-dependent, meaning that the context may have a substantive effect on the students' learning processes, and that they must rely on accurate, thorough portrayals of contextual variables (Denyer et al., 2008), such as teacher, student population, available resources, and system factors.

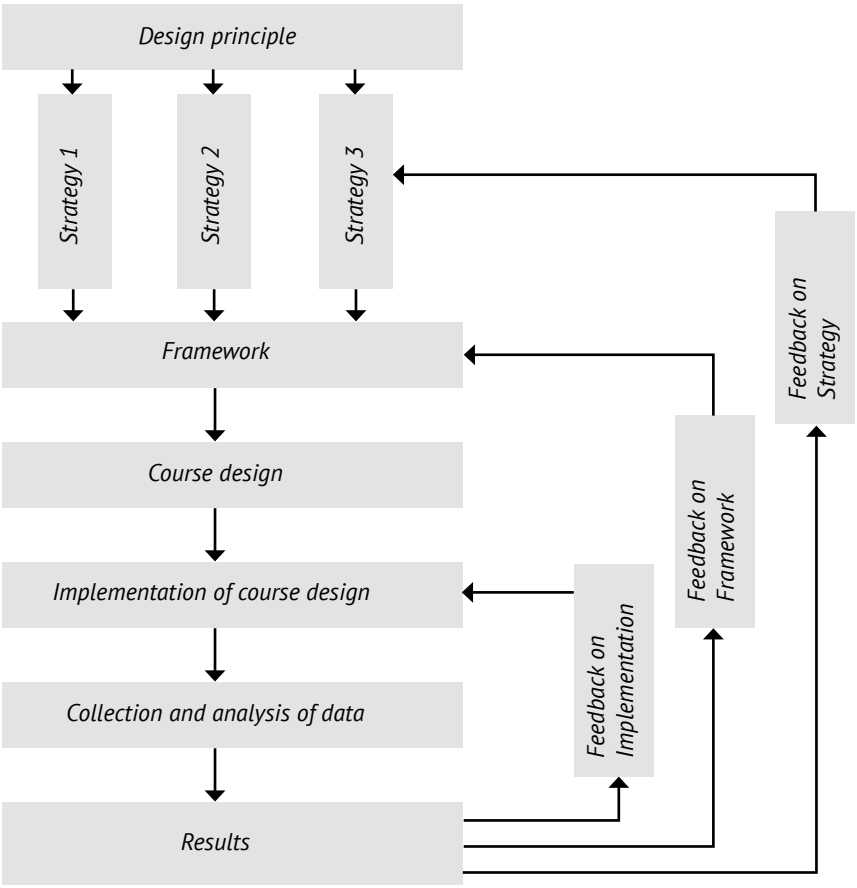
The present study starts with the deduction of design strategies from literature. These design strategies will then be integrated into a course framework, which is the blueprint of a course. Next, the framework will be elaborated into a detailed course design, with a description of the learning materials and specific tasks.

In a holistic approach the framework is implemented, and the level of implementation of the course design in the classroom will be described.

Qualitative and quantitative methods are used in order to evaluate the expected outcomes of each strategy, and to evaluate the whole course design for its functionality: does the course design do what is expected in terms of opportunity identification by students? Finally, the findings of this study will be discussed and recommendations for improvement of strategies will be suggested.

Figure 3.1 on the next page is a diagram of the research approach.

Figure 3.1: Diagram of the research approach in this study



Notes: Feedback can be expected on the levels of: strategy, course framework and implementation. The results will lead to improvement of the design principle.

THEORY

Teaching and learning of opportunity identification

A search of the literature on the teaching and learning of opportunity identification resulted in a limited number of publications, which were analysed in an attempt to find relevant design strategies. Saks and Gaglio (2002) examined how entrepreneurship educator-practitioners

conceptualise and teach the opportunity identification process. Three-quarters of the teachers reported that they expected their students to learn how to notice potential ideas. Teachers who do emphasise finding opportunities in the classroom use either an analytical or an experimental approach. The premise of the analytical approach is that if students search for opportunities often enough, the underlying pattern becomes apparent and the student can internalise that pattern. The experimental approach uses assignments to improve students' ability to perceive people's needs. Saks and Gaglio (2002) concluded that little is known about whether and how opportunity identification is taught in the classroom.

DeTienne and Chandler (2004) empirically ascertained a series of strategies for stimulating opportunity recognition in students. In their training, they used four approaches: securing, expanding, exposing and challenging. 'Securing' is registering opportunities that occur throughout the day, while 'expanding' is spotting problems and generating and sharing ideas to solve them. 'Exposing' is promoting the generation of ideas by the application of certain techniques, and 'challenging' is achieved through competitive assignments. This approach resulted in improvements to both the number of ideas generated and the innovativeness of those ideas.

Muzychenko (2008) focused on international opportunity identification and advocated a competence-based and experiential approach for teaching. This approach focuses not only on opportunity identification, but also on the self-perceived task competence (self-efficacy) of the entrepreneur, because self-efficacy and opportunity recognition are strongly linked (Krueger, 2000). In fact, self-efficacy can be seen as an intermediate variable in education: through education self-efficacy can improve, which in turns fosters the competence of opportunity identification. Kickul (2006) outlined a set of assignments for teaching students: for example an opportunity proposal that specifies how students should exploit the opportunities uncovered following their analysis of an industry. The assignments resulted in an increase in entrepreneurial self-efficacy. In another publication, Kickul et al. (2009) reported on the significant role of different cognitive styles in opportunity identification and recognition. Individuals with an intuitive cognitive style were more confident in their ability to identify opportunities, while individuals with an analytic cognitive style were more confident in their abilities to assess, evaluate, plan and marshal resources.

The strategies discussed above can provide support in designing education in the field of opportunity identification. However, most studies have focused on business students (Kickul, 2006; Kickul et al., 2009; DeTienne and Chandler, 2004), who have an advantage due to their knowledge of areas of business such as finance, marketing and accounting when compared to science students. The study by Saks and Gaglio (2002) focused on the teachers in entrepreneurship programmes. Therefore, it can be concluded that no studies have been found on how to design education on opportunity identification for the science students in particular, while science students are a specific population, because they possess scientific knowledge that can be valorised.

In addition, science students are characterised by analytical and critical thinking due to their training in solving science problems, and it can be assumed that they have a more analytical than intuitive cognitive style in terms of opportunity identification (Kickul et al., 2009). According to Wolf

and Kolb (1984) the strengths of academics from the field of natural sciences lie in the creation of theoretical models and the ability to make sense of disparate observations. This indicates that, for science students, a limited match exists between their cognitive styles and the divergent thinking skills which are necessary to identify opportunities, and for this reason extra emphasis must be given on the stimulation of divergent thinking.

Therefore, the studies discussed above may help in setting up design strategies for science students. Creativity stimulation, increasing self-efficacy and divergent thinking and giving students autonomy and responsibility can be useful, and these activities should be laid down in a design principle. The use of interventions as mentioned by DeTienne and Chandler (2004) is in line with the aim of this study and can contribute to educational design. Therefore, theories of opportunity identification, models of creativity and learning theories will be used to supplement the findings outlined above. However, for those wishing to design education in the field of opportunity identification, it is difficult to derive clear strategies from the literature. It is unclear how these findings should be interpreted or implemented in education, and how a set of strategies acts as a whole.

Design strategies in teaching and learning in the domain of opportunity identification

This raises the question of how education on identifying business opportunities can be designed. To begin with, several authors have argued that creativity plays an important role in fostering opportunity identification (Corbett, 2005; Hills et al., 1999). Cognitive processes in opportunity identification bear a resemblance to cognition of creativity (Plesk, 1997), in which existing mental schemas are expanded and combined. Opportunity identification can be considered as a domain-specific form of creativity (Ucbasaran et al., 2009), which means that theories, concepts, techniques and instruments from the creative domain and from learning creativity can be applied in this study. This study emphasises the concept of skills, which are relevant to creativity (Amabile, 1996, p.82), because of the potential for training students in the generation of novel ideas. Skills that are relevant to creativity include implicit or explicit knowledge of heuristics for the generation of novel ideas, which can be stimulated by training (DeTienne & Chandler, 2004). Creativity heuristics are best considered as ways of approaching a problem that can lead to novel ideas, rather then as strict rules to be applied.

Encouraging and developing divergent thinking is a consistent element in most efforts to increase creativity, and divergent thinking is structured around the use of techniques for the generation of ideas (Scott et al., 2004). In the encouragement of creativity, attempts should be made to identify, learn, and apply effective creativity heuristics (Amabile, 1996, p.255). Students must know and understand the concepts behind heuristics when using techniques, which can be achieved by reflection and discussion following their experiences.

These arguments lead to design strategy A: *In the context (C) of 'fostering of science students' competence in opportunity identification' the strategy (S) to stimulate the use of idea generation techniques and knowledge of heuristics by means of exercises and experiences leads to the expected*

outcome (EO) that students will be able to use idea generation techniques in creating new business opportunities, because of the mechanism (A) that students are able to think divergently about new opportunities.

Secondly, theories on opportunity identification by entrepreneurs in practise can help to understand the process of learning of this competence. Gravemeijer and Cobb (2006) recommend to use domain-specific theories in educational development, and therefore dominant theories regarding opportunity identification will be explored: the discovery theory, the creation theory and the theory of effectuation.

According to *discovery theory* (Alvarez, 2005; Kizner, 1973; Shane, 2003), opportunities exist in every environment, independent of the individual who discovers them. Opportunities can be derived from the attributes of the industries or markets within which the entrepreneur is operating. Every price, invention and piece of information has within it objective opportunities (Alvarez, 2005). If an entrepreneur understands these attributes, he or she will be able to anticipate existing opportunities. Discovery theory implies that individuals with the relevant knowledge have an advantage, and that knowledge of the relevant domain, markets, consumer problems and ways to serve consumers is constructed through dialogue and participation. Learning, according to this view, encompasses gathering, processing and interpreting information.

According to *creation theory*, opportunities are created through testing hypotheses and learning on the part of the entrepreneur (Alvarez, 2005; Schumpeter, 1934). The individual creates an innovation that did not exist before, and an opportunity is created by recombining existing information, with or without the use of heuristics. Creation theory implies the reorganisation and reconnection of mental schemas, and the formation of prototypes in individuals. According to creation theory, the learner is a (re)constructor of knowledge based on experiences. Baron and Enslay (2006) argued that pattern recognition is a key component of opportunity identification. Entrepreneurs match their business opportunity with their prototype (Shane, 2003), and the closer the match, the more likely they are to conclude that they have identified an opportunity. In fostering students' competence, mental prototypes must therefore be developed.

The process of *effectuation* (Sarasvathy and Dew, 2001) is characterised by imaginative rethinking of possibilities and continual transformation of targets. Effectuation has the premise that the future is (at least) partially created by wilful participating agents. Entrepreneurs in this view collaborate to create new markets and the theory of effectuation implies elements of both the cognivist as the social constructivist view, and creativity is a crucial factor.

In short, opportunities are either discovered by analysing market and industry structures, or opportunities are created through hypothesis testing and learning (Alvarez, 2005). Science students have limited knowledge of markets, and this knowledge is hard to be gained by them during a limited time and within the school system. But these students do have science knowledge that can be applied for innovations. Therefore for science students the creation of innovative ideas from

their domain knowledge should be fostered.

At this point, learning theories may contribute to the development of design strategies. Cognitive learning theory is based on the development of mental schemas and scripts, and according to this view, instruction strategies should focus on activating pre-knowledge, elaborating on and combining knowledge, applying knowledge in various contexts and structuring and developing heuristics (Valcke, 2007). Students must be systematically coached towards an autonomous role. According to the social constructivist viewpoint (Vygotsky, 1989), students should work on rich and meaningful tasks in a realistic context, and a meaningful relationship between the students must be stimulated. For the purposes of this study, it can be concluded that students should have experiences in opportunity identification, and need to conceptualise these experiences through discussion, collaboration and reflection and by developing criteria. From both learning theories students should have meaningful experiences and reflect on them to learn.

These arguments lead to design strategy B: *Let students conceptualise their experiences in opportunity identification and build their own criteria by means of group experiences and reflection (S), with the expected outcome (EO) that students will be able to identify opportunities and select potential opportunities using self-developed criteria, because by conceptualisation prototypes will be developed that will help in identifying opportunities (A).*

Another point that should be made is that context plays an important role in learning, which was first addressed in the theory of situated learning (Brown et al., 1989), and this has relevance for learning to identify opportunities. Students have difficulties transferring what they have learned in the classroom to new situations, meaning that students must learn idea generation techniques and the concepts of opportunity identification in realistic situations.

Perkins and Solomon (1988) argued that, for the promotion of transfer, the individual's domain-specific knowledge base is crucial. In addition, the use of general heuristics and problem-solving strategies are important factors in the transfer of knowledge for complex and ill-defined problems, such as those, which arise in entrepreneurship. Meta-cognitive knowledge or reflection determines whether knowledge and skills will be transferred to another situation. Pea (1987) presented measures for stimulating transfer in students by teaching them self-regulation, learning and problem-solving strategies and meta-cognitive knowledge. For the stimulation of transfer, concepts and heuristics should be applied in professional tasks in a professional context (Simons, 1999), which can be achieved by bringing authentic elements into education (Herrington and Oliver, 2000; Chapter 3), by meta-cognitive activities using experiences and prototypes, and through assessments in which clear criteria have to be met (Simons, 1999). This leads to design strategy C: *Let students work on identifying business opportunities in authentic experiences, and encourage them to reflect on their experiences (S), with the expected outcome that they will be able to apply the concepts of opportunity identification in real-life situations (EO), because self-regulation, reflection and realistic assessment stimulate the transfer of competences to new situations (A).*

Three strategies are brought together in one educational design principle. As a result, the research questions for this study can be stated as follows:

1 What design strategies for the fostering of science students' competence in opportunity identification can be developed from theories of opportunity identification and of learning?
2 Based on an evaluation of a course that was designed with these strategies, what is the level of implementation of strategies?
3 Based on an evaluation of a course that was designed with these strategies, do the students show expected outcomes?

The last research question needs further specification. Based on an analysis of students' products and on observations:

a Do the students apply idea generation techniques and knowledge of heuristics (elements stimulated by the design strategy) in order to create opportunities?
b Do the students identify and select potential opportunities by using self-developed criteria as the design strategy for conceptualisation and developing criteria wants to achieve?
c Do the students identify opportunities in other situations as stimulated by the design strategy for encouraging students to identify opportunities in authentic experiences and to reflect on them?

METHOD

In this study, the educational design research approach was used (Figure 3.1). For the evaluation of the design strategies, they were integrated into a coherent course design that was subsequently elaborated into a detailed course design and then implemented.

Case selection

This case at Utrecht University was selected because this course had to be designed from scratch, and it offered the possibility to develop design strategies from theory, to integrate these strategies in the course design, to evaluate the degree of implementation of the strategies, and to evaluate the indicative functionality of the course design. The course offered the possibility for co-creation, together with the teacher. The proximity of the course for the researcher gave many possibilities to study the development, implementation and evaluation of the course (design) in detail.

Course framework

In the course design instruction strategies from cognitivism as well as from social constructivism were applied. Instruction strategies from cognitivism focus on encouraging students to be mentally active in opportunity identification through explanations, instruction, discussion, practise with scaffolding, articulation of experiences and reflection. According to the social constructivist

Table 3.1: Teaching and learning activities as implementations of strategies, distributed over learning phases

Learning phases	Strategy A: Stimulate the use of idea generation techniques and knowledge on heuristics	Strategy B: Let students conceptualise their experiences in opportunity identification and and develop criteria	Strategy C: Let students work on identifying opportunities in authentic experiences, and encourage them to reflects their on experiences
Orientation	• Learning goals, assignments and assessment criteria for opportunity identification are presented explicitly during introductory lecture.		
		• Presentation of models and theories regarding opportunity identification and creativity • Discussion on examples of business opportunities and underlying concepts	
Extension of knowledge	• Workshop on techniques for idea generation 1 Experience the impact of quoting the number of ideas and having a goal 2 Slice and dice method, based on listing attributes 3 SCAMPER, which is a checklist of idea-spurring questions	• Guest lecturers discuss the business opportunities that were most relevant and skills to their company	

Learning phases	Strategy A	Strategy B	Strategy C
Practicing knowledge and skills	• Individual students identify five science-related business opportunities from their surroundings, describe these opportunities, select the best and elaborate on selection criteria • Feedback by the teacher • Group business opportunities are articulated in class, and the best opportunity is selected by the peers • Formative feedback on the assignment is given by the teacher and by peers using forms		
Reflection and preparing for transfer of knowledge	• Students elaborate on heuristics and usefulness of idea generation techniques	• Students substantiate criteria for opportunities	• Business plan teams elaborate on the business idea • Consultancy assignment teams have to outline the business opportunity of the company • Students elaborate upon criteria and concepts in discussions
Assessment		• Co-assessment of business opportunities by students and teacher	• Students doing the consultancy assignment have to articulate the business opportunity of the company to the firms' management

viewpoint, students must be stimulated by tasks that provoke the exchange of information, discussion, collaboration and peer feedback. Students should learn by doing, and have experiences in opportunity identification. In order to learn, these experiences need to be conceptualised through discussion, collaboration and reflection.

Constructivist instruction strategies were used in design strategy A for the development of heuristics through experience, practise and reflection. Cognitive instruction strategies were used for design strategy B for the purposes of conceptualisation, through explanations, examples, having students work actively on assignments, reflection, discussions and articulation. A constructivist approach was also used in design strategy C regarding transfer, as students had to work autonomously in groups on meaningful, authentic tasks.

The sequence of learning activities was chosen purposefully: first, idea generation techniques had to be internalised, and then used in experiences for opportunity identification, which in turn provoked conceptualisation and the development of criteria. Finally, the resultant concepts and criteria had to be applied in authentic tasks (business plans or consultancy assignments) in order to further develop concepts and promote transfer. The assessment of authentic tasks was carried out by entrepreneurs and by the teacher using authentic criteria as much as possible. All learning activities related to the strategies and the timeline are presented in Table 3.1. (See pages 56/57.)

Prior to or simultaneously with this course, training in specific areas of business such as finance, marketing and accounting were offered, and this knowledge had to be applied in opportunity-based assignments. During the course, students were given autonomy and responsibility for their work. Groups of students had to prepare and present lessons on entrepreneurial issues, and had the freedom to organise their work during the consultancy assignment or the writing of a business plan, and also in other assignments

Participants

This study was conducted in 2008/2009 in a mandatory entrepreneurship course as part of the master's degree in Science and Business at Utrecht University. All 23 participating graduate students had a background in science and were in their final year before graduation. Ten of the students were female (43.4%), and the mean age of the group was 24.2 years. The entrepreneurial intention of the students was determined with a questionnaire. Of the students, 52% had plans to become an entrepreneur sooner or later, with the modus at more than five years after the course. Two students owned a company while attending the course. Thirteen students (56%) had prior experience of entrepreneurship. The course framework was a co-design between the teacher and researcher; the latter had also an active role in teaching during the piloting of strategies.

The pedagogical format of the course was consistent with that of the master's programme, and consisted of tutorials of 1.5 hours on a particular subject, lectures and working groups on specific subjects, guest lectures by entrepreneurs and debates (see Course Framework). The students were familiar with these pedagogical formats. The duration of the course was ten weeks of 20 hours per week, and it was credited with 7.5 ECTS. Assessment was performed on the basis of:

1 an individual paper (50%)
2 either a business plan or a consultancy report (35%)
3 active participation in tutorials (15%).

The students' competence in opportunity identification was assessed as part of the consultancy assignment or the business plan.

Observation, field notes and interviews

Strategies for fostering the students' competence in the field of opportunity identification were observed using an observation list. The collected data were discussed between the researcher and the observer. All of the lessons during the course were observed, and field notes were worked out after each lesson. After the course, two volunteer students were interviewed individually. The interviews were semi-structured, with a list of items gathered from the design strategies. Interviews were audiotaped and transcribed verbatim. The observations, field notes and interviews were labelled, using the expected outcomes as a labelling scheme. Labelled fragments were collected for each design strategy, and then scored. We used three categories for the scoring system: if a labelled text did not confirm with the expected outcome, the score was 'none'; if both confirmative and non-confirmative remarks were found, the score was 'partially', and if only or mainly confirmative remarks were found, the score was 'good'.

Measuring students' perceptions of competence and perceptions of the learning environment

The questionnaire measuring the students' perceptions of their competence in opportunity identification consisted of seven subscales, each correlating with creativity or opportunity techniques; intrinsic motivation; extrinsic restraints; problem-solving style; working style; divergent thinking and self-efficacy. The homogeneity (Cronbach's alpha) of all of the scales was calculated with the completed questionnaires of 86 students enrolled in various entrepreneurship courses. Four subscales had a Cronbach's alpha value above .70, where three subscales were above 0.60. For this study, 19 students completed the questionnaire with 53 items as a pre-test and 16 students completed it as post-test. An independent samples t-test was conducted in order to compare the scale means of the pre-and post-tests. Significant differences were seen as a confirmation of the expected outcomes, with a score of 'good'; no significance was scored as 'none'.

A second questionnaire measured the extent to which the students perceived the learning context as stimulating opportunity identification. This questionnaire had 49 items in eight subscales: encouragement through education; encouragement by the teacher; autonomy; pressure; challenge; peer support; climate and criteria to be met. The homogeneity of the scale was calculated using 54 questionnaires completed by students in various entrepreneurship educations. The homogeneity of all of the scales was calculated using SPSS. Six out of eight subscales had a Cronbach's alpha value above .70, where the subscales Criteria and Autonomy had Cronbach's Alpha > 0.60. For this study, 17 students voluntarily completed this questionnaire during the final meeting, while six students did not take part. Scale means over 3.8 (mean + 1 SD) were considered to confirm the expected outcome.

The items in both questionnaires used a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'.

Measuring students' products in terms of opportunity identification

Worksheets from the exercises and assignments on the generation of ideas were collected. For the first assignment, all of the students had to search for five recent business opportunities outside the classroom, and select the best of the five by discovering and applying criteria. In another assignment, groups of four to five students had to find a business opportunity based on their own competences and scientific knowledge. The groups prepared a document and articulated their ideas in the fourth week of the course. Peer feedback forms were used by the students and were then collected. Subsequently, the groups had the option to work on either a business plan (one group) or on a consultancy assignment (six groups). The consultancy assignments were built on real problems, which were sourced from Dutch science-based companies. The other students had to work out their own business opportunity in a business plan or describe the opportunity that formed the basis of the company. All of the students' output regarding opportunities was analysed by the teacher who used two scales, adapted from the review study of Garcia and Calantone (2002): one measuring the degree of innovation and the other measuring the market potential of the business ideas. The scale for measuring the degree of innovation had three rubrics: imitative, evolutionary and radical. The second scale used in this study for rating the market potential included four topics: added value, feasibility, market size and competition. This instrument is presented in Table 3.2. The percentages for the rubrics were calculated.

Table 3.2: Scales for determining the degree of innovation and market potential, used for rating business ideas

Degree of innovation	**Description**
Imitative	Copy of existing and well-known business products, services or processes or otherwise obvious and expected improvements to existing products, services and processes within the domain/discipline. Can be new to the firm.
Evolutionary	Transfer of an existing idea, approach or strategy from one domain to another, or to a new situation.
Radical	Ideas, approaches and strategies that introduce a new, not yet existing element or the innovative application of existing technology to an existing situation, or the introduction of a totally new, non-existing concept. New to the world or industry.
Market potential	**Description**
Added value	Customer need or problem that is met/solved.
Feasibility	Availability of resources, business model, production, distribution, organisation, finance, return on investment.
Market size	Target group, market segment, characterisation of market, number of users.
Competition	Alternative solutions and providers.

Source: Adapted from Garcia and Calantone (2002)

RESULTS

Results on the level of implementation

An important condition for the evaluation of design strategies is its level of implementation, or feasibility. Therefore, the meetings were monitored and the students were interviewed, in order to detect whether the implementation of the course deviated from the course design.

The observations and interviews showed that the course was implemented, to a large extent, as intended, apart from some lack of authenticity in the tasks and a need for some students to apply idea generation techniques. In the interviews, one of the students mentioned that she did not apply idea generation techniques later on, because the consultancy assignment did not provoke the need to do so. In addition, there were some time constraints on the reflective discussions, and one assignment was not completely clear to all of the students.

The students' perceptions of the course were discerned in the interviews. The students indicated that the atmosphere in the classroom was not authentic, as it would be expected in a start-up, but they did experience a freedom to organise their work and collaborate with their self-selected peers. Their teachers were not seen as role models for opportunity identification, but the guest speakers were. The students perceived a small degree of competition in education and also restraints and pressures were perceived. Encouragement from the learning environment was perceived as average (3.1 on a 5-point Likert scale), as was encouragement by teachers (3.1). The climate in the course was experienced as safe for expressing novel ideas (3.8). Peer support was perceived as average (3.3). Challenge in the course was felt to be average (2.9).

It can be concluded that the strategy on conceptualisation of opportunities was implemented as intended, where the strategies on the use of idea generation techniques and on the application of concepts in authentic experiences were implemented to a large extend. Some improvements in the implementation of the course are necessary. Students felt stimulated by real-life experiences (guest speakers and consultancy assignment), and experienced average stimulation and challenge by the learning environment.

Expected outcomes of design strategies

Realization of expected outcome of the design strategy A: use of idea generation techniques

An analysis of students' worksheets as a result of using idea generation techniques showed that all of the students came up with serious ideas, and were able to apply these techniques to specific problems. This was confirmed by observations showing that students participated actively and collaborated when working with the techniques. In the 'attributing' exercise, the students had an average of 8.2 ideas, and when using the checklist SCAMPER they were able to apply five or more of the seven questions to a specific problem. Sources of more idea generation techniques were exchanged for further reading. For the scale of creativity techniques, no difference was found between the pre-test and post-test, nor was a difference found for the scale of divergent thinking. One of the interviewed students did apply the idea generation techniques and found them useful.

Table 3.3: Realisation of expected outcomes of the design principle 'Fostering science students' competence in opportunity identification'

		Instruments						
Strategy	**Expectations**	Interview	Observations	Field notes	Questionnaire 1	Queationnaire 2	Product analysis	Realization of expected outcome
Strategy A: Stimulate the use of idea generation techniques and knowledge of heuristics	• Students are able to use idea generating techniques • Students are able to think divergently about a business problem	partial	good	good	none	none	good	partial
Strategy B: Let students conceptualise their experiences in opportunity identification and develop criteria	• Students are able to recognize business opportunities • Students can mention criteria for business opportunities and can select good business opportunities	good	good	good	none	none	good	good
Strategy C: Let students work on identifying opportunities in authentic experiences, and encourage them to reflect on their experiences	• Students can transfer the concepts and criteria of opportunity identification to new situations, and are able to use the concepts in practice.	partial	n.a.	good	n.a.	none	good	partial

(N.A. meaning the instrument was not applicable)

It is remarkable that the students' perceptions of creativity did not change during the course. The realisation of the expected outcomes from this design strategy is summarised in Table 3.3. It can be concluded that the expected outcomes of the strategy to stimulate the use of idea generation heuristics were partially realised.

Realization of expected outcome of the design strategy B: conceptualisation and developing criteria

From observations and field notes, it appeared that students devised feasible concepts and criteria on the basis of a discussion of examples of opportunities presented by the teacher. All of the students were able to detect five science-related opportunities and select the best of them. In a group discussion which provoked a large number of responses, the students were able to induce the concepts of opportunities and criteria with which to recognise potential opportunities. During another assignment, all of the student groups came up with two business ideas based on their personal competences, thereby further elaborating in a new situation on the concepts and criteria they had acquired. Concepts such as combinations, business models, improving functionality, using trends and analysing consumer needs have been discussed. The concepts of opportunity identification were applied spontaneously in more than 50% of the lessons presented by the students, for example in relating opportunity identification to personal attributes, gender or franchising, or by presenting a case in which the students' peers had to find a specific opportunity. In the interviews, the students stated that they had learned the concepts of opportunity identification, and were able to apply them. One of them reported increased self-efficacy. The results for this strategy are summarised in Table 3.3. It can be concluded that this strategy, which allowed the students to conceptualise their experiences of opportunity identification and encouraged them to find and apply criteria for the selection of opportunities, met the expected outcomes.

Realization of expected outcome of the design strategy C: let students identify opportunities in authentic experiences and reflect on them

Analyses of the students' products showed that all of the students were successful in finding five business opportunities from outside the classroom, and in making a selection by applying relevant criteria. Science-related opportunities were mostly found on the Internet and in professional literature. Business ideas were scored on two scales: the degree of innovation and their market potential. On the innovation scale, 45% of the business ideas were scored as imitative, 41% were scored as evolutionary, and 13% were scored as radical innovations (see Table 4).

Table 3.4: Innovation degree of business opportunities generated by students

Type of innovation	**Percentage of business opportunities**
Imitative	45%
Evolutionary	41%
Radical	13%

All of the students were successful in meeting the market potential standards, although there was limited depth and foundations in these topics. These results indicate that this assignment was clear and could be performed. In a second assignment, the students had to identify two business opportunities that had to be grounded in their own competences and scientific knowledge. Four out of the six groups came up with two business opportunities, for example coaching PhDs, or supporting spin-off companies. Business ideas from consultancy reports were coded as evolutionary, and the business plan was scored as imitative. One of the students confirmed that he applied concepts and criteria in identifying opportunities; another student did not confirm this expectation. From field notes, it was clear that students used the concepts and criteria of opportunity identification spontaneously in six of the eight group lectures. One item from the questionnaire showed that the business report and the consultancy report were not found to be as stimulating in terms of the generation of new ideas (mean 3.3). The results for this strategy are summarised in Table 3.3. These findings mean that the expected outcomes of this strategy to stimulate the transfer of concepts to new experiences were partially realised. The scale for divergent thinking did not confirm the results obtained by other methods.

CONCLUSIONS AND DISCUSSION

The crucial finding of this study is that the design strategies for the fostering of science students' competence in opportunity identification appear to realize the expected outcomes, as might be expected from the underlying mechanisms of the strategy. Although we did not measure the competence of opportunity identification at the beginning of the course, the fact that the students in this course were able to identify opportunities, indicates the functionality of the strategies in fostering students' competence to identify opportunities. Establishing that this competence develops because of this course and that there is a (causal) relation with the strategies needs further elaboration in forthcoming research.

This is an important finding for designers and educators interested in developing entrepreneurship education, because only a few design strategies in the domain of entrepreneurship education have been published. Most studies concern a single strategy, whereas here a set of three strategies was studied in an integrated design. The strategies in this study require further elaboration, as two of them did not fully realize their expected outcomes.

It has been assumed that using idea generation techniques and understanding the heuristics behind them (Amabile, 1996) will foster the identification of opportunities by improving divergent thinking. In addition, divergent thinking must be directed towards opportunity identification by specific tasks and assignments. Although the expected outcomes of this strategy were partially realized, our results seem to correspond with the findings of DeTienne and Chandler (2004) who successfully promoted idea generation by the application of techniques, as a way to foster opportunity identification in business students. These results also comply with Amabile's (1996) findings, which state that using idea generation techniques will increase divergent thinking. Because

this design strategy was not fully implemented as was intended, more attention must be paid to the implementation in future studies and in practise. Overall, it can be argued that stimulating the use of idea generation techniques and developing an understanding of the heuristics behind them contribute to the indicative functionality of the course. In addition, we suggest that idea generation techniques should be related to business cases and contexts that are as authentic as possible.

The expected outcome of the second design strategy, which was aiming at letting students conceptualise their experiences of opportunity identification and build their own prototypes and criteria regarding opportunity identification, was fully realized in this study. This result complies with the cognitive and social constructivist instruction theories that this strategy was built on. Both cognitive as well as social constructivist types of instruction were integrated into the course. Once the concepts and prototypes were internalised, the students reported they were more able to identify opportunities, and by re-using these concepts, concepts were extended and refined. The repeated use of prototypes further contributed to this process, meaning that tasks should be repeated and extended over time. Encouraging the students to develop their own criteria was found to be a useful way of conceptualising, because it forces the students to evaluate opportunities and, more importantly, lets them build mental maps and procedures that they can apply in forthcoming experiences. However, this design strategy was not fully implemented as intended. By integrating the conceptualisation step more fully into the tasks themselves by, for example, incorporating peer feedback and implementation, the strategy itself appears to be versatile. The inclusion of peer feedback in authentic entrepreneurial tasks could strengthen conceptualisation (Herrington and Oliver, 2000).

The expected outcome of the third design strategy, regarding the authentic context in learning to identify opportunities, was partially realised. In order to stimulate transfer, specific tasks were introduced which included the formation of a business plan or consultancy. As stated above, one of these major assignments did not provoke the need for all of the students to apply their skills on opportunity identification, and measures need to be taken to further improve the learning outcomes of this major assignment. It is a well-known problem that the transfer of competences from the learning situation to professional situations is often limited. Learning is context dependent, and what is learned in one context will not automatically be applied in other situations. The transfer of knowledge and skills can be enhanced by bringing in more authentic elements, by setting clearer criteria to be met, by introducing meta-cognitive activities and through assessment (Simons, 1999). The assessment of students' products, such as business plans and consultancy reports, by entrepreneurs can stimulate the use of knowledge and heuristics, if authentic criteria are used. The design strategy regarding transfer can be maintained, but the assessment tasks must be developed in such a way that they provoke the need to apply learned concepts and skills.

Students 'products show that at the end of the course students were able to identify entrepreneurial opportunities, and this is an indication for functionality. The course does what it is designed for, and this is a first step in design research. Demonstration of a causal relation between strategies and outcomes is a next step to be taken, and this needs experimental designs.

The perception of one's own competence is crucial in learning to identify opportunities, because it is related to self-efficacy, which was shown to be a stimulating, intermediate factor in opportunity identification (Krueger, 2000). However, an inconsistency was observed between the students' perceptions of this competence and the actual demonstration of the competence as shown in their products. Perceptions were measured by means of questionnaires and students' products were assessed by the teacher and by peers. It is agreed upon that field experts are in the best position to assess opportunities, and therefore their deployment is advocated for assessment in entrepreneurship education. In this study, the teacher as well as peers assessed students' products and this might have introduced inconsistency between instruments used. Secondly, the mandatory character of the course might have influenced the motivation of students, where intrinsic motivation is a stimulating factor in creativity (Amabile, 1996) and in opportunity identification (Ardichvilli et al., 2003). It is a possibility that students in this study were mostly extrinsically motivated what might have influenced their perceived competences. And thirdly the inconsistency that was found between the results from the questionnaires and other data raises the question of the construct validity of the questionnaire. Scales are derived from creativity theories, but the issues and items have not been validated for entrepreneurs. Students' perception was measured by means of a questionnaire with scales of proven reliability. But the self-evaluation of perception might have caused bias and this can be seen as a limitation of this study.

Another explanation may be that, in general, it takes a long time and a great deal of effort to acquire a complex competence (Van Merriënboer, 1997) such as opportunity identification. In order to develop this competence, the students need to have knowledge and skills in specific domains and knowledge of the market (Ardichvilli et al., 2003). Students' domain-specific knowledge of science was guaranteed by their grades. However, specific market-related knowledge still had to be developed, which might be difficult and time consuming for science students. It could be doubted whether this can be achieved in the classroom. Besides, a ten-week course might not be long enough for a competence to fully develop. Therefore, this issue deserves further empirical study on the development of the competence of opportunity identification and the validity of the questionnaire.

In addition, the context of a science master that is primarily focussed on analytical and critical thinking may have influenced the study. Students entering this master's programme had all been preselected due to their gift for science and are then further shaped by their education. The strength of academics in the field of science is their power of conceptualisation (Wolf & Kolb, 1984). Kickul et al (2009) distinguished between intuitive and analytical individuals; intuitive people are likely to discover opportunities, while analytical people have qualities to evaluate and plan for the new venture. Both styles prefer different roles in the stages of opportunity identification. In the present study, one of the cognitive styles could have been represented more frequently than the other (Wolf and Kolb, 1984), and this may explain the results regarding the students' levels of competence as perceived by themselves. This implies that in future studies, the population of science students should be analysed more profoundly with regard to their specific strengths.

It can be concluded that the set of three design strategies in this study has shown an indication for functionality, although emphasis must be given to a more optimal form of implementation. In order to make the design strategy more effective, we recommend the inclusion of authentic learning situations that are expected to improve some of the imperfections in the design principle and its implementation.

With regard to generalization of the results of this study, caution must be called for. The results of this study have value for a specific context, and that is why the context has to be described in the design principle. Contextual factors may influence the outcomes of design strategies, and therefore the strategies should be evaluated in various contexts in order to establish robustness.

The present study cannot be seen as conclusive, and this issue deserves further empirical study on the effects of authentic learning strategies on the teaching and learning of opportunity identification.

Organiser for this research

	Educational Context	***Content Opportunity Identification***
Relevance and theory	*Chapter 1* *Introduction*	
Exploratory case study	*Chapter 2* *Case study on characteristics of successful entrepreneurship education*	
Pioting design strategies		*Chapter 3* *Development and evaluation of design strategies on fostering opportunity identification*
Evaluating design strategies in other contexts, and finding new strategies		*Chapter 4* *Evaluation of design strategies on opportunity identification by expert entrepreneurship teachers in science education*
Evaluation of integrated design strategies	*Chapter 5* *Evaluation of design strategies on fostering opportunity identification and on an authentic learning context in a single course design*	
Reflection on this thesis	*Chapter 6* *Conclusions and Discussion*	

Chapter 4

Strategies of expert teachers in teaching opportunity identification[3]

ABSTRACT

The process of opportunity identification is under-emphasized in higher education; and there is a need for educational strategies to foster this competence in science students. In a previous study, three design strategies were piloted and evaluated in the classroom: stimulating the use of idea generation techniques, stimulating the conceptualization and evaluation of business opportunities, and promoting the transfer of knowledge and skills on opportunity identification. The focus of this evaluation study is on whether expert teachers use these strategies in teaching, which sub-strategies they use and whether they use additional strategies with the same objective. Expert teachers reported that they frequently applied the previously reported strategies and reported various sub-strategies. Moreover, they described three additional strategies: selecting students for an elective by assessing their business idea, providing time for incubation of the business opportunity and challenging students to abandon routine problem-solving patterns.

[3] This chapter is an adapted version of Nab, J., Keulen, H. van, & Pilot, A. (2014). Strategies of expert teachers in teaching opportunity identification. Industry & Higher Education, 28(2), 97-111.

Entrepreneurship education is promoted by European government policies at all levels of education (European Commission, 2005, 2008). Because opportunity identification or opportunity recognition is at the heart of entrepreneurship (Nixdorff & Solomon, 2007), it should be part of entrepreneurship education. In most programmes, opportunity identification is an implicit element of entrepreneurship education. For example, in many entrepreneurship courses students have to write a business plan and therefore they are expected to propose business opportunities and subsequently explore the market potential and feasibility of those opportunities. However, this first step in the process of opportunity identification is rarely emphasized in education. Whilst some studies have reported on this topic (Saks & Gaglio, 2002; DeTienne & Chandler, 2004; Corbett, 2005; Muzychenko, 2008), design strategies on how to develop education on opportunity identification have rarely been published and design strategies for this type of education cannot be easily deduced from scientific and non-scientific sources. As such, design strategies are required for teachers who are developing and implementing education on opportunity identification.

In this study, we use the concept of strategy as part of a design principle (Denyer et al, 2008; McKenney et al, 2006). The term 'strategy' refers here to a process and/or a sequence of planned and/or executed activities in a designed teaching and learning process. A design principle also contains underlying arguments (theory for learning and teaching, mechanisms and evidence-based and practical experiences) that relate to the chosen strategy and to the intended pedagogical effects. In addition, a design principle has a heuristic nature and is valid for a specific context (Denyer et al, 2008; Meijer, 2011; McKenney et al, 2006).

In a previous study strategies for encouraging science students to identify opportunities were piloted. They were grounded in the literature and in empirical evidence and were evaluated in the classroom (Chapter 3). Nab *et al* proposed three design strategies: (1) stimulate knowledge and skills of idea-generation techniques; (2) stimulate the conceptualization and evaluation of business opportunities; and (3) allow students to apply their knowledge and skills in authentic tasks in order to promote transfer.

The present study aims to evaluate these previously reported strategies by asking expert teachers whether they use these strategies in their teaching. Next, this study aims to discover additional strategies.

THEORY

The main theories on opportunity identification are the discovery theory (Alvarez, 2005; Kizner, 1973), the creation theory (Alvarez, 2005; Schumpeter, 1934) and the effectuation theory (Sarasvathy & Dew, 2005). There are, however, no studies on the explicit use of these theories in the development of education on opportunity identification, although some studies do give directions for designing education in this subject. DeTienne and Chandler (2004) successfully focused on stimulation of creativity to foster students' competence to identify opportunities. They applied to good effect a set of exercises, which consisted of registering opportunities, idea-generation

techniques, exchanging ideas and setting challenges. Their approach resulted in improvement of both the number of ideas generated and the innovativeness of these ideas. Saks and Gaglio (2002) asked expert teachers about the teaching of opportunity identification and found that they had varying opinions on whether the creation of business ideas could be taught. However, expert teachers all agreed that the evaluation of business concepts could be taught. Kickul (2006) showed that perceived entrepreneurial self-efficacy and entrepreneurial intention are both related to the competence to identify new opportunities.

A previous study (Chapter 3) proposed three strategies to foster the competence in identifying the opportunities of Master's students with a BSc Degree but with limited knowledge of business issues. These strategies are based on the literature and empirical evidence, and were piloted and evaluated in the classroom.

The first design strategy devised in Chapter 3 is to *stimulate knowledge and skills relating to idea generation techniques*. Ideation is the term used to describe the creative process of generating, developing and communicating new ideas, whereby an idea is understood as a basic element of thought that can be visual, concrete or abstract (Graham & Bachman, 2004). Ideation is strongly related to creativity, which is defined as the process of producing something new that is both original and worthwhile (Sternberg & Lubart, 1996), where 'new' may refer to the individual creator or the society or domain within which novelty occurs. The difference between ideation and creativity lies in the expected value of the idea. In fact, ideation and value evaluation are two steps of the same process.

Nixdorf and Solomon (2007) argue that creativity plays an important role in opportunity identification. Models of opportunity identification in entrepreneurship (Shane & Venkataraman, 2000; Shook et al, 2003) correspond to models of creativity research (Amabile, 1983; Hills et al, 1999). Cognitive processes in opportunity identification also show resemblance to creativity cognition (Corbett, 2005; Plesk, 1997). Opportunity identification can be considered a domain-specific form of creativity and so theories, concepts, techniques and instruments from creativity education can be of value in teaching opportunity identification. In fostering this competence, attempts should be made to stimulate the effective application of creativity heuristics (Amabile, 1996, p 255). Students should therefore acquire skills in idea-generation techniques and have an understanding of the heuristics behind those techniques, which can be obtained by practice and reflection. Subsequently, students must apply these heuristics in opportunity identification in various practices.

The second design strategy is to *stimulate the conceptualization and evaluation of opportunities*. A business or entrepreneurial opportunity is defined as an innovation, which has value for the customer or society, is feasible and can be profitably exploited by the entrepreneur (Gaglio & Katz, 2001). The concept of opportunity identification is somewhat complex, as mapped by Ardichvili et al. (2003). In the principal theories of opportunity identification, knowledge plays an essential role; and this knowledge must be recombined or reframed in order to identify new opportunities. This means that entrepreneurs as well as students must learn to reorganize their knowledge about

opportunities and recognize patterns and prototypes (Baron, 2004; Baron & Enslay, 2006). According to cognitive learning theories, students who learn to identify opportunities must build mental schemas and scripts on this concept. In this view, instruction strategies should focus on activating pre-knowledge, elaborating on and combining knowledge, applying knowledge in various contexts and structuring and developing heuristics (Valcke, 2007). These strategies are especially suited for ill-defined problems (Ertmer & Newby, 1993), such as identifying opportunities, and develop through reflection in action. In addition, students need knowledge of markets and industry that can be obtained by participating and collaborating in professional communities (Wenger, 2008). Possession of relevant knowledge is an advantage in terms of discovering opportunities; and knowledge of relevant domains, markets, consumer problems and ways to serve consumers is constructed through dialogue and participation. Learning in this way encompasses gathering, processing and interpreting information.

Repeated use of concepts and mental prototypes contributes to the refinement and extension of opportunity concepts. Also, encouraging students to develop their own criteria for opportunities is a useful method of conceptualization, because it forces them to develop their own criteria and, more importantly, allows them to build mental maps and heuristics that can be applied in the future.

The third strategy is to *stimulate transfer by means of learning through authentic tasks.* Transfer depends on the degree of analogy between the context of learning and the context of application (Gerntner, 1983, 1989; Gerntner & Smith, 2013; Schwartz et al, 2008). Three types of transfer have been defined: near, further and far. To stimulate transfer, students must be guided through a series of tasks with decreasing analogy, where meta-cognitive knowledge of concepts and heuristics for idea-generation determines whether the competence of opportunity identification will be applied in other situations. Such meta-cognitive knowledge can be obtained by reflection on experiences (Pea, 1987; Kolb, 1984; Corbett, 2005). Simons (1999) stated that the transfer of concepts and heuristics is stimulated by their application in professional tasks in a professional context, which can be achieved by introducing authentic elements in education (Herrington & Oliver, 2000).
Authentic learning environments share the essential characteristics of an entrepreneurial environment, but they may be adapted for the purpose of learning (Herrington & Oliver, 2000). In another study (Chapter 2) the authentic entrepreneurial learning environment was characterized as a professional working atmosphere, embracing the roles of students, types of tasks and activities, the role of the teacher and assessment. Meta-cognitive activities on domain-specific knowledge and opportunity identification also contribute to transfer, as do assessments where clear authentic criteria have to be met (Simons, 1999).

The three design strategies above were piloted and evaluated in the classroom (Chapter3). However, the findings hold for the specific context of the case (Denyer et al, 2008): for generalization it is necessary that these strategies prove to be robust in various contexts of entrepreneurship education. If a strategy is implemented in various ways and in various contexts, this is evidence of the robustness of the strategy: 'Ones that produce impressive results, not only under ideal

conditions, but also under realistic constraints' (van den Akker et al, 2006, p 13).

This study therefore aims to evaluate if expert teachers report to apply the design strategies, and how they implement these strategies. Furthermore, the intention is to discover additional strategies to teach opportunity identification, and to describe the implementation of these additional strategies. Thus, the research questions for this study are as follows.

(1) Do expert teachers in entrepreneurship education report to apply the following strategies to teach opportunity identification, and how do they implement the strategies to

a stimulate the knowledge and skills of idea-generation techniques;

b stimulate conceptualization and the evaluation of opportunities;

c stimulate transfer by means of learning through authentic tasks.

(2) What additional strategies do expert teachers in entrepreneurship education report to apply in teaching opportunity identification, and how do they implement these additional strategies?

METHODS

In this qualitative study, the selection of participants started with purposeful sampling (Patton, 1990) of known good practices in entrepreneurship education in the Netherlands. Expert teachers were selected that have at least three years of experience in entrepreneurship education for science students in higher education. Next, more expert teachers are detected by the snowball method: each interviewed expert is asked to name one or two other teachers in the field. To begin with, four expert teachers from science programs at Dutch universities were selected. Besides, two expert teachers from universities of applied sciences were selected. Next, a teacher from a Flemish university, and a teacher from a French university were selected, and at last an expert teacher from a technical university was included. Eventually, teachers from seven Dutch, one Flemish and one French university were selected. All teachers who were interviewed were responsible for teaching one or more courses. Most of the courses that were investigated in the interviews were electives.

Data collection consisted of interviews that were semi-structured and used topics derived from a previous study (Chapter 3) as subjects for the interview questions. First, the interviewer investigated whether the three strategies described were used. If this was confirmed, the teacher's perception of feasibility and effectiveness of the strategies were explored in the interview, as was the way this strategy was implemented. Ways of implementation will be expressed as sub-categories in this study. Second, the interviewer asked which additional strategies the teacher had used successfully for teaching opportunity identification. Expert teachers were asked if they perceived these strategies effective and feasible, and how they had implemented these strategies. Also here, ways of implementation will be expressed as sub-categories in this study.

For the data analysis, the interviews were coded and the three strategies as described in Chapter 3 were used as an analytical framework. For analysis of the authenticity of learning, a framework (Chapter 2) was used which consisted of a professional working atmosphere, the roles

of students, the types of tasks and activities and the role of the teacher and assessment. The interviews were audiotaped and transcribed verbatim, and then segmented into fragments covering an interview question plus answer. Intermediate analysis was performed after each one or two interviews, and interviewing of teachers continued until saturation occurred after nine interviews, meaning until no more new strategies were found. The inter-rater reliability was measured by independent coding for the presence of previously established design strategies (Cohen's Kappa was established as 0.69, 0.83 and 0.90 with $p<0.001$, for design strategies A, B and C respectively, based on 76 fragments of two interviews). The inter-rater reliability of additional strategies in the interview fragments was established as 0.72. Subsequently codes were clustered and experiences and arguments were structured.

The results are reported for each of the design strategies mentioned, together with the outcome of the implementations in the classroom. Results were scored as the proportion of teachers that applied a design strategy and perceived it as feasible and effective. Thus, for example, (3/9) means three out of nine teachers applied this sub strategy in education. If teachers did not have a statement on a strategy they were not included in the calculation of the proportion.

Most interviews and transcripts were in Dutch and therefore most quotations in this paper from participants are translations from Dutch into English. During the interviews some elaboration on the concept of opportunity identification occurred and if relevant to the present study this is described in the Results section.

RESULTS

Preliminary remarks

The basic assumption behind the study is that opportunity identification can be learned or developed by students, and for this reason this assumption was also investigated during the interviews. Most expert teachers (6/8) were convinced that the competence of opportunity identification can be learned to a certain extent, and one teacher did not know. Personal attributes and attitudes of students, and knowledge of the market and of the science domain, were considered to be necessary for the learning of opportunity identification. In all entrepreneurship programmes, students were required to identify one or more business opportunities. In most programmes this business opportunity was evaluated with regard to innovativeness, feasibility and market potential and subsequently elaborated in a business plan. In two cases the business opportunity had to be implemented as a student start-up.

Use of previously described design strategies

The first research question was designed to elicit confirmation of the previously reported strategies. We therefore investigated whether teachers report to use these strategies practically and effectively and in various contexts. In addition, we examined the sub-strategies that were used in implemented. The results are summarized in Table 4.1.

Design strategy 1: stimulate knowledge and skills relating to idea-generation techniques.

All of the expert teachers reported an emphasis on idea generation techniques and the stimulation of divergent thinking in their entrepreneurship programmes. The overall experience of the teachers was that the use of idea-generation techniques fostered opportunity identification. The majority of the teachers reported specific lessons or workshops on creativity where students practiced techniques for idea-generation – such as brainstorming, mind-mapping, morphological thinking, and the 'thinking hats' of de Bono (de Bono, 2000). For example, one teacher with a background in arts was involved in promoting creativity: creativity training was considered useful only if combined with science or business content, and with realistic and meaningful problems and tasks, and thus authentic problems were used in several cases. Another teacher reported a specific industry-based method (Systematic Inventive Thinking) to stimulate idea-generation. In addition, theories on opportunity identification were used to provide students with different perspectives on business opportunities.

'We deliberately have them look through various theoretical lenses, and it works very well. We see that they come to different conclusions every week . . .' (Teacher 2)

Also, business models and theories were mentioned as being used to stimulate different perspectives.

'. . . we want them to really understand the concept of a business model . . . How is the venture organized? How do they make money? . . . The product is only one out of eight or nine components that are necessary. We want to let them shift their minds from the product towards everything around it . . .' (Teacher 2)

Reflection on the process of idea-generation and on heuristics was propagated, creating awareness of procedural knowledge on techniques and fostering the transfer of the techniques to new situations as a result.

'I think it is of utmost importance that when you are looking for something you not only show the result of your quest but also the way you have organized your quest. Therefore, all students have to keep a log. They have to register their argumentation, in bullets. It does not need to be prosaic . . .' (Teacher 3)

About half of the teachers emphasized the importance of domain knowledge when using this strategy: students possess domain knowledge that can be used for innovation and opportunity identification. In one case, special emphasis on information management was used to stimulate creativity.

'We have a seminar, six sessions on information theory . . . If you want to be creative in developing business opportunities, and want to start a successful business, you need to know what is happening outside . . . Without information you can do nothing in innovation . . . You must have the best domain knowledge, knowledge on

technology. But also the knowledge behind that technology . . . Find the people and names behind the patents . . . But you also need knowledge of the market. Who are your clients? Who are they? Do they have the money? What is their expenditure profile?' (Teacher 3)

Most expert teachers mentioned the importance of a safe social and learning environment for idea-generation and avoided factors that hindered idea-generation – such as a lack of freedom. In one case extensive and expliciting emphasis was given to team building to produce multidisciplinary teams as a way of creating a safe and stimulating learning environment for creativity. In most cases, creativity meant changing or recombining existing concepts or products, and using heuristics to achieve this. Finding new ideas is predominantly regarded as an adaptation of existing concepts; seldom an idea is radically innovative. Most ideas were derived from the students' domain knowledge or were at the cutting edge of disciplines. In one case the high expectations of the teacher regarding the output of creativity were said to promote creativity and divergent thinking. Quantity as well as quality of ideas was demanded, in addition to special conditions and requirements for business ideas.

Our findings show that the selected teachers perceived the strategy to stimulate knowledge and skills of idea-generation techniques to be feasible and effective in various contexts with different teachers (see Table 4.1). It can therefore be concluded that this design strategy showed robustness.

Table 4.1: Use of previously described strategies for teaching opportunity identification, and their sub strategies in implementation

Strategies	Sub-strategies and proportion of teachers applying them
1 Stimulate knowledge and skills on idea-generation techniques	Teach and allow application of idea generation techniques (9/9).*
	Schedule specific lessons on creativity (8/9).
	Stimulate reflection on experiences with idea-generation (5/8).
	Demand the use of domain knowledge (5/9).
	Create a safe learning and social environment (5/9).
	Make demands for quantity and quality (4/9).
	Let teachers have high expectations (1/9).
2 Stimulate the conceptualization and evaluation of opportunities	Allow students to identify opportunities in the market (9/9) or by innovation (6/9).
	Stimulate elaboration on the concepts of opportunities (7/9).
	Separate identification of opportunities from evaluation (6/9), or combine them (3/9).
	Allow students to develop criteria (2/9), judge opportunities (6/9) and rank/select opportunities (3/9).
	Make specific demands regarding opportunities (4/9).

3	Stimulate transfer by means of learning through authentic tasks	Create an entrepreneurial working atmosphere (7/9) and stimulate team-building (6/9). Allow students to assume the role of problem-solver (8/9) and other entrepreneurial roles (8/9). Give students entrepreneurial tasks and activities (9/9) Allow teachers to assume the role of coach (7/9), expert (3/9) and/or CEO (1/9) Have business ideas assessed by external experts (8/9), who use explicit (8/8) and intuitive criteria (4/9) Provide co-assessment and feedback by entrepreneurs and teachers (9/9); stimulate co-assessment (3/9) and feedback (8/9) by peers.

**Note: '9/9' means that all nine interviewed teachers implemented this sub-strategy (and so on, throughout the Table).*

Design strategy 2: stimulate the conceptualization and evaluation of opportunities.

The teachers distinguished two types of business opportunities: opportunities in the market and in the (science) domain of the students. All teachers wanted students to identify business opportunities in the market; a majority also expected students to develop opportunities related to their domain knowledge. Explicit self-reflection on students' own learning experiences was required in some programmes in order to promote conceptualization of opportunity identification. Six teachers considered business idea identification as a phase that should be separated from evaluation, because evaluating opportunities too early would reduce idea-generation. Other teachers considered the identification and evaluation of opportunities as inseparable activities:

> *'The classic view is that entrepreneurship starts with opportunity recognition. Here, we follow the effectuation literature, which is more in the direction of creation . . . Effectuation supposes that an entrepreneur does not start from an idea or a goal but from what is available at the moment. You have to search what you have. Your own competences, your network, your interests, and from there you start to expand, together with others . . . It is an iterative process, and social construction is an important element. You will cooperate with clients and suppliers, maybe even with your competitors. You develop your product idea, and development and realization of your product idea go together.' (Teacher 2)*

> *'[Entrepreneurship] . . . is about many aspects happening at the same time. It is a problem in entrepreneurship education, because you should be doing everything simultaneously. But in practice it is not like that. In teaching you have to do one thing after the other. Therefore, I see it as a logical order from the sparking of the idea to making money with it.' (Teacher 3)*

Elaboration on concepts of opportunity identification is part of most entrepreneurship courses. Usually, examples of business opportunities would be analysed and discussed as a means of understanding the business opportunities concept. In a few cases the focus was on business

models. In one case the students had to find markets and a business model for a validated, science-based innovation, in cooperation with the researcher involved in that innovation.

'That's why we start with innovations from science. These innovations have already been recognized as innovative . . . But nobody knows what it will do in the market. Is it an opportunity?' (Teacher 7)

In academic entrepreneurship programmes, theories and models of opportunity identification were emphasized.

'We give students the assignment to study a real case from different perspectives. Then they have to answer: what kind of business development suits this company? What opportunities does it offer to the company? . . . We take a limited number of perspectives: the economic, social, technological and the marketing perspective. Each perspective leads to other opportunities for the same company . . .' (Teacher 2)

Judging business opportunities by students and developing criteria were expected to foster the students' competence to identify potential business opportunities. Some teachers stimulated students to develop criteria and then allowed them to apply these criteria to opportunities of fellow students as a form of peer feedback. In most cases students had to give peer feedback without having explicit criteria, and sometimes the teacher provided criteria. An effective way of judging and applying criteria was the ranking of opportunities.

Four expert teachers reported that they make special demands that have to be met; for example, the business ideas had to be found within the science domain or had to be innovative. One teacher stated that he made unusual demands in order to foster divergent thinking among students, and it resulted in better quality of students' opportunities.

'Without specific requirements there is no challenge. The more specific conditions we demanded the better were the products that were delivered.'(Teacher 4)

In conclusion, the strategy of allowing students to conceptualize and evaluate business opportunities was reported to be effective and practicable, according to different teachers in various contexts; and, as a result, robustness was demonstrated.

Design strategy 3: stimulate transfer by means of learning through authentic tasks.

In this study, we used previously reported strategies for learning in authentic contexts (Chapter 2) as a framework for data analysis: simulation of a working atmosphere, the role of students, types of tasks and activities, role of the teacher and authentic assessment.

Most teachers reported that they strive to provide a working atmosphere similar to that experienced with a (start-up) company. Working in self-selected multidisciplinary teams was found to be an authentic condition. Most entrepreneurship courses were situated in the university

and authentic learning elements had to be brought in by introducing activities that occur in entrepreneurial life. Student consultancy in existing companies was also reported.

Students fulfilled entrepreneurial roles as initiators of companies or real start-ups in the majority of programmes. They were encouraged to adopt the role of problem-solver by being given responsibility for and ownership of a range of entrepreneurial tasks as well as their learning activities. In addition, students acted as staff members in a business or as researchers in the entrepreneurship domain. Other methods employed to introduce students to entrepreneurial role models were analysis of videos, studying biographies and monitoring and analysing the behaviour of entrepreneurs.

In most programmes students were encouraged to solve problems and respond to questions, as would happen in the entrepreneurial world. All programmes included authentic tasks related to finding business opportunities. A wide variety of entrepreneurial tasks was reported, including visits to a business cafe, writing a business plan, market research, pitching, starting a business, managing a student company, finding capital, financing a company, specific tasks for companies and risk analysis.

'An opportunity is the other side of a risk. By analysing the risks, it is possible to fine-tune and adjust the opportunity. Our risk management is never based on a number . . . it is always a range. We always predict the profits as a range. In the beginning, I have to teach them [students] how to estimate risks. The risk includes all aspects. It includes patents, client risks, and suppliers' risks. By the end we have the whole package.' (Teacher 3)

Other authentic tasks were reported: for instance, inviting guest speakers, internships, case studies and desk research on entrepreneurship. Students had to go out into the business world to network, bring business ideas into the market, present business ideas to investors, or sell stocks for their company. They also had to find members for the Board of the company and go to banks and chambers of commerce.

'When students start their company, they have to register at the Chamber of Commerce and start a bank account. They sell shares, which implies that their company can go bankrupt.
The company with the highest rates has the best performance . . . This gives some competition
. . . They sell shares in their social environment, family and so on . . . These are small shares of 20 or 25 Euros. There is hardly any risk.' (Teacher 1)

'I think that authenticity is one of the most important characteristics for learning to become an entrepreneur. It means little structure, uncertainty, ambiguity and a need for new knowledge. This is in contrast to what is propagated at universities: closed doors and salary scales. That's my view on authenticity and what I experienced myself as a starting entrepreneur.' (Teacher 3)

Teachers are an important factor in the learning environment and must have roles that relate to students' activities. In most cases teachers reported having fulfilled the role of coach; in fewer

cases they acted as an expert or as the CEO. Entrepreneurs were invited as guest speakers and performed some teacher activities and served as role models and assessors.

Authentic feedback and assessment play an important role in entrepreneurial learning environments. Peers and teachers who assessed the business ideas of students mostly analysed market potential and feasibility. The students then used the resulting feedback to refine their business ideas. Finally, students were assessed, as in entrepreneurship, by presenting their opportunities to a forum of entrepreneurs, investors or venture capitalists. This forum assessed business plans and ideas and entrepreneurial behaviour or entrepreneurial attitude. Most external assessors applied explicit criteria that are generally accepted in entrepreneurship and were also known by the students. Innovation and market potential were usually used as criteria.

'I think we have a good view on the market, the number of clients and the competitors. We have some kind of formula in our head.' (Teacher 8)

One of the teachers expressed this belief, however:

'An innovative idea cannot be assessed.' (Teacher 5)

Other criteria mentioned related to financial aspects or the feasibility of the opportunity (the 'reality check') and the business model. In the majority of programmes feedback of peers or co-assessment of teachers and students was used.

Teachers assumed that by assessing others students would learn to distinguish between successful and non-successful opportunities. In general, however, there was little explicit evaluation of the criteria themselves; criteria were applied but rarely analysed and reflected upon. Almost half of the assessors reported that they also used 'intuitive' or implicit criteria.

'In the end intuition is the most important. Many investors and venture capitalists think that intuition is the main criterion. Do you believe that one is able to do it? Do you trust your money to a person, and believe that he is going to make more out of it?' (Teacher 2)

'We use a group of experts, and they don't have a checklist . . . But they say you have to work on this and that. It is based on their expertise and experience. For me that is a good form of assessment.' (Teacher 4)

The respondents reported the use of summative as well as formative feedback. Feedback from entrepreneurs and venture capitalists was used for improvement, largely in relation to feasibility. In one course students had to find business opportunities in a theoretical case, as part of their assessment.

The findings lead to the conclusion that the expert teachers reported that they applied the strategy to stimulate transfer by means of authentic learning practically and effectively in all programmes in this study. Therefore, this strategy showed robustness across various contexts.

Additionally reported design strategies

The second research question was aimed at finding additional design strategies that entrepreneurship teachers apply for teaching opportunity identification. Three additional strategies were reported, as summarized in Table 4.2.

Table 4.2: Additionally reported strategies for teaching opportunity identification and their sub-strategies in implementation

Additionally reported strategies	Sub-strategies and proportion of teachers applying them
4 Challenge students to abandon their routine patterns of problem-solving	• Provide authentic, open-ended, interdisciplinary and complex tasks, in authentic contexts (9/9).* • Foster the formation of interdisciplinary teams (5/9). • Give students autonomy, responsibility and initiative in their roles in the start-up and learning activities (9/9). • Organize deadlines, work pressure, competition and complexity (9/9). • Foster intergroup competition (6/9). • Demand implementation of business ideas (2/9). • Take students out of their familiar context (1/9).
5 Select students for the quality of their business ideas	• Make the identification of a business opportunity conditional for admittance to the course (2/9). • Assess the opportunity for its market potential (2/9). • Select students for the quality of the opportunity and/or their presentation and defence of their idea (2/9). • Select for 'talent' as perceived by the teacher to further explore the idea, and on motivation (3/9). • Select by interview/questionnaire (2x).
6 Provide incubation time for opportunity identification	• Provide sufficient time between giving assignment to identify an opportunity and its assessment (2/9). • Create the possibility for iteration of idea generation and evaluation (8/9). • Provide feedback on immature opportunities that can be used for improvement (7/9). • Create possibilities to compare and discuss (9/9).

**Note: '9/9' means that all nine interviewed teachers implemented this sub-strategy (and so on, throughout the Table).*

Additionally reported design strategy 4: challenge students to abandon their routine patterns of problem solving.

This strategy requires that students be challenged to go beyond their familiar actions and contexts and to step out of their routine patterns of solving problems. All those interviewed reported that they challenged students with entrepreneurial tasks that were open-ended, interdisciplinary and complex.

'In education I try to give vague assignments . . . For some students (. . .) this is a radical change . . . Students get vague assignments with some ambiguous guidelines. If I give them too much structure, they will start doing a blank exercise. And this is not what I want.' (Teacher 2)

All teachers reported that they organized their courses in a manner that challenged students to abandon their routine patterns of problem solving. Students worked in multidisciplinary teams and it was reported that this stimulated the generation of new ideas. The students were required to work on interdisciplinary problems and tasks that could only be solved with knowledge from several disciplines.

'The approach of entrepreneurship in our programme is interdisciplinary . . . It is not possible to understand entrepreneurship from one discipline.' (Teacher 9)

Most teachers imposed deadlines and other pressures of work and supplied clear criteria that had to be met by the students; all expressed high expectations of students' achievements. The opinions of the expert teachers differed with regard to the use of intergroup competition as a way of challenging students: in one case intergroup competition was fierce and groups of students had to bring the same business opportunity into the market.

'Everything they have to do is difficult. What is the assignment? I have to come up with an innovative idea. What can I introduce on the market? What technology is involved? I don't know what is going on. I see the problem but do not know how to handle it. And this is exactly how a starter in business begins. It is my experience that if you manage to challenge students, education will be successful.' (Teacher 4)

Some teachers preferred to avoid competition on the grounds that it might decrease knowledge sharing and idea-generation.

'I introduced elements of competition and the course did not improve by that. It put a serious brake on the exchange of knowledge. I regretted it afterwards . . .' (Teacher 6)

Competition between teams was also promoted by selection for and participation in business plan competitions. In one programme students could invest in the business plans of competitors;

and the share prices of the firms provoked competition between virtual start-ups and were also an authentic method for providing feedback on the plans.

All of the expert teachers reported that during the course students were encouraged to adopt various roles, which required autonomy, responsibility and initiative, in terms of both their entrepreneurial activities and the learning process itself.

'I give students as much responsibility and autonomy as possible.' (Teacher 2)

Students were also challenged to exploit their opportunity in the market, which encouraged and extended their level of commitment. In conclusion, the design strategy of challenging students to step out of their routine problem-solving patterns was reported to be practicable and effective in various learning contexts, and therefore the robustness of this strategy was shown.

Additionally reported design strategy 5: select students on the basis of the quality of their business ideas.

In two electives, students were admitted on the basis of the quality and the presentation of their business idea. In one course selection was used to identify talented students; in the other case, selection was introduced primarily to improve the quality of the business ideas.

'We offer a workshop at the start of the Master's . . . Those who are interested in entrepreneurship are asked to start thinking about a business idea. We put the students to work well in advance of the course. During this time the mailbox of the teacher is very patient. The teacher comments on the ideas and is very critical.' (Teacher 8)

Teachers assessed this business opportunity for its potential in the market by using explicit and intuitive criteria.

'We put students on a spot, just a yellow doormat, without a PowerPoint. Then they have ten minutes to present themselves and their ideas, and next we have a thorough discussion of about ten minutes with a panel of five teachers who know the students. It's a bit like Idols[1].' (Teacher 4)

As well as assessing the quality of the idea, teachers judged the presentation and the persuasiveness of the presenters. If the pitch was found to be adequate, the student was admitted to the elective.

'I am enthusiastic about looking for the X-factor. Students give a performance, short and intense, and they have

[1] *'Idols' is a television show that is broadcast on the Dutch television network RTL 4. It is a contest to find supposedly the best young singer in the Netherlands, according to the votes of a panel of judges on the programme and subsequent public voting by telephone.*

worked towards it very hard. A group of experts is assessing them and they do not use a checklist. But these people say you have to work on this and another had to work on that. And that is based on their experience and expertise.' (Teacher 4)

Both teachers and entrepreneurs who used this strategy reported an improvement in the quality of business ideas at the start of the elective.

'We were impressed by the overall quality of ideas. It has improved dramatically over the last few years.' (Teacher 9)

In conclusion, the strategy to select students based on the potential of the business opportunity and/or the 'talent' of the students was said to practicable and effective in two cases.

Additionally reported design strategy 6: provide incubation time for opportunity identification.

Two of the teachers who were interviewed reported that they allowed students an extended incubation period for idea identification, because the maturation of a business opportunity requires considerable time, iteration and feedback. Students had more time to find ideas, compare and evaluate them, and further refine these in time.

'Our course is stretched over a year. For people without an idea this is too short a time to bring an initial and vague idea to the market. People who enter without a business idea need longer than a year. It takes time, because one cannot work on an idea eight hours a day.' (Teacher 2)

Students elaborated on and discussed their opportunities with friends, family and peers, and they perceived this as improving their ideas. During the incubation period students received formative feedback from teachers, peers and entrepreneurs and they used the feedback to improve their business opportunity. In all programmes students had the chance to discuss and evaluate their business opportunities, and this was considered essential for feedback and learning.

'At the end of the meeting I let students propose improvements on their ideas. Here, the cross-fertilization of teams proves very important. I take two students from one team and two from another team, and mix them. I see that students are very critical towards each other. But exactly about the things I would say myself.' (Teacher 8)

It can be concluded that the strategy to provide an incubation period for opportunity identification was reported to be a practicable and effective strategy in two cases.

CONCLUSIONS

In this study, three strategies for teaching opportunity identification to science students that were proposed in an earlier design study were evaluated in other contexts. These strategies are:

(1) Stimulate knowledge and skills relating to idea-generation techniques;

(2) Stimulate conceptualization and evaluation of opportunities; and

(3) Stimulate transfer by means of learning through authentic tasks.

The results for these design strategies are summarized in Table 4.1. Our main findings are that these strategies were said to be achievable and effective in various learning contexts, as reported by the majority of expert teachers, and various sub-strategies were reported for each strategy. It can therefore be concluded that the design strategies show robustness. This suggests that our design strategies could be applied more generally, to a wider context of entrepreneurship education for science students.

Furthermore, three additional strategies for teaching opportunity identification were reported by expert teachers:

(4) Challenging students to abandon their routine strategies for problem solving;

(5) Selecting students on the basis of the quality of their business ideas; and

(6) Providing extended incubation time relating to opportunity identification.

The results of the data analysis regarding these additional strategies are summarized in Table 4.2.

The strategy of challenging students to abandon routine problem solving was reported to be effective and practicable by the majority of interviewees and was found to be robust in various contexts. Therefore, this strategy is a useful addition to the existing design strategies for fostering the competence of opportunity identification.

The strategy of selecting students on the basis of the quality of their business idea was reported to be practicable and effective in two cases, as was the strategy of providing incubation time for opportunity identification. These are limited numbers with regard to generalization, but the strategies can usefully extend the previously identified strategies and thus help entrepreneurship teachers in developing entrepreneurship education further. These design strategies have heuristic value for designing educational programmes and can help teachers, developers and designers.

DISCUSSION

Previously identified design strategies

Our results for the strategy for stimulating knowledge and skills of idea-generation are consistent with the findings of DeTienne and Chandler (2004), who reported idea generation exercises as one of their interventions in education to improve the competence of opportunity identification. Our findings are also consistent with the creativity model of Amabile (1983).

The results reported for the strategy for stimulating conceptualization and evaluation

of opportunities are consistent with the expectations of cognitive theories on opportunity identification (Ardichvili *et al*, 2003; Ward, 2004). These theories provide insight into attributes for learning such as prior knowledge, cognitive mechanisms, heuristics and creative abilities. These attributes may help students gain a deeper understanding of a phenomenon when they discover the concepts of their mental actions. This strategy is also in agreement with cognitive theory on experiential learning in opportunity identification (Corbett, 2005), whereby conceptualization is one of the major steps in learning.

The strategy for stimulating the transfer of learning in the identification of opportunities through authentic tasks is built on existing theories of learning in authentic contexts (Herrington & Oliver, 2000) and on transfer of concepts theory in learning (Simons, 1999). The three previously identified design strategies comply with the theories as presented in detail in the Theory section.

Challenging students to abandon their routine strategies of problem solving

The first additional strategy was intended to challenge students to abandon their routine strategies of problem solving. In educational activities, or in daily life, students acquire a relevant set of skills and competences in problem solving. In this study routine problem solving must be distinguished from non-routine problem solving. Routine problem solving can be performed by the use of fixed procedures and knowledge and there is no need to develop alternative ways of problem solving, provided that the existing level of competence is sufficient. Routine problem solving stresses the use of known or prescribed procedures (algorithms) to solve problems.

When students are brought into entrepreneurial circumstances of uncertainty and ambiguity, such as opportunity identification, they are confronted with the ineffectiveness of their routine problem-solving skills. Challenging circumstances force students to reflect on their competences and a need arises to develop new, creative solutions and knowledge. Non-routine problem solving stresses the use of heuristics that do not guarantee a solution to the problem but provide a higher probability of solving the problem. Jonassen (2000) described various types of problems and ranked them according to the required learning activities, inputs, success criteria and context and the extent of both structure and abstraction. In this classification, the identification of business opportunities can be characterized by many uncertainties and lack of information on how to solve the 'problem'. This means that identification of opportunities demands the use of heuristics, or development of heuristics, where students are prompted to act by tasks that are challenging. This is in agreement with Cope (2003) who stated that entrepreneurs learn from critical incidents that force them to reflect. Cope built his statements on theories that distinguish lower-level learning from higher-level learning, such as single- versus double-loop learning (Agyris and Schön, 1978), and instrumental versus transformative learning (Mezirow, 1990). Higher-level learning is related to the uncertainty in heuristics and elements or even the lack of heuristics and will therefore challenge students more than lower-level learning. Vermunt and Verloop (1999) described the concept of constructive friction, which is the perceived gap between demands or goals and the competence of students. If students are convinced that they are able to bridge this gap they will

accept the challenge to increase skills in thinking or learning. Constructive friction is directed by the degree of scaffolding of teachers and corresponding levels of autonomy and responsibility of the students. Deliberately and selectively bringing students into a situation of constructive friction can provide a strong mechanism for the development of new patterns for problem solving.

Selecting students on the basis of the quality of their business ideas

In this study two cases were found where students were admitted to the course on the basis of the quality of their business plan. In both cases it was reported to be an effective strategy in improving the quality of business ideas of students. It is interesting to take a closer look at these. In one case, students had to provide an idea and received feedback. They also had the opportunity to refine the idea and to discuss it with peers in advance of the assessment. Ultimately it was decided that all students would be admitted to the course. It was the case that formative feedback was used in this approach, a technique proven to be effective in learning (Hattie & Timperley, 2007).

In the second case, students also had to provide an idea and then pitch the idea to teachers and entrepreneurs. The outcome was that they were either admitted to the course or rejected. This was a typical example of summative feedback. Students in this case learned from the experience, but less so from the feedback. The assessment was aimed primarily at selecting students with the potential, in the eyes of the assessors, to become entrepreneurs rather than on learning to find business ideas. Because this feedback was partly intuitive and also directed towards students' traits, it was less suited to improving learning and conceptualization. In addition, selection may have influenced this process – for instance, in raising the self-efficacy of admitted students, an intermediate variable in opportunity identification (Krueger, 2000). It raises the long-standing debate on nature and nurture in entrepreneurship; but if we consider the process of opportunity identification as a cognitive and social activity (Baron, 2004; Corbett, 2007; Gaglio & Katz, 2001) this offers the premise that opportunity identification can be learned. From that perspective the formative feedback will be most effective in learning. We suggest that the types of feedback and their effects on learning and becoming entrepreneurial are worthy of investigation, as part of further studies on the current topic. In particular, an analysis of the intuitive feedback from entrepreneurs, which is derived from their tacit knowledge, could provide a better understanding of the opportunity concept and help in teaching opportunity identification.

Incubation time for opportunity identification

The third additional strategy that was reported was designed to provide incubation time for opportunity identification. Creative work typically involves periods of incubation, where one is not consciously thinking about the task. This can remove fixations and provide access to knowledge in long-term memory that can lead to a solution (Finke et al, 1992). Ideas need to be developed after the first discovery or creation and to become mature in iterative cycles of evaluation and refinement. Incubation is described (Amabile, 1996, p 101; Nickerson, 1999, p 417; Csikzentmihalyi, 1996) as a period in which, on a subconscious level, one proceeds with cognitive activities

that contribute to idea maturation. During incubation, individuals cognitively process thoughts subconsciously while they are thinking about an idea or working to solve a problem. If incubation time is provided, one of the steps in the opportunity identification process is extended. Shook *et al* (2003) propose an opportunity identification model that shows strong resemblance to phase models of creativity (Corbett, 2005; Hills et al, 1999; Ward, 2004); and several creativity models include an incubation period (Amabile, 1996, p 101; Csikszentmihalyi, 1996; Nickerson, 1999, p 417): thus it can be assumed that incubation can be part of opportunity identification.

In entrepreneurship education students have relatively little time available for incubation. Courses last for a limited number of weeks and the process of opportunity identification is compressed into a short period, leaving little time for incubation. The design strategy of providing incubation time is intended to extend the overall time for identification and incubation and, as such, to stimulate the cognitive processes. Students are then encouraged to start searching for ideas earlier, and are allowed a substantial period for incubation and refinement.

Another relevant issue is reflection on experiences (Cope, 2003, 2005), something that is influential for learning and conceptualization (Baron & Ensley, 2006), leading to better performance in subsequent experiences. With a long incubation period substantial time for reflection is created; and reflection will be strengthened by feedback from teachers or peers. Feedback that is given in a proper manner, in time and with the possibility of use for refinement, is effective in learning (Hattie & Timperley, 2007). The question arises of whether time on task has an effect on the reported outcomes. If students spend more time on a task or subject, it can be anticipated that this will affect the learning results. However, in a study on the contribution of variables to the effectiveness of instruction (Valcke, 2007, p 392) it was found that the effect of time allowed for this type of task was small, whereas the effect of feedback, expectations of teachers and cooperative learning was large. If we apply this to our study it means that time on task can explain little of the perceived effect of this strategy, whereas other variables do better.

In a previous study (Chapter 3) students reported discussing their ideas with peers, friends and family and browsing the Internet when the assignment to identify a business opportunity was given well in advance of the course. In fact, students refined their idea after the 'first spark' by discussing it in their social networks. This is consistent with the finding of Ozgen and Baron (2007) that entrepreneurs use social sources of information for opportunity identification and, in this way, develop a mental schema and heuristics by participation in their networks. It can be anticipated that the same mechanisms have a role in students' learning.

Limitations and generalization

In our study we used the interviewees' examples as a demonstration of 'effectiveness'. Two remarks about this approach need to be made. First, the conclusions about the effectiveness of the strategies are based solely on the opinions of the interviewees; no additional methods were used to determine effectiveness. As a result, proof of effectiveness, in terms of learning to identify opportunities, and students' perceptions about it, must be incorporated into future experimental

research on our design strategies. Second, if teachers did report effectiveness, it should be understood that their conclusions are restricted to the specific learning context of their cases.

As indicated in the Methods section, the feasibility and effectiveness of the strategies were questioned in the interviews with expert teachers. The majority of interviewees implemented the previously identified strategies that were evaluated in this present study and our findings can therefore be generalized to a broader range of science and presumably also to technical studies. Also, the additional strategy of challenging students to abandon their routine ways of problem solving was reported by the majority of the interviewees and might therefore be generalized to a broader range of science students. However, the two additional strategies, 'to select students' and 'on incubation time', were mentioned by only two interviewees – and this is too small a sample to provide a generalized demonstration of feasibility.

Among the sub-strategies there are examples that were used by only one out of nine teachers. Whilst it may help teachers considering a variety of strategies to know the possibilities, caution must be exercised in generalizing the additional strategies and sub-strategies to other contexts.

Because our study focused specifically on science students in terms of fostering the competence of opportunity identification, generalizations to non-science domains should also be made with caution. Populations of students can be typified by specific characteristics or traits: for example, science students are trained primarily in analytical and critical thinking and are strong on conceptualization (Wolf & Kolb, 1984). Moreover, Kickul et al (2009) distinguish two types of students in entrepreneurship education: analytical and intuitive individuals, each with different potential for the process of opportunity identification. It can be assumed that the science student population is more analytical than students from domains such as humanities or social sciences, and this might have consequences for the generalization of our design strategies. Also, the science domain provides many opportunities for technical innovations that have value and can be sold at a profit. Although the creative potential of other domains exists, it is not clear if other domains offer similar potential for generating financial profit.

Our research was mainly conducted in the Netherlands and, although generalization of our findings to other cultural contexts seems reasonable, many factors are involved. For example, McGrath and MacMillan (1992 as cited in Shook et al, 2003) demonstrated that entrepreneurs from Anglo-Saxon, Nordic and Chinese cultures differed significantly in their psychological characteristics (for example, beliefs, values, attitudes). It is also likely that demographics (for example, education, past experiences, competences) and cognitions (that is, content and process) vary among cultural contexts. Hence, enterprising individuals may be affected differently by their national context. Shook et al. (2003) argue that the cultural context may have an effect on all four 'steps' of the venture creation process (that is, entrepreneurial intent, opportunity search and discovery, the decision to exploit a new venture creation, and opportunity exploitation activities). Thus, cross-cultural research shows that strategies gained from European samples may not be applicable to entrepreneurship education in other cultures.

Sequence of strategies

In this study the strategies are presented as separate items, but in other design studies (Meijer, 2011) it became evident that the coherence and sequence of strategies in the design of the activities determined their effectiveness. The sequence of learning activities must be related to learning phases and instructional functions. The strategies in this research were treated in a logical sequence because most activities can only be performed in a specific order and activities in many cases depend on the result of a former activity. Therefore, emphasis should be given to the sequence of activities. In addition, isolated strategies will not be effective, but the combination of several strategies proved relevant in designing an authentic learning environment (Barab et al, 2000). Further studies on this issue should therefore include the sequence and coherence of strategies in education on opportunity identification.

Teachers

Last, but not least, teachers are an important factor in the implementation of design strategies. The success of strategies strongly depends on the role and competences of the teacher (Haase & Lautenschläger, 2011; Löbler, 2006; Chapter 2). This implies the necessity for professional development of entrepreneurship teachers in understanding and applying these strategies in an effective way. A challenging task for further research would be to focus on professionalization programmes for the development of competences and roles of entrepreneurship teachers.

Organiser for this research

	Educational Context	***Content Opportunity Identification***
Relevance and theory	*Chapter 1* *Introduction*	
Exploratory case study	*Chapter 2* *Case study on characteristics of successful entrepreneurship education*	
Pioting design strategies		*Chapter 3* *Development and evaluation of design strategies on fostering opportunity identification*
Evaluating design strategies in other contexts, and finding new strategies		*Chapter 4* *Evaluation of design strategies on opportunity identification by expert entrepreneurship teachers in science education*
Evaluation of integrated design strategies	*Chapter 5* *Evaluation of design strategies on fostering opportunity identification and on an authentic learning context in a single course design*	
Reflection on this thesis	*Chapter 6* *Conclusions and Discussion*	

Chapter 5

An authentic learning environment in fostering students' competence to identify entrepreneurial opportunities[4]

ABSTRACT

The professional context plays a crucial role in the process of opportunity identification by entrepreneurs, and therefore context factors can play a leading part in designing educational programmes that aim to develop and hone this competence. In this case study design strategies are explored that specifically aim at developing opportunity identification in a learning environment that includes relevant context factors from entrepreneurship practice. Strategies for the development of authentic learning have been described before (in Chapter 2): the type of tasks and activities, the physical and social context, access to expert performance, variety in perspectives, collaborative construction of knowledge, reflection, articulation of knowledge, type of coaching and assessment. These strategies for authentic learning were combined with previously described strategies for teaching opportunity identification. All strategies were applied in the course and various ways of application were described for each strategy. Subsequently, the degree of realization of strategies was evaluated and most strategies were fully realized. Also students' products were analysed in order to determine if students are able to identify opportunities after this course. Students' opportunities scored highly with regard to innovation and market potential as assessed by external experts. This resulted in an indication for functionality of the course. This study shows that students in a course that complies with the strategies for an authentic learning environment were able to identify entrepreneurial opportunities. A set of strategies is presented for the design of education in opportunity identification in an entrepreneurial learning environment.

[4] This chapter has been submitted as Nab, J., Janssen, S., Van Keulen, H., & Pilot, A. (submitted). An authentic learning environment in fostering students' competence to identify entrepreneurial opportunities.

INTRODUCTION

Higher education institutions can play a fundamental role in the creation of new enterprises, because they represent a main source of knowledge that can be valorised by entrepreneurs. 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 and should be explicitly emphasized in entrepreneurship education.

The entrepreneurial context is crucial in the process of OI (Alvarez, 2005) as a source of information and learning. Moreover, Gibb (2002) underpinned the importance of the context to the learning of entrepreneurs. Also Lans (2009) showed the importance of the working context for learning to identify opportunities by small business owners. Although the findings may give direction in the design of entrepreneurship education that aims at teaching and learning OI, a need exists to investigate which factors of the entrepreneurial context contribute to teaching opportunity identification.

OI as an entrepreneurial phenomenon has widely been studied, but few studies reported on developing OI abilities in education, which implies that, design strategies have to be found in curriculum development. Some rules of thumb for designing education in OI are described by DeTienne and Chandler (2004), Kickul (2006), and Saks and Gaglio (2002). Nab, Bulte, and Pilot (2013) in an empirical study reported on design strategies for teaching OI: idea-generating techniques, conceptualization and criteria for OI, and the transfer of concepts to new contexts. They also gave recommendations on challenging students to abandon their routine thinking patterns.

As for entrepreneurs the context plays an important role in the process of OI, it can be expected that the context will also influence teaching of OI. Several scholars from the entrepreneurship domain have argued for the introduction of authentic elements in entrepreneurship education (Gibb, 1993; Pittaway & Cope, 2007; Taatila, 2007; Vincett & Farlow, 2008). And where experiential learning is most often reported as a successful teaching approach (Corbett, 2005; Hannon, McBride, & Burns, 2004; Heinonen & Poikkijoki, 2006; Kickul, Griffiths, & Bacq, 2010; Pittaway & Cope, 2007), the learning context of experiences is seldom specified in literature. Therefore we introduced the concepts of authentic learning in this study with the aim to enter into deeper detail of an entrepreneurial learning environment. Studies on authentic learning suggest that bringing in relevant context factors of professional entrepreneurship might contribute to the teaching of opportunity identification. An authentic learning environment means that essential factors from professional practice that reflect the way the knowledge is used in real life, are introduced in education. According to the situation cognition paradigm, learning is domain specific as well as context specific, and learning should therefore be contextualized (Brown et al., 1989; Carlson et al, 1990). The learning environment should be designed to evoke the key cognitive activities of entrepreneurship. Design strategies for developing authentic learning were defined by

several authors (Herrington & Oliver, 2000; Renzulli, Gentry & Reis, 2004; Rule, 2006), and these strategies can have value for entrepreneurship education. Nab, Pilot, Brinkkemper, and Ten Berge (Chapter 2) described design strategies for authentic learning in entrepreneurship education for informatics students, and these design strategies show similarities to those of Herrington and Oliver (2000). However, it is not known how authentic learning in entrepreneurship education influences the acquisition of students' competence in OI.

Therefore, this case study evaluates the contribution of an entrepreneurial learning environment to teaching and learning opportunity identification, in order to contribute to further understanding of entrepreneurship education.

This paper starts by defining the concept of OI and by describing the known strategies for teaching this subject. The importance of the context in OI is elaborated upon, as well as its implications for teaching and learning. This results in two design principles, both consisting of several strategies for educational design: one for fostering opportunity identification and a second for the creation of an authentic learning environment. These strategies are used as a framework in a case, that was studied to determine the presence of these strategies in the course design, and how these strategies were applied. Then the strategies are evaluated for their degree of realization, and an indication for functionality of the course was determined by analysing students' products. Finally, the results and the value of authentic learning design strategies in teaching and learning OI are discussed.

THEORY

Opportunity identification

The identification of entrepreneurial 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, and Peterson, 1994). In fact, OI is considered as a core competence for entrepreneurs (Man, 2006; Nixdorff and Solomon, 2007). Several definitions of opportunity recognition and opportunity identification have been described (Hulbert, Brown, and Adams, 1997; Kirzner, 1979; Shane and Venkataraman, 2000, p. 220). Based on these definitions, we use the following definition of OI in this study: opportunity identification is the creation and/or discovery of something novel that is of value to the customer or society and can result in profit for the entrepreneur. Opportunities are recognized in the form of new products or services, new ways of production, new markets, new resources, or new ways of distribution.

Three main theories exist regarding opportunity recognition: the discovery theory, the creation theory, and the effectuation theory. According to the *discovery theory*, opportunities exist in the environment independently of the individuals who discover them (Alvarez, 2005; Kirzner, 1979). A knowledge advantage enables some to discover opportunities where others do not (Shane, 2000). In this view, OI is largely a cognitive process of knowledge acquisition about

market disequilibria and resources and finding ways to exploit these.

In the *creation view* (Alvarez, 2005), the entrepreneur is the creator of opportunities. Opportunities are based on entrepreneurs' subjective perceptions and created by the entrepreneur or co-created through collaboration and learning processes. From this viewpoint, the entrepreneur creates new opportunities that did not exist before and knowledge is (re)constructed.

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 the participating agents. Entrepreneurs in this view collaborate in partnerships to create new markets. Opportunities are created by a dynamic and continuous reconstruction guided by actual resources and interests. In this view, knowledge is created as well as constructed.

In practice, the processes of knowledge acquisition and knowledge construction occur alternately or simultaneously. In all three theories on OI, the context plays a central role in knowledge acquisition and construction and thus in learning. This provides a strong argument for involving relevant elements of the entrepreneurial context in education that aims to foster OI competence.

The literature uses different terminology for OI, and logically this terminology evokes strong associations with the theory from which it is derived. In the present study, we prefer to use the terminology of "opportunity identification", which expresses that discovery as well as creation and effectuation can underlie this process.

Strategies in the teaching and learning of opportunity identification

Many studies have reported on OI in entrepreneurship practice, however few empirical studies have described its use in entrepreneurship education. Some scholars have advocated the use of creativity in fostering OI competence (Corbett, 2005; Hills, Shrader, and Lumpkin, 1999). Others have reported on teaching opportunity identification or opportunity recognition (Saks and Gaglio, 2002; DeTienne and Chandler, 2004; Muzychenko, 2008; Kickul, 2006; Kickul, Gundry, Barbosa & Whitcanack, 2009), and the results of these studies are reported in Chapter 1.

In Chapter 3 a set of design strategies for developing OI competence was presented. The *first strategy* aims at stimulating knowledge and skills regarding idea-generating techniques. Cognitive processes in OI strongly resemble creativity cognition (Corbett, 2005; Plesk, 1997), meaning that knowledge and heuristics for generating novel ideas can support OI. Scott, Leritz, and Mumford (2004) reported that developing divergent thinking is a consistent element in efforts to increase creativity, and divergent thinking is stimulated by idea-generating techniques. Therefore, students should acquire idea-generation techniques and heuristics by practice and reflection.

A *second strategy* involves stimulating students to conceptualize their OI experiences, thereby developing and extending their mental schemas, connecting these with knowledge of science and markets to combine them into new entrepreneurial opportunities (Corbett, 2005). Evaluating

opportunities and developing criteria will contribute to further conceptualization of OI.

A *third strategy* aims at using concepts and heuristics in realistic professional experiences and assessments, to promote transfer (Simons, 1999). Transfer can be considered as the learner's meaningful use of parts of a mental map, derived in relation to a specific context, in another context (Gilbert, Bulte & Pilot, 2011). Meta-cognitive knowledge, such as heuristics and problem-solving skills, influences the transfer of knowledge and skills.

A *fourth strategy* involves challenging students to come to new solutions, out of routine thinking patterns, and assigning problems and tasks that cannot be solved by routine problem-solving strategies (Jonassen, 2000). If students are confronted with circumstances of uncertainty and ambiguity, they will realize that routine problem solving patterns will not suffice, and they will look for new ways to solve the problem.

Two more design strategies for fostering OI were suggested in Chapter 4.

The *fifth* strategy aims at initial assessment of students' opportunities. Before the course starts, students get the assignment to identify an opportunity and they are admitted based on the quality and potential of it. Assessment at the start of education stimulates active learning, keeps students on tasks and let them focus on the learning goals. It is especially successful if combined with peer feedback and self-evaluation, and helps students with social construction of knowledge (Nitko & Brookhart (2014). This strategy also aims at activating knowledge structures, stimulating motivation and prolonging the process of refinement of opportunities.

Nab *et al*. (Chapter 4) also used the finding that creative work typically involves a period of incubation, not consciously thinking on the task (Amabile, 1996, p. 101; Nickerson, 1999, p. 417). The *sixth strategy* aims at prolonging the time span for identification and incubation of the entrepreneurial opportunity. Students will start searching for ideas earlier if they are admitted to the course only when they bring in a promising entrepreneurial idea. This strategy is expected to contribute to the quality of entrepreneurial opportunities.

The six strategies for fostering competence in OI are summarized in Table 5.2.

In these strategies, knowledge acquisition and construction are crucial, either specific domain knowledge or knowledge of markets, clients, and industries. This knowledge is acquired from the entrepreneur's social context, which should have a substantial role in developing OI competence. The importance of the context in learning is derived from the theory of situated learning which argues that knowledge and skills should be learned in contexts that reflect the way the knowledge will be used in real life (Collins, 1988). This idea is elaborated on in the theory of authentic learning.

Strategies for developing authentic learning contexts

Entrepreneurial contexts are characterized by complexity, deadlines, uncertainty, various roles, multidisciplinary and open-ended tasks, unstructuredness, and ambiguous conditions. The learning of the small business owner is characterized by learning from peers, by doing, from feedback, by copying, by experimenting, by opportunity taking, and from mistakes (Gibb, 1997).

In these circumstances entrepreneurs learn from collaborating with a diversity of persons in their professional and personal environments, in multiple communities of practice. Cope (2005) describes critical incidents evoking high-order learning in entrepreneurs. Non-routine situations force the entrepreneur to question taken-for-granted beliefs and to reframe mental frameworks, changing personal beliefs and feelings. Deep reflection is essential for learning from critical incidents. Lans, Biemans, Verstegen, and Mulder (2008) showed the impact of the entrepreneurial context for learning of entrepreneurs. Entrepreneurs experienced support and guidance, external interactions, internal communications, and task characteristics as essential.

In education, the learning context is strongly defined by the pedagogical approach that is chosen. For entrepreneurship education, experiential learning (Kolb, 1984) is often reported as a successful pedagogical approach (Corbett, 2005; Kickul et al., 2010; Pittaway & Cope, 2007). However, in literature a clear description of the learning contexts of students' experiences is rarely given. Moreover, entrepreneurship education (EE) is located within the school system that by default hardly has characteristics of an entrepreneurial context. So, if the entrepreneurial context is conditional for learning in EE, it means that relevant authentic elements of entrepreneurship must be brought into the classroom (Gibb, 2007).

The emphasis in university education is traditionally on theory, extracting essential principles, concepts, and facts, and teaching them in a rather decontextualized form (Resnick, 1987). Snowman and Biehler (2003, p. 306) state that learning will be more meaningful in authentic learning environments. Education might be supported by an entrepreneurial learning context that directs the cognitive activities and learning of students in a similar way as in entrepreneurship.
Several authors have given guidelines for the development of an authentic learning environment. In an overview on interpretation and usages of authentic learning, in relation to developing education for students in middle schools, Renzulli, Gentry and Reis (2004) identified four criteria for real-life problems.

1 The real-life problem is open ended and prescribed solutions do not exist
2 A real-life problem has a personal frame of reference for the student, and must involve an emotional and inner motivation as well as an interest
3 Real-life problems and consecutive solutions motivate changes in attitudes, beliefs and actions
4 Real-life problems target a real audience and include collaboration outside the classroom
Renzulli et al. (2004) argue that the teacher is a mentor and a resource provider rather than an instructor. While Renzulli et al. (2004) focused on the characteristics of the task, Rule (2006) describes the entire learning environment for authentic learning:

- Provide real-world problems that mimic the work of professionals and the results are presented to an audience beyond the classroom, which makes the problem more than just an exercise
- The open-ended character of the problems allows for creative and critical inquiry, which stimulates higher level thinking skills and reflection.

- External resources may have to complement the textbook, because of the multi-disciplinary perspectives of the problem.
- Students must be engaged in discourse and social learning in a community of learners
- Students are empowered to choose and direct their own learning to a work problem
- Teacher's contribution must be personalized, starting from the learner.

Gulikers, Bastiaens and Kirschner (2004) reported a framework for authentic assessment in vocational education, and this framework provides five dimensions: tasks, physical context, social context, learning results and criteria.

For this study, we use the critical characteristics for authentic learning by Herrington and Oliver (2000) who identified these from an extensive body of literature. The authors suggested that the intended learning outcomes are best gained in a learning environment that features nine dimensions or contextual strategies, as listed in the first column of Table 5.3 (See Results section). Several of the dimensions of Herrington and Oliver (2000) correspond to the strategies for an authentic learning environment in entrepreneurship education, as presented in Chapter 2, although differences in terminology were used. Besides, other dimensions by Herrington and Oliver comply with recommended strategies from Chapter 2, and these provide valuable strategies with respect to learning: access to role modelling and modelling of processes, collaborative construction of knowledge, reflection to enable abstractions, and articulation to enable tacit knowledge to be made explicit. The dimensions of Herrington and Oliver (2000) are therefore a useful extension of earlier findings in this dissertation, and will be used in this study as a framework.

Learning in authentic contexts does not simply imply that real life must be brought into the classroom, but that a learning environment must be designed that evokes key cognitive activities, as in entrepreneurship. Herrington, Reeves, and Oliver (2007) as well as Gulikers et al., 2004) found that the "physical fidelity" of the simulation is less important than the simulation of a realistic problem-solving process, which the author describes as the "cognitive realism" of the task. Functional fidelity is defined as the degree to which a simulation imitates the information and stimulus-response options as in the real world. Stanton (1996) differentiated between physical fidelity and functional fidelity in simulations, where functional fidelity proved vital for the transfer of skills.

Learning in authentic contexts does not occur through implementing one isolated strategy, but the interactions of several strategies proved to be relevant in designing an authentic learning environment (Barab, Squire, and Dueber, 2000). It implies that for the creation of authentic learning a coherent complex of combined design strategies has to be implemented.

Research question

In Chapter 2 we reported design strategies specifically focusing on authenticity in entrepreneurship education in computer science. Six strategies were drawn from an entrepreneurship course that proved successful in learning outcomes, as well as students'

evaluations. The strategies of these authors can be summarized as: learning as in a start-up, students' roles as problem solvers, multiple roles of students, types of tasks and activities, the teacher's role, facilities and infrastructure, and assessment as in entrepreneurship. While these strategies focus on entrepreneurship education in a broad sense, in the present study the specific influence of an authentic learning environment in OI teaching and learning is investigated. Based on theory, it can be conjectured that strategies that strengthen the authenticity of the context will foster students' competence. Therefore, the research question for this study is:

To what extent can design strategies for authentic learning and for fostering students competence in opportunity identification be integrated into a single course design?

Three sub-questions have to be answered in this study:

1 Are the strategies for teaching OI and for creating an authentic learning context applied in the course coherently, and how are these strategies applied?
2 To what extent are these design strategies for teaching OI and for creating an authentic learning environment realized as intended?
3 Do students 'products show that students are able to identify opportunities after a course that complies with these strategies?

METHODS

An ICT Entrepreneurship course (Table 5.1) was used as a single-case study (Yin, 2009, p. 46). This case was selected because during exploratory meetings, the teachers indicated that strategies for teaching OI as well as for authentic learning were both applied in this course, meaning that the case is useful for investigating the issues mentioned in the research questions. Besides, the course has a long and preserved history of development and proved successful in stimulating new start-ups. For example, after the course in 2006 nine out of the seventeen start-ups had plans to enter the market, and continued in an incubator facility. During a fifteen year long process this course was developed, analysed and refined in steps, and underlying design strategies have been documented (Bruggencate et al., 1995; Ten Berge et al., 2006). The course was accessible for observations, interviews, distribution of questionnaires, and videotaping of lessons.

Design strategies as deduced in the theory section were used for analysing the data. First, it was investigated whether and how the strategies were applied in the course. The feasibility of the design was evaluated as the degree of realization and by students' perceptions. The indicative functionality of the course design was determined by external assessment of students' products with regard to OI.

Characterization of participants

A set of questionnaire items was used to determine students' prior experiences of

entrepreneurship. Thirty-one students participated in the course, among them two females. 71% of them had plans to start a business, 58% reported some entrepreneurial experience with family or friends, and 29% owned a company. The students worked in ten self-selected groups of three to five students.

The two teachers in this case study had experience of more than ten years in teaching this course, and one of the teachers had a background as entrepreneur. Besides being a teacher, they have a role as the CEO of the virtual holding company and act as a coach. Entrepreneurs and investors with a thorough background in IT entrepreneurship are involved as guest speakers and assessors.

The researcher's role in this study was mainly focusing on data-collection: observing, making field notes, videotaping, distributing questionnaires, interviewing, and collecting artefacts of students and assessors. The researcher was not actively involved in education or in the design of the case.

Determining the application of strategies

Sub research question 1 aims at determining if the strategies for teaching OI and for creating an authentic learning context are coherently applied in the course, and at describing ways of application of the strategies. For this purpose three data sources were used: course documents, observations of lessons and interviews with teachers.

In order to determine the intentions of the course as stipulated in the course design, course descriptions as well as study guides, policy documents, and publications were used as a data source. At the start of the course, the teachers were interviewed about the current course design, and this interview was audio taped and transcribed verbatim. Relevant parts of meetings, lessons, and classroom activities related to OI were observed, videotaped, and transcribed verbatim.

Empirically supported strategies for authentic learning as described by Herrington and Oliver (2000) and for fostering opportunity identification (Chapter 4) were used as an analytical framework in data analysis. Notes, transcriptions and video fragments were scored for the presence of strategies on OI and on authentic learning. Observed activities that contributed to each specific strategy were scored and clustered per strategy.

Determining the feasibility

Sub research question 2 aims at the determination of the degree of realization of the course design in the classroom. All meetings, lessons, and classroom activities related to OI were observed, and videotaped. *Students' perception of the learning environment* was determined by a questionnaire and interviews with individual students. The questionnaire consisted of 33 items on 6 sub-scales: encouragement by the educational environment, encouragement by the teacher, autonomy, pressures, peer support, and learning climate. It was completed in the final meeting. The items used a 5-point Likert scale from "strongly disagree" to "strongly agree". 77% of the participants filled in this questionnaire. The homogeneity of the scales was determined in an

earlier study (Nab, Oost, Pilot, & Keulen, 2008), and was confirmed during this study as all scales had a Cronbach's Alpha above 0.70.

Five students volunteered for an individual semi-structured interview regarding their perception of the course. The interview items were derived from the two design principles. The interviews were audio taped, transcribed verbatim, and coded for design strategies and implementation.

Observations, questionnaires, and interviews were used in triangulation to determine the degree of realization. Strategies for authentic learning (Herrington & Oliver, 2000) and for fostering opportunity identification (Chapter 4) were used as a framework. Strategies were scored as the degree of realization of strategies as intended. The degree of realization was determined and scored in three categories. The score "fully realized" (75–100%) was given if all data confirmed the strategy. "Partially realized" (25–75%) was scored if data were confirming as well as rejecting the realization of the strategy. "Not realized" (0–25% realization was scored if the majority or all data pointed at rejection.

The functionality of the course

The third sub research question aims at determining an indication for functionality of the course, or in other words do students' products show that students are able to identify opportunities in the eyes of external assessors. Therefore, students' products with regard to opportunity identification were analysed. Business plans and other deliverables of student project groups were collected. The assessments by experienced entrepreneurs of these products were used for determining if the outcomes of the course were reached as intended. A team of entrepreneurs, investors, venture capitalists, and an IT journalist assessed the opportunities underlying the business plan and the presentations. The assessors used an assessment form with two scales (Chapter 3): on innovativeness and on market potential, each ranging from -5 to +5 (see Appendix A). Entrepreneurial ideas were scored on both scales, and feedback on specific issues was provided. The means of the scores per business plan were calculated. This instrument was tested during the mid-course review, and for the final assessment an adjusted version of the instrument was used. The presentations of all business plans and feedback from the assessors were videotaped, and video fragments were coded for design strategies. The students' marks at the end of the course were used for calculating means and ranges.

Students' *perception of their competence in identifying entrepreneurial opportunities* was measured by a second questionnaire with four scales: use of idea-generating techniques, intrinsic motivation, divergent thinking, and self-efficacy. Homogeneity of the scales was determined with the data of 95 science students taking various entrepreneurship courses. All the scales had a Cronbach's alpha above 0.70, in agreement with a previous study (Nab *et al.*, 2008). During the last session of the course, 25 students (81%) completed this questionnaire. The means of scales were used to determine the realization of OI strategies, and to calculate the effect size for self-efficacy with pre- and post-test.

RESULTS

Case description

An overall description of the course in this case study is presented in table 5.1.

Table 5.1: Brief description of ICT Entrepreneurship course

Time	10 weeks, 20 hours weekly
Study load	7.5 ECTS = 210 hours of study load
Programmes and institutes	Elective in Master of Business Informatics at Utrecht University
Format	Project work on business start-up supported by just-in-time lectures. Student groups work on the development of business plans and prototypes. Deliverables have to be produced within strict deadlines. Students fulfil staff roles in a virtual holding of start-ups
Assessment	Formative mid-term assessment and summative final assessment of business plan presentations by investors and entrepreneurs

The ICT Entrepreneurship course (Table 5.1) is mainly a team-based project, where professional tasks in a professional context are the key features. Students form start-up teams, identify an idea for a software product or service, and evaluate and refine this idea as in a start-up. Deliverables such as product definition, a prototype, and a business plan have to be produced within strict time limits. Furthermore, the students take part in one of the staff departments or so-called *horizontal* teams of a virtual holding company of the participating start-ups. The students should gain a thorough understanding of developing and exploiting a product software company, and experience work in an IT firm. The course aims to stimulate entrepreneurship through these challenging experiences. The course was developed and refined in iterative cycles over many years.

Application of the strategies in the course design

The first sub research question aims at clarifying if strategies for teaching OI and for creating an authentic learning context were applied in the course coherently, and how these strategies are applied. The realization of the strategies for fostering opportunity identification is described as observed applications in Table 5.2.

Table 5.2: Observed applications of the strategies for teaching opportunity identification

Strategies	Observed applications
A1 Stimulate knowledge and skills on idea-generation techniques .	• A workshop on creativity, innovation, and idea-generating techniques in entrepreneurship was scheduled and given. • Presentations and discussions on successful innovations and firms are organized. • Students apply idea-generation techniques in solving entrepreneurial problems.
A2 Stimulate the conceptualization of opportunities and let students discover criteria.	• Activities that promote the conceptualization of entrepreneurial opportunities as in entrepreneurship. • Students extract criteria for "successful" entrepreneurial opportunities. • Let professionals that use entrepreneurial criteria perform formative and summative assessment.
A3 Stimulate transfer by means of learning through entrepreneurial tasks	• Students apply concepts and criteria in the improvement and tuning of entrepreneurial opportunities according to the examples of peers and the feedback of peers, teachers, and assessors. • Students perform entrepreneurial tasks as in a start-up. • Innovation and creativity are used as criteria in the assessment of the entrepreneurial idea.
A4 Challenge students to abandon routine patterns of problem solving	• Students work on long-lasting, open-ended, complex, and interdisciplinary activities. • Students have ownership, autonomy, responsibility, and initiative in start-ups and in staff teams. • Teams are stimulated by competition with other teams. • Students exploit the entrepreneurial opportunity in a real market.
A5 Select students for the quality of their entrepreneurial opportunity	• Students have to hand in an entrepreneurial opportunity in advance of the course, and have to present it.

	• The opportunity is assessed for its potential • Students are admitted for the quality of the opportunity or the presentation, and receive feedback on their entrepreneurial idea
A6 Provide incubation time for the identification and development of opportunities.	• There is a period of two months for incubation between the assignment and the start of (and admittance to) the course. • The teacher gives formative feedback on ideas, and students can use this to improve or reject opportunities.

From the results above (Table 5.2) it can be concluded that all strategies for teaching opportunity identification were applied in this course. Strategies were applied in various ways, as for each strategy several activities were observed.

Strategies for authentic learning were investigated as a second condition in this study. The observed applications of the strategies for authentic learning are described in Table 5.3.

It can be concluded from the results in Table 5.3 that all strategies for creating an authentic learning environment were applied in the course. Strategies were applied in various ways, as indicated for each strategy. Students and teachers experienced the order of the strategies for OI and for authentic learning as logical.

Answering the first research sub question, it can be concluded that all strategies for opportunity identification as well as for creating an authentic learning environment were applied in the course, and that each strategy was achieved by various interventions. Because the design has proved to be robust in various circumstances over a prolonged period of time, and students perceived the activities as logical, it can be concluded that the strategies were realized coherently.

Table 5.3: Strategies for an authentic learning environment and observed applications of the strategies

Strategies	Observed applications
B1 Provide authentic contexts that reflect the way the knowledge will be used in real life.	• Deliverables are submitted within strict deadlines. • Students work in an informal atmosphere as in a start-up. • Students have a room where they can work during start-up working hours. • Students have full ownership of their entrepreneurial ideas. • Students select the team (members) themselves. • Students have autonomy and responsibility for the project and learning.
B2 Provide authentic problems tasks that have real-world relevance. Tasks must provide the opportunity to organize work and provoke the need to detect information.	• Students work together on extensive, ill-defined, and complex, and open-ended tasks and activities. • All tasks and activities contribute to a final main task and thereby to assessment. • Students use real-life resources and tools. • Students produce deliverables common to entrepreneurship. • Students feel the need to gather information, models, and theory.
B3 Provide access to expert performances and modelling of processes.	• Entrepreneurs and teachers are role models for students • The teacher provides process modeling .
B4 Provide multiple roles and perspectives.	• Students have the role of a business starter and are stimulated to perform various roles (manager, IT worker, developer, and marketer). • Students have specific staff roles in the virtual holding company.
B5 Support the collaborative construction. of knowledge	• Students are addressed as team for the creation of a common team commitment. • Students have common responsibility for group processes, work planning, product quality, and other tasks.

	• Discussions in and between teams are stimulated. • Groups are assessed as a team. Incentives must mainly be based on group activities and products.
B6 Promote reflection to enable abstractions to be formed.	• In teams students develop concepts and criteria from their experiences. • Students feel the need to understand mechanisms and concepts in order to continue.
B7 Promote articulation to enable tacit knowledge. to be made explicit	• Students create, share, and clarify knowledge and ideas in staff teams • Students articulate their intermediate results to peers and teacher(s). • Students present and discuss conceptual entrepreneurial opportunities and business plans within and between teams. • Students present the final product (business plan) to external assessors.
B8 Provide coaching and scaffolding by the teacher at critical times	• The teacher acts more as a coach/mentor and CEO than as an expert. • The teacher supplies formative and summative feedback on the process, on activities and deliverables • The teacher gives feedback on students' ideas and asks critical questions. • The teacher stimulates students to improve their entrepreneurial opportunities.
B9 Provide authentic assessment by learning. within the tasks	• Professionals and teachers perform summative co-assessment of the business plan presentation. • Students are assessed in a formative way on deliverables as in entrepreneurship. Deliverables must directly contribute to the start-up or to the virtual holding. • Entrepreneurial opportunities must be exploited in reality. • For assessment objective as well as intuitive criteria are used as in entrepreneurship practice.

Degree of realization of strategies

To answer the second research question, the degree of realization of the strategies was evaluated. Findings regarding the degree of realization of the design strategies to foster OI abilities are presented and summarized in Table 5.4. Subsequently, the findings on the authentic learning environment are reported and summarized in Table 5.5.

Strategies for opportunity identification

Strategy A1: Stimulate knowledge and skills on idea-generation techniques

Supportive as well as non-supportive data were found for this strategy. In a workshop on innovation and creativity, successful examples of creativity in IT entrepreneurship were presented. The students exercised creativity in solving an entrepreneurial problem, and also had to use creativity to solve specific problems related to the start-up process. However, the creativity meeting was scheduled after the first entrepreneurial ideas and after the product definition phase, making it difficult for students to fully apply techniques in OI. From the questionnaire it appears that at the end of the course the students felt somewhat familiar with the techniques used to generate new ideas (3.38), felt moderately stimulated in learning to generate new ideas (3.39), and perceived the teacher as stimulating creativity (3.71). On the Divergent Thinking scale, the students scored positively (3.68). Students had little time for practicing and reflecting on idea-generating techniques (confirmed by the questionnaire mean of 3.05 for the use of idea-generation techniques). In summary, it can be concluded that this strategy was partially realized.

Table 5.4: Degree of realization of design strategies for teaching opportunity identification

Design strategy	Degree of realization
A1. Stimulate knowledge and skills on idea-generation techniques.	Partially
A2. Stimulate the conceptualization of opportunities and let students discover criteria.	Fully
A3. Stimulate transfer by means of learning through entrepreneurial tasks	Fully
A4. Challenge students to abandon routine patterns of problem solving	Partially
A5. Select students for the quality of their entrepreneurial opportunity	Fully

A6. Provide incubation time for the identification and development of opportunities.	Fully

Strategy A2: Stimulate the conceptualization of opportunities and let students discover criteria

The data support the conclusion that this strategy was fully realized as intended. Observations show that students discussed the factors of successful innovations and firms as presented by the guest speakers. The essential concepts of entrepreneurial opportunities (such as customer value, market potential, innovativeness, and profitability) were induced implicitly and explicitly from students' experiences, by comparing their own entrepreneurial opportunity with those of others and by studying successful firms and entrepreneurs. Conceptualization was also promoted by discussions with peers and teachers. From the interviews it appears that the students also discussed their ideas with outsiders, which contributed to the conceptualization.

The students felt stimulated by their peers (3.88) and by the teacher (3.71). In the interviews the students valued the formative and summative assessment by entrepreneurs and investors, which helped to elucidate entrepreneurial criteria (innovativeness and market potential). The students felt directed by feedback, which resulted in a change of their plans. The students confirmed that they learned the essentials of entrepreneurial opportunities from writing a business plan.

Strategy A3: Stimulate transfer by means of learning through entrepreneurial tasks

The data support the conclusion that this strategy was fully realized. Most activities were related to the main task: the start-up of a company. During the start-up the students had to apply concepts and criteria for OI. The feedback of peers, teachers, and assessors generated new concepts and criteria that had to be applied in the refinement of their own entrepreneurial opportunities. Because the innovativeness and originality of the opportunity was an important criterion in the assessment, the students were stimulated to rethink their ideas on this criterion. The students particularly appreciated the mid- and end-of-course review because these helped them to gain an impression of their OI competence (3.30). The course helped them to gain insight into discovering entrepreneurial opportunities (3.46). The students reported that they felt safe in expressing new ideas. The atmosphere was open, and expressing one's own opinion was appreciated. They stated that new ideas were discussed in a fair and constructive way (4.09). They also learned to discover new entrepreneurial opportunities (3.52): the students felt familiar with concepts and criteria.

Strategy A4: Challenge students to abandon routine patterns of problem solving

The data support the conclusion that this strategy was partially realized. For their start-up the student teams produced a business plan, which was an open-ended, complex, and course-lasting task, in which many elements had to be integrated. The data from the questionnaire reveal that,

in general, the students felt stimulated by the tasks (3.56). They experienced a high degree of autonomy (3.61 on the Autonomy Scale), responsibility, and initiative in this process. Also, some intergroup competition was experienced because one team was finally acclaimed as the best team and could win virtual capital. The business plans' presentation to the external assessors challenged the students to perform. The students knew that assessors who wanted to invest in promising start-ups could invite teams, and this was a challenge to excel. The questionnaires show that the students felt stimulated by their fellow students (3.52) and supported by their peers (3.96), because the teacher was enthusiastic about their ideas (3.71) and because the students experienced an energetic atmosphere (3.65). It can be concluded that the start-up activities were challenging for students.

On the other hand, the students had to do smaller tasks in producing deliverables for the virtual holding company within strict deadlines. These were experienced as less challenging. The students did not find these activities very instructive, and experienced less autonomy in these activities. This is confirmed by the questionnaire: the students did not feel challenged by the work of the horizontal teams (2.76). From the interviews it appears that these activities were perceived as not very useful.

Strategy A5: Select students for the quality of their entrepreneurial opportunity

This strategy was fully realized. The observations show that students in groups or individually provided an entrepreneurial opportunity at the beginning of the course. These ideas were presented and discussed, and peers and teachers gave feedback. Interviewed students stated that they used their domain knowledge as well as knowledge from hobbies to find opportunities. Also Internet was a resource for opportunities. They discussed their ideas with friends and family in order to refine the idea. Teachers used objective criteria s well as intuitive criteria for assessment. The assessment was mainly formative with the aim to further improve the opportunities, and all students were admitted. Only general criteria were given in advance, and the students were stimulated to search for concepts and criteria regarding opportunities in the assessments.

Strategy A6: Provide incubation time for the identification and development of opportunities.

The data support the conclusion that this strategy was fully realized. The students were asked to hand in an IT opportunity two months before the course started. The interviews with the students show that the ideas came from personal interests and skills, social media, prior work, partners' activities, conversations with friends, and brainstorming with peers. The 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 the students used the feedback to improve or reject opportunities. The students found the feedback of the teacher helpful (3.71).

To summarize, the results with regard to the design principle on teaching and learning OI show that four out of six strategies were fully realized as intended and two were partially realized. The conclusion is that the design principle was largely realized as intended.

Strategies for the creation of an authentic learning environment

The degree of realization of authenticity in the course was analysed, using nine strategies for authentic learning as an analytical framework. The results are presented below and summarized in Table 5.5.

Strategy B1: Provide an authentic context that reflects the way the knowledge will be used in real life.

The data show that this strategy was fully realized. We observed that the teachers emphasized a safe social atmosphere. The students formed a team around an entrepreneurial idea and were autonomous in forming the start-up team. The students organized social activities, such as coffee breaks, collaborative lunches, drinks, and dinner. The teachers participated in these informal activities. In the questionnaires the students confirmed the open atmosphere (4.32) and that they felt safe in expressing new ideas (4.08). Also, the chance to express one's own opinion was appreciated (3.88).

The students experienced ownership of their entrepreneurial opportunities. To underline this, the students had full intellectual rights and were free to exploit their entrepreneurial ideas. The students felt they were in charge of their work (3.64) and felt responsible for the production of deliverables (3.84). The students had to be present during working hours, as in a company, and were monitored by one of the staff teams, but this was perceived as being less authentic for a start-up process.

Strategy B2: Provide authentic problems and tasks that have real-world relevance.

The data show that this strategy was fully realized. The major task for students was the production of the business plan, which is complex, course lasting and it requires the integration of expertise from various domains. At the start it was unknown what the outcome would be, and every team outcome was a unique product. The course was perceived as intensive, because the start-up process was condensed into ten weeks.

The start-up teams had to produce intermediary products (product definition, marketing plan, and business model) that contributed to the final products (business plan and prototype). These intermediary products are commonly in use in entrepreneurship and in start-ups, and therefore authentic. In preparing prototypes, the students used domain-specific tools and found their own resources, as in IT entrepreneurship. The questionnaires show that the students considered it stimulating to search autonomously for the appropriate information (3.65).

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

The data show that this strategy was fully realized. From the interviews it appears that the students felt inspired by the guest speakers, who told stories about their start-up process, their successes, and their failures, and discussed these. Also, the students were stimulated by the external assessors and had the chance to contact them personally. The teacher presented successful examples of IT entrepreneurial opportunities. However, in the questionnaire students considered the teacher to be an average example of finding opportunities (3.17).

Table 5.5: Degree of implementation of design strategies for the creation of an authentic entrepreneurial learning environment

Design strategy	Degree of realization
B1 Provide an authentic context that reflects the way the knowledge will be used in real life	Fully
B2 Provide authentic problems and tasks that have real-world relevance. Tasks must provide the opportunity to organize work and provoke the need to detect information	Fully
B3 Provide access to expert performances and modelling of processes	Fully
B4 Provide multiple roles and perspectives	Partially
B5 Support the collaborative construction of knowledge.	Fully
B6 Promote reflection to enable abstractions to be formed	Partially
B7 Promote articulation to enable tacit knowledge to be made. explicit	Fully
B8 Provide coaching and scaffolding by the teacher at critical times.	Fully
B9 Provide authentic assessment by learning within the tasks	Fully

Strategy B4: Provide multiple roles and perspectives.

The data show that this strategy was partially realized. From observations it was clear that two major roles could be distinguished: being a member of a start-up team and being a member of a staff team or horizontal team in the virtual holding. During the start-up process the students were confronted with various roles, and they sought their preferences for roles and felt motivated by them.

Although all activities and products of the staff teams contributed to the success of the virtual holding company, the students did not feel stimulated by this work (2.76). This is confirmed in the interviews:

"Staff teams must be removed from the course. I hear many students agree on this" (Student 1).
"The staff teams are often redundant" (Student 2).

Strategy B5: Support the collaborative construction of knowledge

This strategy was fully realized. The questionnaires reveal that the students felt supported by their peers in the start-up and the other teams (3.85 on the peer support scale). They appreciated discussing entrepreneurial opportunities with other students (3.52), and discussed new ideas in a fair and constructive way (4.09). The students also appreciated the ideas of others because they enriched their own ideas (4.08). Decisions on products and processes had to be taken as a team, which required discussions and decision-making. 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.

The data show that this strategy was partially realized. 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.

Entrepreneurial problems evoked the need for students to induce general concepts and criteria in order to improve their entrepreneurial opportunity and to meet the criteria in the end review. However, few explicit discussions were observed on students' conceptualizations in an authentic way. The process of reflection of students could not be monitored.

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

The data show that this strategy was fully realized. We observed many formal and informal activities where entrepreneurial ideas were articulated, by writing and speaking. The start-up teams discussed their entrepreneurial opportunities, intermediate products, and deliverables. The questionnaires show that the students enjoyed discussing entrepreneurial 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. One or more members of the start-up team presented the plan to the external assessors, and often this task was divided. The students took their presentation seriously, which was illustrated by spontaneously organized try-outs and discussions to improve the presentations.

Strategy B8: Provide coaching and scaffolding by the teacher at critical times

This strategy was fully realized. As observed, the prominent teacher role was that of coach/mentor, stimulating students' enthusiasm and giving feedback and hints. The teachers were in the working environment and were asked for advice. The teachers also took the role of the CEO in the virtual holding company, and they fulfilled this role informally.

The teachers gave feedback on the initial entrepreneurial opportunities and on the intermediate products, feasibility, and market potential, and gave hints for improvement (observation). The questionnaires show that the students experienced the teacher's feedback as helpful (3.71). They

were already working on an entrepreneurial opportunity before the start of the course, and the teacher gave feedback on the first entrepreneurial opportunities and later on the improvement of ideas. The students perceived that the teacher encouraged them to persevere with work (3.83) and supported them in finding new ideas (3.46).

Strategy B9: Provide authentic assessment by learning within the tasks

Data show that this strategy was fully realized. As observed, the external assessors assessed the business plans. They used professional criteria that were formalized by a standardized form on innovation and market potential. The external assessors emphasized the business models proposed by teams, the feasibility of plans, and competition. The assessors also gave hints on contacts and markets (observation). In the interviews the students were positive about the feedback of the assessors, because it was very instructive for improving their business idea. The teachers also assessed students on their work in the staff teams. Rewards were given for special fulfilment of roles. The students felt stimulated by invitations from the assessors to discuss the possibility for investments in their opportunities.

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

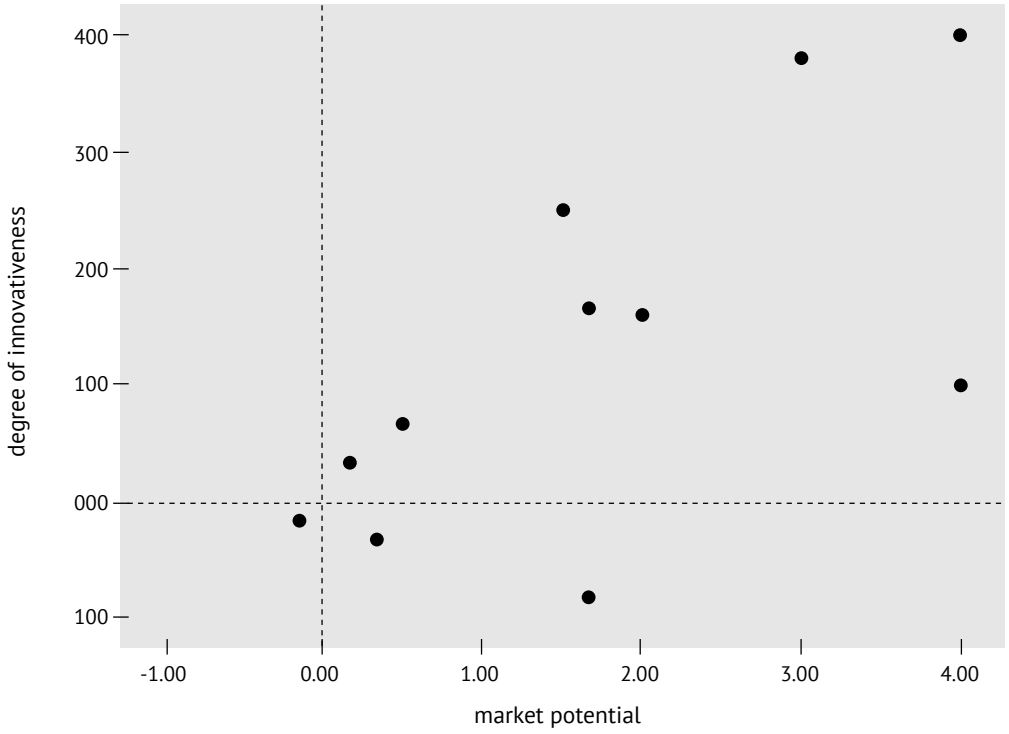
Results with respect to the functionality of the course design

Based on analysis of students' products, students were able to identify opportunities at the end of the course, thus the course does what it was intended to do. The degree of functionality was determined by analysing students' learning outcomes in identifying entrepreneurial opportunities, self-efficacy perception of students and final marks.

The external assessors assessed the entrepreneurial opportunities, business plan, and presentations by scoring on two scales (-5 to + 5): innovativeness and market potential. The supervisors read the business plan in advance of the presentation. For scheduling reasons, the number of assessors per business plan varied during the day. Ten presentations were assessed by two or more assessors, and one plan was assessed by one assessor. The four most promising entrepreneurial opportunities were pre-selected by the teachers, and were assessed by all the assessors. The mean scores per team are presented in Figure 5.1.

Eight out of eleven teams scored positively on innovativeness as well as on market potential (73%), which can be considered as an acceptable score. 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 in the eyes of external assessors, students were able to identify opportunities at the end of the course.

Figure 5.1: Assessment scores of entrepreneurial opportunities on two scales: innovativeness and market potential



EXAMPLES OF ENTREPRENEURIAL IDEAS FROM THIS CASE

Start-up A provides a new communication channel for parents and mentors. Schools and parents speak out the need to give parents more responsibility and involvement in the education and upbringing of their offspring. Schools are busy with informing parents and making them aware of the problems their offspring are facing. Knowing the status, performance, homework and absence of your offspring together with an easy communication channel to the offspring's mentor helps parents in giving guidance to their child and makes them aware of problems. This service will be sold to schools directly and through school software manufacturers. Schools on their side are able to sell the service to the parents by selling subscriptions.

A vast amount of time and resources are needed in human resource management of big companies and in the way that job agencies are managing job applications and job vacancies data. It would be better to operate with the assistance of a tool that automates the basic procedures and hence save time and money for the companies.
This tool of **Start-up B** fills this gap and will automate the pairing between job vacancies and job seekers. The tool uses a powerful comparing algorithm combined with textual and keyword comparison and can easily be attached within existing IT infrastructures. This service can be useful for any big company with a headcount above 100. In parallel, this service will be offered to job agencies and job portals.

Start-up C provides a service that enables visitors of events to communicate and share their experiences on a big central screen. This service allows the users to send in their SMS, Tweets and E-mails, containing text, photos and movie clips to the platform. This content will be displayed on a large screen. Paying customers will be the organizers of events, varying from music to business IT events. Visitors of the events will be the actual users of the service. An after event service offers organizers an opportunity to reach their visitors after the event has ended

The marks for the course were composed of the scores for the deliverables, the prototype, and the business plan. The external entrepreneurs assessed business plans as team products; all the team members received the same mark. All 11 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 to 10, ranging from 5.9 to 7.7. The final individual marks for the course, based on teamwork and individual work, ranged between 6.6 and 7.7. All the students were successful in passing the course.

Feedback by the assessors in the end review and the interviews with teachers was analysed for comments on the quality of the presented business plans and ideas. The assessors were impressed by the quality of the ideas that has increased during the years that they participated in assessment. The assessors perceived improvement of the ideas growing in comparison with a few years ago, when many ideas were a variation on the same theme. One to three start-ups from the course do actually enter the market every year. After this course four out of the eleven teams continued in some way with a business start-up.

Self-efficacy is an intermediate variable in opportunity identification. Entrepreneurial self-efficacy (with relation to opportunity identification) was determined with a scale of nine items on a five-point Likert scale. During the course the self-efficacy of students increased from mean 3,59 (0,60) in the pre-test to a mean of 3,78 (0,59) in a post-test, although no significant difference was found. From this data an effect size of 0.3 (mean) was calculated.

In summary, based on an analysis of student's products, the majority of the student teams were able to identify an entrepreneurial opportunity that was technologically innovative and had market potential in the opinion of professional assessors. Because only a post-test was performed, the course design showed an indication for functionality in achieving the intended outcomes.

CONCLUSIONS

The *first research question* was: are the strategies for teaching OI and for creating an authentic learning context applied in the course coherently, and how are these strategies applied? This study showed that all the strategies were applied in the course in various ways for each strategy. The strategies could be integrated into a coherent set of learning activities, which is one of the criteria for a robust course design (McKenney, Nieveen, and Van den Akker, 2006). During several years this course design has proved to be robust under various circumstances. It can be concluded that a coherent course design based on all strategies can be developed (a 'proof of concept').

The *second research question* concerns the degree of realization of strategies in practice. This study shows that four out of six design strategies for fostering OI competence were fully realized as intended. Two strategies appeared partially realized: the strategy to stimulate knowledge and skills on idea-generation techniques (A1) was partially realized, as was a second strategy to challenge students to abandon their routine way of problem solving (A5).

Seven out of nine design strategies for authentic learning were fully realized, and two strategies were partially realized. The strategy to promote reflection to enable abstractions to be formed (B6) was partially realized. There was little emphasis on explicit conceptualization. As the students proved to be able to apply concepts and criteria in assessments, it can be assumed that conceptualization occurred implicitly.

Also, the strategy (B4) to provide students with multiple roles and perspectives was partially

realized. The students experienced various roles in their start-up activities as instructive, but their role as a staff member in the virtual holding company was felt to be not very meaningful. Answering the second research question, it can be concluded that a learning environment that complies with design strategies for opportunity identification and for authentic learning, was largely realized, proving the feasibility of the course design.

Subsequently, the *third research question* deals with the functionality of the course: are students able to identify opportunities after a course that complies with these strategies. Most student teams were able to identify an entrepreneurial opportunity with a sufficient degree of innovation in the IT domain and with commercial potential in the eyes of entrepreneurs and investors. Although only a post-test was done, and rival explanations could not be excluded, the learning environment shows an indication for functionality in achieving the expected outcome of the course design.

Table 5.6: Overview of design strategies for fostering competence in opportunity identification in an entrepreneurial learning environment

Designing education with the aim of fostering science students' competence to identify entrepreneurial opportunities can best be achieved by the following strategies:

1 Stimulate knowledge and skills on idea-generation techniques
2 Stimulate the conceptualization of opportunities and let students discover criteria
3 Stimulate transfer by means of learning through authentic tasks
4 Challenge to abandon routine patterns of problem solving
5 Select students on the quality of their opportunity
6 Provide an incubation period for identification and development of opportunities.

This can be done in an authentic learning environment that is characterized by the following strategies:

1 Provide an authentic context that reflects the way knowledge will be used in real life
2 Provide authentic problems and tasks that have real-world relevance
3 Provide access to expert performances and the modelling of processes
4 Provide multiple roles and perspectives
5 Support the collaborative construction of knowledge
6 Promote reflection to enable abstractions to be formed
7 Promote articulation to enable tacit knowledge to be made explicit
8 Provide coaching and scaffolding by the teacher at critical times
9 Provide authentic assessment by learning within the tasks

As a final conclusion, a coherent course design can be developed that complies with design strategies for opportunity identification and for authentic learning, and which is feasible and which

gives an indication that the expected outcomes of the course are achieved. This study presents two sets a set of theoretically and empirically supported design strategies: for the fostering of OI competence and for the creation of an authentic learning environment. Both sets of strategies can be now be combined into design principles that are summarized in Table 5.6.

DISCUSSION

This case analysis shows that a course was developed and realized where students were able to identify entrepreneurial opportunities in a learning environment that has essential characteristics of an authentic entrepreneurial working context. The study therefore provides two promising design principles each with several strategies that provide a detailed description of a learning concept (opportunity identification) in an entrepreneurial context. This means that the strategies that were applied in this course can be used as heuristics to design entrepreneurship courses. The strategies give directions to developers of entrepreneurship education. In this section, the theory behind some of the strategies will be discussed, and suggestions are given for optimization of some strategies.

Incubation period for opportunities

This design strategy (A6) aims at providing students with a substantial incubation period for their entrepreneurial opportunities. The effects of this strategy can be explained by several mechanisms. By introducing this strategy the students had a prolonged period in which to find their entrepreneurial idea, and were stimulated by the use of the idea for admittance. Ideas have to mature after the first spark of discovery or creation and mature in cycles of evaluation and refinement. This incubation is described (Amabile, 1996, p. 101; Nickerson, 1999, p. 417) as a period in which on a subconscious level one proceeds with cognitive activities that contribute to idea maturation. The assessors reported that the quality of entrepreneurial opportunities had improved sharply in comparison with previous years when only two weeks were available for finding opportunities. Otherwise, the students also felt proud to be selected. This may have influenced students' self-efficacy and their development of competence in opportunity identification (Krueger, 2000).

Pre-assessment as a strategy

Pre-assessment is a form of diagnostic or formative assessment, and it is conducted to identify what knowledge and skills students have mastered before entering a course. Pre-assessment evaluates current work against the learning objectives, and provides the student with information about the goal of the course and for improving. The motivational benefits of this type of diagnostic assessment helps students to feel being in control of their own learning and supporting self-regulation (Nitko & Brookhart, 2014). Identifying an entrepreneurial opportunity is higher order thinking. A basic rule in higher order thinking skills is to use tasks that require

application of knowledge and skills in a new or novel situation, and one way to that is to use context-dependent items. Students show a deeper understanding when they are able to a) use a concept to solve a problem, b) relate the concept to other concepts, principle and generalizations they have learned, c) use the concept to learn new material (Nitko & Brookhart, 2014). Therefore the design strategy to assess the potential of a students' entrepreneurial opportunity at the start of the course, activates various learning processes, and this might explain the contribution of this strategy to the fostering of students' competence to identify opportunities.

Challenging students to abandon routine patterns of problem solving

The strategy of challenging students to abandon their routine patterns of problem solving (A5) was partially realized. Routine problem solving is the use of fixed procedures and knowledge. When students are brought in entrepreneurial circumstances of uncertainty and ambiguity, such as opportunity identification, they are faced with the ineffectiveness of their routine skills. Such circumstances force students to reflect on their abilities and a need arises to develop new, not yet existing solutions and knowledge. Challenging students to abandon routine thinking is essential in higher order learning, as in 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, and where new ways of solving problems have to be discovered. Several authors described how students can be challenged (Deci & Ryan, 1985; Csikszentmyhalyi, 1975; Scager, Akkerman, Pilot & Wubbels, 2012). Students feel challenged if their expectations do not match the demands of education, which provokes degrees of frustration at not having enough capability. Then, the need arises to restore this gap in capabilities. This situation is similar to entrepreneurial circumstances in which one has to be innovative in finding resources, new markets, etc.

In this case, the challenge was successfully achieved in the start-up activities that were experienced as meaningful and motivating. The teachers expressed high expectations of the students. The students may have experienced constructive friction in these activities (Vermunt and Verloop, 1999). Friction can be a stimulus for learning if students are convinced that they are able to bridge the distance between demands and competence. On the other hand, the activities in the staff teams in the virtual holding company did not provoke these experiences. Providing more challenge in the activities for horizontal teams might help students to further abandon their routine thinking.

Also, the various roles (strategy B4) connected to staff team activities were experienced as hardly stimulating. In a forthcoming course design emphasis must be given to making the roles in the horizontal teams more meaningful and motivating, and this can be combined with more challenging tasks.

Creativity and opportunity identification

This strategy for stimulating knowledge and skills on idea-generation techniques (A1) was not implemented properly, and as a consequence the students could not easily use idea-generation techniques for finding opportunities. In developing complex competences such as OI, the sequence and timing of training is crucial (Van Merriënboer, 1997). Our findings confirm the need for a design principle on the sequence of learning activities in a course as was argued for by Meijer, Prins, Bulte, and Pilot (2008). It is advisable to add such a principle in forthcoming studies.

Stimulating reflection

The strategy for 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 for learning. Students must develop mental schemata and scripts for identifying information patterns that may lead to opportunity identification. In this case, the students were able to conceptualize, as was shown in the learning outcomes. Learning from experience is strongly stimulated by explicit reflection, and schemata may develop from this (Cope, 2003; Simons, 1999). Although explicit reflection is often difficult to implement in an authentic learning environment, it is recommended to stimulate explicit reflection in an authentic way, for example by peer feedback combined with the development of criteria by the students themselves.

Teaching in an academic setting

Understanding the theory and concepts might help in identifying opportunities, but there are many components of OI, such as social networks, domain knowledge, and market knowledge, that are difficult to realize inside the classroom. The dilemma of teaching entrepreneurship in an academic setting 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 conceptualization of OI, in an authentic entrepreneurial context. Because conceptualization and practice were realized successfully, the design therefore combines the demands from the academic community with those from entrepreneurial practice.

Quality and limitations

Defining a set of design strategies can be considered as a first step in a range of research approaches that moves from speculation, observation, description, prototyping, to models and guidelines, to studies on scaling, correlation and causation, and ultimately leading to diffusion of innovations (Barnan-Ritland, 2003). This study provides design strategies for an entrepreneurial learning environment that aims at fostering students' competence to identify opportunities, and so this study contributes to the teaching and learning of a competence that is crucial for entrepreneurship and for society. This study evaluated the combination of two sets of strategies

of entrepreneurship education (fostering OI and authenticity), which feasible and indicated that the expected outcomes were achieved. 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. The study shows a description of strategies, together with theoretical underpinning and an indication for functionality. A causal relation between the design strategies and students' competence to identify opportunities was not investigated in this study, but the quality of students 'products might be an indication that the course may have potential in fostering students' competence to identify opportunities. Anyway, the next step in research should be the determination of a causal relation by means of an experimental study of the design strategies in learning environments with various degrees of authentic learning, and comparison of learning effects with relation to opportunity identification. In this study, a qualitative approach was chosen in order to attain a rich description of strategies and forms of realization that can assist educational designers in the development of entrepreneurship education.

Yin (2009) presented measures to maintain quality in case studies that were applied in this study. The content validity of this study was checked by using multiple sources of evidence for each strategy and by key informants reviewing the outcomes and interpretations. Using the previous theoretical framework for design strategies in data collection and analysis helped in preserving the content validity.

The results of our study largely comply with the theories underlying the design strategies, providing replication of these theories in another domain. It implies that theories on OI in entrepreneurship may be generalized to the domain of entrepreneurship education. Because in most entrepreneurship education OI as well as authentic learning are important elements, our findings from computer science students may be generalized to other science disciplines in university education. Evaluation of the design strategies in other disciplines is needed because it can be expected that the implementation of strategies in the specific authentic contexts of other domains will differ profoundly, because students have different characteristics and knowledge as in science.

The teachers in this study had extensive experience of entrepreneurship education and this may have influenced the outcomes in a positive way. It is common in educational design research to start with a good practice, but it also would be interesting to investigate whether less experienced teachers can gain the same results using the design strategies.

In addition, opportunity identification is a creative process and the results are unique to the moment of creation. What is innovative now will not be innovative tomorrow, and therefore learning outcomes are also time dependent and relative. The value of entrepreneurial opportunities can only be determined after exploitation in real markets and therefore a more longitudinal study of the effects in the market to validate our findings is recommended.

Appendix A: Form for scoring entrepreneurial opportunities of students, as used by external entrepreneurs.

Name of start-up:	***Assessor:***

Innovativeness

Imitative	***Evolutionary***	***Radical***
Copy of existing and well known business products or services OR Obvious or expected improvements of existing products, services and processes within a market or industry.	Transfer of existing idea, approach or strategy to a new domain, market or industry	Introduction of new, not yet existing element OR innovative use of existing technology into existing situation OR Introduction of a totally new, not existing concept
Comment:		

Score innovativeness

-5	-4	-3	-2	-1	0	1	2	3	4	5

Score market potential

-5	-4	-3	-2	-1	0	1	2	3	4	5

Market	***Comments***
Solves an existing problem or need	
Feasibility technical	
Feasibility commercial	
Business model	
Competition	
Market size	
Profitability	
Presentation	

Organiser for this research

	Educational Context	***Content Opportunity Identification***
Relevance and theory	*Chapter 1* *Introduction*	
Exploratory case study	*Chapter 2* *Case study on characteristics of successful entrepreneurship education*	
Pioting design strategies		*Chapter 3* *Development and evaluation of design strategies on fostering opportunity identification*
Evaluating design strategies in other contexts, and finding new strategies		*Chapter 4* *Evaluation of design strategies on opportunity identification by expert entrepreneurship teachers in science education*
Evaluation of integrated design strategies	*Chapter 5* *Evaluation of design strategies on fostering opportunity identification and on an authentic learning context in a single course design*	
Reflection on this thesis	*Chapter 6* *Conclusions and Discussion*	

Chapter 6

Conclusions and discussion

INTRODUCTION

Opportunity identification is a key competence for entrepreneurs (Ardichvilli, Cardozo & Ray, 2003; Eckhardt & Shane, 2003; Man, Lau & Chan, 2002; McMullen, Plummer, & Acs, 2007; Shane & Venkataraman, 2000), and as a consequence this competence should be emphasized in entrepreneurship education. This research aims to explore how science students' competence in identifying entrepreneurial opportunities can be taught and learned, because educational design strategies for the development of such an education have been sparsely described. This chapter presents an overview and reflection on this research. The first part of this thesis (Chapter 2) describes an explorative case study on the characteristics of successful education in entrepreneurship. The following chapters focus on exploring design strategies that foster science students' competence in identifying business opportunities. This part includes a design study, piloting three design strategies (Chapter 3), an evaluation study of these strategies in other contexts (Chapter 4), and a case study where all previously found strategies are synthesized into a single course design (Chapter 5). The main result is the development of two design principles, each with several strategies and sub strategies, to foster science students' competence in identifying opportunities in entrepreneurship education.

In this chapter, the central research question is answered. The methods used in this research are discussed as well as the role of the researcher. The knowledge claims are reflected upon, and the contribution to theories on entrepreneurship education is described. The consequences for teaching as well as for the sequencing of design strategies are discussed. This chapter ends with a generalisation of the findings, the limitations of this research, and the implications and recommendations for the practice of entrepreneurship education.

ANSWERING THE CENTRAL RESEARCH QUESTION

The findings of the individual studies enable us to answer the central research question, which was given in Chapter 1:

What are the design principles for an education that aims at fostering the competence of science students in identifying business opportunities?

This research resulted in the description of two design principles, each consisting of several theoretically supported strategies. After a course that was based on the these two designprinciples,

students were able to identify opportunities in the eyes of experts which indicates that the design principles are functional. The first design principle focuses on teaching science students to identify entrepreneurial opportunities. Conceptualization of opportunities is the central cognitive activity in this strategy and therefore it is called the **concept design principle**. It includes six design strategies (Table 6.1), and proved to be feasible. Evaluation of the design principles indicated that the expected outcomes of the (synthesis of) strategies were achieved, meaning that students were able to identify opportunities after a course that was designed with this principle. Because this was shown in various cases and with various teachers, the design principle shows robustness. This design principle is aimed to influence directly the learning outcomes. An overview of strategies and sub-strategies of this design principle is given in Table 6.1.

The second design principle aims at the creation of an entrepreneurial learning context for the teaching of opportunity identification. Chapters 2 and 5 show that an authentic entrepreneurial practice can be simulated in education and is assumed to support the first design principle on opportunity identification. The result is a design principle with nine design strategies. This design principle for the creation of authentic learning contexts in entrepreneurship education proved to be feasible. Evaluation of the design principle provided an indication that the (synthesis of) strategies were functional in various circumstances and with various teachers, and therefore the principle proved to be robust.

Students were able to identify opportunities after a course that was designed with this principle. This design principle describes a pedagogical context for entrepreneurship education and therefore it can be called a **context design principle** for entrepreneurship education. The strategies and sub-strategies of this design principle are presented in Table 6.2.

Summarising, the answer on the central research question is presented as two design principles, each comprising several strategies and sub-strategies, for fostering students' competence in opportunity identification in entrepreneurship education:

A concept design principle on fostering students' competence in identifying business opportunities

A context design principle for the creation of authentic learning environments in entrepreneurship education

These design principles provide guidelines for designers and teachers of entrepreneurship education, and contribute to an understanding of teaching and learning of opportunity identification in higher education. The importance of the sub-strategies from this research must be underlined, because these provide concrete heuristics for teachers and developers in entrepreneurship education.

Table 6.1: Overview of design principle for fostering students' competence in identifying business opportunities with strategies and sub-strategies

Design principle 1 for teaching the concept of opportunity identification:
For teaching science students in entrepreneurship education to identify entrepreneurial opportunities it is advised to use the following strategies (1-6) and sub-strategies, with the expectation that the students learn how to discover or create opportunities from their knowledge of domain and markets, in new contexts, and learn what is needed to develop opportunities and how to judge opportunities.

Strategy	Sub-strategies
1) Stimulate knowledge and skills on idea- generation techniques	• Provide and apply idea-generation techniques in entrepreneurial problems • Schedule specific lessons on creativity • Stimulate reflection on experiences with idea generation • Present examples of successful opportunities • Demand the use of domain knowledge • Create a safe learning and social environment • Make specific demands on quantity and quality of ideas • Teachers should have high expectations
2) Stimulate the conceptualisation and evaluation of opportunities and let students discover criteria	• Let students identify opportunities in the market or by innovation • Stimulate elaboration on the concepts of opportunities • For educational reasons separate the identification phase from the evaluation phase, or otherwise combine them in one assignment • Let students develop criteria, judge opportunities and rank/select opportunities • Require specific demands on opportunities • Organise assessments by professionals that use entrepreneurial criteria for opportunities
3) Stimulate transfer by means of learning through authentic tasks	• Let students apply concepts and criteria for the improvement of business ideas • Provide co-assessment and feedback by entrepreneurs and teachers; stimulate co-assessment and feedback by peers

	• Let students use the feedback of peers, teachers and entrepreneurs • Let students take the role of problem solver and other entrepreneurial roles • Give students entrepreneurial tasks and activities • Let teachers take the role of coach • Have business ideas assessed by external experts, who use explicit and intuitive criteria
4) Challenge students to abandon their routine patterns of problem solving	• Provide authentic, open-ended, interdisciplinary and complex tasks, in authentic contexts • Foster the formation of interdisciplinary teams • Give students autonomy, responsibility and initiative in their roles in the start-up and learning activities • Organise deadlines, work pressure, competition and complexity • Create intergroup competition • Demand implementation of business ideas • Take students out of their familiar context • High expectations of teachers on quality and quantity
5) Provide incubation time for the identification and development of opportunities	• Provide a sufficient time period between giving an assignment to identify an opportunity, and its assessment • Create the possibility for iteration of idea generation and evaluation • Provide first ideas with feedback that can be used for improvement • Create possibilities to compare and discuss • Let students use their networks
6) Select students based for the quality of their entrepreneurial opportunity	• Students will only be admitted to the course if they have identified an entrepreneurial opportunity • Select students based on the potential of their opportunity and/or on their presentation and defence of their idea • Assess the opportunity for its market potential • Select students for their 'talent' to further explore the idea, and on motivation as perceived by the teacher • Select by interview/questionnaire

Table 6.2: Overview of design principle for the creation of an authentic learning context in entrepreneurship, with strategies and sub-strategies

Design principle 2 for an entrepreneurial learning context:
For the creation of an entrepreneurial learning environment in entrepreneurship education for science students it is advised to use the following strategies (7 - 15) and sub-strategies, with the expectation that such a learning context stimulates the processing of information as in entrepreneurship, and thereby contributes to students' competence in identifying opportunities.

Strategy	Sub-strategies
7) Provide authentic contexts that reflects the way the knowledge will be used in real life	• Deliverables have to be submitted within strict deadlines • Create conditions for an informal atmosphere as in a start-up • Create a space where students can work during start-up working hours • Give students ownership of their business ideas • Let students select the teams themselves • Give students autonomy and responsibility for the project and learning
8) Provide authentic problems and tasks that have real-world relevance; tasks must provide the opportunity to organise work and provoke the need to detect information	• Let students work together on extensive, ill-defined, complex, and open-ended tasks and activities • Let all tasks and activities contribute to one final main task • Let students use real-life resources and tools • Demand deliverables common to entrepreneurship • Create students' need to gather information, models, and theory
9) Provide access to expert performances and modelling of processes	• Provide role modelling by entrepreneurs and teachers • Provide process modelling by the teacher • Provide multiple roles • Put students in the role of a business starter to perspectives stimulate them to perform various roles (manager, IT worker, developer, and marketer) • Give students specific staff roles in the horizontal teams of the virtual holding company

10) Provide multiple roles and perspectives	• Put students in the role of a business starter to stimulate them to perform various roles (manager, IT worker, developer, and marketeer) • Give students specific roles in staff teams of a virtual holding company • Provide role model of entrepreneurs
11) Support the collaborative construction of knowledge	• Create a common team commitment by addressing the students as such • Give students common responsibility for group processes, work planning, product quality, and other tasks • Stimulate discussions in and between teams • Assess groups as a team; incentives must mainly be based on group activities and products
12) Promote reflection to enable abstractions to be formed	• Let students develop concepts and criteria from their experiences • Create a need to understand mechanisms and concepts
13) Promote articulation to enable tacit knowledge to be made explicit	• 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 and between teams • Let students present the final product (business plan) to external assessors
14) Provide coaching and scaffolding by the teeachter at critical times	• The teacher should act as a coach/mentor and as a CEO than as an expert • The teacher supplies formative and summative feedback on the process, activities and deliverables • The teacher gives feedback on students' ideas and asks critical questions • The teacher stimulates students to improve their business ideas

15) Provide authentic assessment by learning within the tasks	• Professionals and teachers perform summative co-assessment of the business plan presentation • Assess students in a formative way on deliverables as in entrepreneurship; deliverables must directly contribute to the start-up or to the virtual holding • Stimulate real exploitation of the business ideas • Use objective as well as intuitive criteria as in entrepreneurship practice

From the enumeration in Tables 6.1 and 6.2 it appears that the design of entrepreneurship education is complex, as many factors are involved and theories from various domains can be used either to develop or to explain the strategies and sub-strategies. This research started with an exploration and description of strategies, and continued with a theoretical underpinning of strategies, and next the degree functionality of strategies was determined. This research succeeded in providing an understanding of the factors and underlying concepts and theories that are involved in teaching opportunity identification in higher science education. The studies in this thesis focussed on the pedagogical side of education, but it should be realised that other and new strategies might contribute to this type of education. This exploration and description of educational design principles for teaching opportunity identification should be further developed in future research.

REFLECTION ON THE METHODOLOGY

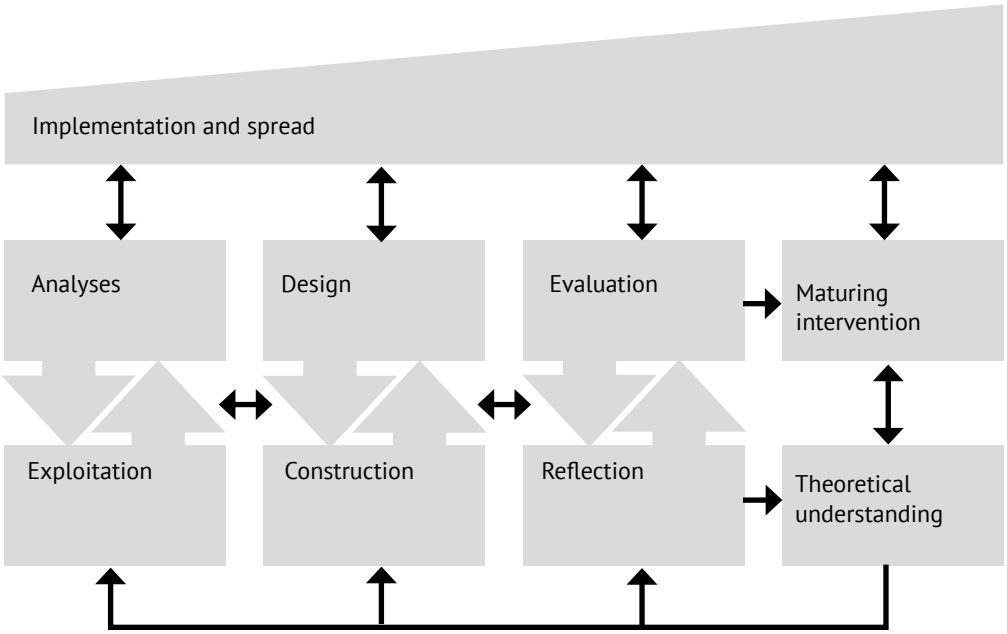
Introduction

In general, the yield of the educational design research (EDR) approach is twofold: 1) development of knowledge to support the process of designing and developing a specific educational problem (Blessing & Chakrabarti, 2009; Plomp & Nieveen, 2007), and 2) development of overall knowledge and an understanding of interventions and processes in education. EDR provides design principles on both 'how to' and 'why' to design education for a specific purpose, describing context, strategy, underlying argumentation (mechanism) and expected outcomes (McKenney, Nieveen, & Akker, 2006; Van Aken & Andriessen, 2011). In this reflection, an overview is given of the methods used in this research, and the quality of the design principles and strategies is elaborated, as are the various roles of the researcher in this research.

Overview of research approaches

Design research usually goes through several stages which McKenney & Reeves (2012, p. 77) phrase as follows: 1) context and problem analysis, 2) design, 3) evaluation, combined with a systematic reflection that is performed during and at the end of the research. Theory for the exploration, construction and reflection of knowledge is situated on a simultaneous track.

Figure 6.1: Generic model for conducting design research in education (from McKenney & Reeves (2012, Figure 3.3, p.77)



In this study, first the learning context of entrepreneurship education was explored (Chapter 2) in order to analyse, describe and understand the characteristics of a successful entrepreneurship course. This study resulted in a framework of five educational strategies for the creation of an entrepreneurial learning context (Chapter 2), and recommendations were given for additional strategies. The first study in our research can be considered as context and problem analysis.

In Chapter 3, in a literature survey, opportunity identification was depicted as the core competence to be emphasized in entrepreneurship education. This assumption was elaborated into a design principle (with three strategies) for fostering the competence of opportunity identification (OI). From these, a conceptual course framework was created that was piloted in three small-scale pilots before strategies were evaluated. In this study, the degree of implementation was determined for all strategies, and the functionality of the individual strategies was evaluated. This resulted in confirmation or adaptation of the design strategies, and suggestions for implementation.

In Chapter 4, the OI design strategies were evaluated by consultation of expert teachers in entrepreneurship education, in order to evaluate, refine and complement the design strategies.

In Chapter 5, a summative case evaluation of the design strategies on opportunity identification and on creating an authentic learning context was performed. Both sets of design

strategies were synthesised into a single course design, which was evaluated on *feasibility* and *degree of functionality*, in other words: are students able to identify opportunities after the course. The experience and role of the teachers appeared relevant in designing and implementing education for the fostering of OI competence (Chapters 2, 5). Various teachers were involved in the prototyping studies and in the case studies, and thereby the possibility of investigating the robustness of the strategies with various teachers and in various learning environments was created, and has contributed to evidence of the robustness of the design.

In summary all stages of educational design research as outlined by Nieveen et al. (2006) are present in our research, and turned out to be relevant and useful.

Quality of research

The quality of our study will be considered from two perspectives: the quality of educational design research as a research approach, and the quality of the design principles.
For educational design principles to be useful and reliable, the research from which they are distilled must adhere to rigorous standards (McKenney et al., 2006, p. 77). A mixture of qualitative and quantitative instruments was used to answer the research question. By applying various measures, the quality of the data, interpretations and inferences from observations were secured. To obtain a good quality of data, we selected good practices by purposeful sampling (Palys, 2008) in the selection of cases (Chapters 2 and 5) and the snowball method for the selection of the expert teachers to be interviewed (Chapter 4).

Data from cases and students' artefacts, such as business plans and documents on opportunities, were gathered by using instruments for assessing opportunities and observation forms. If the researcher was involved in education (during prototyping), an independent observer collected the data (Chapter 5). Independent and/or multiple coding of data contributed to the consistency and reliability of the analysis.

In Chapter 3, 4 and 5 statistical measures for reliability proved to be satisfactory with regard to the questionnaires (Chapters 3 and 5) and the independent analysis of interviews (Chapter 4). Multiple independent external experts assessed the learning results, such as students' products on opportunities (Chapter 5), with a specific instrument for scoring the business opportunities. Moreover, the findings of the studies were discussed with teachers and course coordinators as a member check.

In the case studies (Chapters 2 and 5) and in the design study (Chapter 3) triangulation was used for data sampling and interpretation. An overview of data collection instruments is provided in Table 6.3.

Table 6.3: Overview of data collection methods

Chapter 2: Explorative study	• Selection of good practice • Questionnaires for perception of learning effects and learning environment (Likert-scales and open questions) • Classroom observations of activities, and of mid review and end review (videotaped) • Interview with focus group of students at end of course
Chapter 3: Design study	• Selection of new course that had to be designed • Observations, field notes and interviews • Questionnaires for measuring perception of competences and of the learning environment • Analysis of students' artefacts of idea generationn
Chapter 4: Evaluation study, and exploration for additional strategies	• Purposeful sampling of expert teachers and snowball method • Interviews with expert teachers in entrepreneurship • Tape recorded and transcribed, followed by qualitative analysis
Chapter 5: Case study	• Selection of good practice where all strategies were realized • Questionnaire for perceived competence in OI • Document analysis (course description, study guide, policy documents and publications) • Interviews with teachers • Observations of all lessons related to OI • Questionnaire to measure students' perception of the learning environment • Interviews with students at the end of the course • Analysis of students' products for determining the degree of functionality of the course design, by external assessors using an instrument for innovativeness and market potential

EDR is considered to be the first step in a broad range of research approaches, and it may be seen as a stage-appropriate response in a multistage programme of research that moves from speculation, to observation, to identification of variables and processes via prototyping, to models and guidelines, to implementation studies, scaling studies, correlation and causation studies and further to diffusion of innovations (Bannan-Ritland, 2003). This study provides strategies that are theoretically supported and that may prove to be functional in subsequent research. In our case, EDR appeared to be a useful research approach because it suits the stage of knowledge development and allows for standards of good research to be met. It proved suitable for the determination of the feasibility, degree of functionality and robustness of design principles and their strategies. The result is a detailed description of design guidelines.

Quality of design strategies

The format for design principles was provided in Chapter 1. We emphasised that in our research a design principle consists of several strategies, each with one or more expected outcomes and a mechanism or argument elucidating the outcome. We present design principles resulting from our research in the following format:

In an educational context C Strategies S^{a-z} lead to Actual Outcome(s) O^{a-z}, because of arguments A^{a-z}.

Nieveen (1999) presented four criteria for high-quality design strategies: relevance, consistency, practicality and functionality. **Relevance** is also referred to as content validity. It implies that there is a need for the intervention and that its design is based on state-of-the-art scientific knowledge. The need for practical and theoretical knowledge of competence in identifying opportunities was elaborated in the Introduction chapter and in Chapters 3, 4 and 5. State-of-the-art knowledge from entrepreneurship literature on opportunity identification was applied to develop design strategies (see Chapter 3 and 4). As opportunity identification is a domain-specific form of creativity, theories and pedagogies from creativity and learning theories were included to develop design principles. Relevance was also secured by the use of co-design with practitioners, in the design and evaluation of courses.

Consistency means that strategies must be logically designed into a whole. Multiple strategies were synthesised into a course design, co-designed with teachers and course coordinators, and thereby meeting the demands from the school system (schedules, pedagogy, assessment guidelines, logistics, etc.). This was checked by interviews with students and by observation.

Practicality means that the intervention is realistically applicable in the settings for which it has been designed and developed. In our studies we used the concept of feasibility instead of practicality. The feasibility of design strategies was determined in Chapters 3, 4, and 5.

An important criterion for design principles is its **functionality**: in this specific context of educational design research this means: do the strategies yield the outcomes as expected in compliance with theory? In Chapters 3 and 5 we determined an indication for functionality by scoring students' business opportunities. In Chapter 4 expert teachers were asked for their

perception of effectiveness of strategies. During the prototype phase of this research, the teacher scored business ideas from the students, using a scale for degrees of innovativeness (see Chapter 3). In the evaluation of the course design (Chapter 5) the value of students' entrepreneurial opportunities was defined by a group of experts (investors, entrepreneurs, venture capitalists, and IT journalists) that used two scales: innovativeness and market value. For reliability purposes, multiple independent experts scored each entrepreneurial opportunity, which is considered to be a reliable way of scoring creativity products.

As an added criterion we used the **robustness** of the design. '*We need robust designs - ones that produce impressive results, not only under ideal conditions, but also under severe realistic constraints, and we want sustainable designs that thrive and improve with time, not ones that slide downhill every year*' (Walker, 2006, p. 13). The design principles in this research showed their robustness over a substantial period of time, under the guidance of various teachers, and in various learning contexts. The design strategies for opportunity identification were implemented and evaluated (Chapter 3, 4 and 5). In Chapter 4 the strategies were evaluated in various contexts and with various teachers and were reported to be feasible and effective. Finally, a synthesis of all design strategies was evaluated in another context and again turned out to be feasible and gave an indication for functionality (Chapter 5). Therefore, it can be concluded that the design strategies in this research were feasible and gave an indication for functionality in various case studies in time, and thereby robustness of the strategies was shown. It is interesting to note that Weber, Ropes and Andriessen (2011) argue that doing repeated case studies can be a valuable research method for the determination of effectiveness of design strategies.

McKenney et al. (2006, p. 71) also provided criteria for robust designs: consistency of the course design, harmony between curriculum representations and coherence with the system context. In this research, the consistency of factors was established by using a spider web model for course design (McKenney et al., 2006). In the actual course design (Chapter 5) all strategies were elaborated into a coherent set of learning activities. Harmony was achieved because during this research several curriculum representations (Goodlad, Klein & Tye, 1979) were aligned: the course design (intended curriculum) was in accordance with the course as enacted in the classroom (implemented curriculum), and with the learner outcomes and learners' perception (the attained curriculum).

Coherence with the system context seems less obvious, because a new pedagogy was introduced in an academic school system. Students in our studies were deliberately permitted more responsibility and autonomy than they were used to in the regular university system. However, they were able to take this responsibility and autonomy and felt challenged by it (Chapter 5), and teachers were able to handle this in their teaching. For this reason, there seems no reason to take this lack of coherence with existing systems as a weakness of our design principles.

Taking the quality criteria for educational design research as mentioned above, it could be concluded that the design principles and strategies in our study match the quality criteria as

depicted in the literature. The design principles in this research proved to be relevant, consistent, feasible, and an indication for functionality was found in various circumstances. Therefore, it can be concluded that robustness of the design principles was shown.

Role of the researcher in this research

Educational design research has two perspectives: first to design an intervention for a problem in education, and second to investigate and empirically ground solutions and contribute to theory development (Blessing & Chakrabarti, 2009; Plomp & Nieveen, 2007). These two perspectives in educational design research imply two different roles for the researcher: designer and researcher. Besides this, the researcher is acting as an educational change agent in a field of interests that may evoke resistance in some stakeholders. In one of our studies, one person performed the roles of researcher as well as designer; however, the course was designed with teachers as co-designers.

Moreover, in our research the researcher/designer was also teaching specific aspects during the prototyping phase. These various roles have their own interests, and therefore having multiple roles carries the risk that potential conflicts of interest may arise and bias in data collection may occur. Plomp and Nieveen (2007, pp. 3-32) described measures to compensate for or protect against conflicts of interest, and we use these recommendations as a framework to reflect on roles and quality of products.

First of all, the role of the researcher changed over time. In the beginning, there were two roles: as a researcher of literature surveys in order to find empirical evidence for strategies, and as a course designer in cooperation with teachers and course coordinators. In this phase a balance had to be found between the interests of the researcher and the designer. A course design must cohere with a faculty's educational system, diminishing freedom of choice. In Chapter 3, co-design guaranteed a balance between scientific, theoretical and practical demands to the course design.

In the implementation phase (Chapter 3 and 5) two major roles appeared: as data collector, meeting the standards of research, and as change agent trying to implement new ways of teaching in a larger educational system. Data collection was performed with various qualitative and quantitative methods, as described above. If the researcher had an active role in education, independent observers were involved to collect data. These measures were taken to maintain objectivity of data collection.

Research approaches in educational design research should meet rigorous standards (McKenney et al., 2006, p. 77). To guarantee quality of data and conclusions, we used triangulation to enhance the reliability and internal validity of data. During analysis measures were taken to secure the reliability of results by applying the standards for reliability of instruments (e.g. Cohen's Kappa, interrater-reliability). After prototyping, we consulted a group of external experts to investigate whether they use the proposed strategies in their teaching and whether they use additional strategies. This is an external validity check with domain experts. Furthermore,

interpretations and results of the research were communicated and discussed with teachers as a member check. External experts critically discussed and assessed research products as well as practical solutions in course designs.

The primary aim of the evaluation of strategies is to establish functionality of strategies or course design, or, in other words, are there indications that they play a role in achieving the outcomes, as expected from the underlying mechanisms. For example, are students able to identify opportunities? Therefore, external experts that assessed students' products evaluated students' learning outcomes. Questionnaires and interviews were used for determining students' perception of feasibility and learning results.

During the research the focus of the researcher shifted from creative design to a more critical and detached role in the phase of analysis and interpretation of data in the final cycle (Chapter 5). It can be asserted that taking so many roles may disturb the objectivity of the research. On the other hand, playing an active part in teaching helps to understand better the problems that teachers face in the classroom. By taking on the additional roles of teacher and designer, and by allowing the study to be influenced by the needs and wishes of partners during what was in fact a long-term relationship, the researcher showed involvement and adaptability.

REFLECTION ON THE KNOWLEDGE CLAIMS

The knowledge claims in our research are presented as design principles and strategies (McKenney et al., 2006) that have proven feasibility and that show an indication for feasibility in various contexts. This section elaborates the design principles for fostering opportunity identification and considers the characteristics of an entrepreneurial learning context that are essential for learning.

The most important finding of this research is that it adds new design strategies to existing theories of teaching opportunity identification. In addition, this research presents a detailed description of a learning environment that contains the essential elements of entrepreneurial practice for scaffolding the teaching of OI. Since learning opportunity identification is context specific, an authentic learning environment will support the teaching of opportunity identification. Therefore, this research contributes to the theory of entrepreneurship education and provides a local theory for the teaching of this competence to science students.

Design principle for teaching opportunity identification

The first design principle describes a coherent set of strategies with in indicative functionality in teaching students to identify entrepreneurial opportunities. In this way this research provides heuristics for solving a practical educational problem: the design of education in opportunity identification. Furthermore, this research contributes to the development of theories in entrepreneurship education.

The principle for teaching opportunity identification to science students includes six strategies

that were evaluated for coherence and in practice. In this section both design principles and their strategies will be reflected upon.

The **first strategy** on the stimulation of **idea generation** departed from the linkage that exists between creativity and opportunity identification in entrepreneurship (Ardichvilli, Cardozo, & Ray, 2003; Beattie, 1999; Dimov, 2007; Gielnik, Frese, Graf, & Kampschulte, 2012; Hills, Shrader, & Lumpkin, 1999; Nixdorff & Solomon, 2007). This strategy assumes that teaching students to use idea generation techniques will stimulate their creativity and divergent thinking (Amabile, 1996; DeTienne & Chandler, 2004), which in turn will support the process of opportunity identification. In addition, an understanding of the heuristics behind these idea-generation techniques will stimulate their use.

This strategy was developed and evaluated as described in Chapters 3 and 5. In addition, most expert teachers reported that they stimulated creativity in some way in their teaching (Chapter 4), and several sub-strategies were reported. The stimulation of creativity by providing idea-generation techniques is generally accepted in entrepreneurship education. However, in one of our studies (Chapter 3) it appeared to be difficult to implement this strategy. When during prototyping this strategy was first applied as a series of exercises, students did not directly see the need for it. It became clear that the use of idea-generation techniques should not be taught as a separate activity but should be directed at tasks and assignments that students perceive as meaningful and realistic (or in other words, 'authentic'). This explains why some of the sub-strategies for idea generation are realised in an authentic way. This also explains why this strategy shows similarity with the second design strategies for the creation of an authentic learning context. For example, expert teachers reported that a safe learning environment should be provided which is typically a characteristic of the learning environment. Our findings for this strategy are consistent with earlier findings (Belski, 2009; Gulikers, 2006).

Also, this strategy should be provided just in time, shortly before students can use it in authentic tasks (Merriënboer & Dijkstra, 1997). Most expert teachers confirmed the use of authentic elements in the stimulation of creativity (Chapter 4). Examples of idea-generation techniques that were used are: analogical thinking, morphological reasoning, recombination, and brainstorming (Gundry & Kickul, 1996; Ward, 2004), but also industry specific techniques such as systematic inventive thinking (Barak, 2002; 2009).

It is of interest that some expert teachers reported that they provided restrictions in idea generation, with the result that it improved the quality of ideas. Restrictions such as the demand to use domain knowledge, but also seemingly less logical ones, stimulated idea generation. This implies that when the goal is specified more precisely, better solutions will emerge, and this is in line with previous studies (Jonassen, 2000; Moore, 2007). Other sub-strategies that were reported to improve idea generation are high expectations of the teacher, for example by stipulating specific demands on quantity and quality.

Our research confirms the findings of DeTienne and Chandler (2004), who reported idea-generation exercises as one of their successful interventions in education to improve competency

in opportunity identification. These authors reported four strategies to be successful in fostering the competence in identifying opportunities: securing, expanding, exposing and challenging. Securing is recording into logs the business ideas that occur throughout the day. Expanding means idea presentation exercises and presentation of an idea with peer feedback. Exposing lets students find solutions for existing problems, by the use of brainstorming and brain writing. Challenge involves elevator talks to peers and the stimulation of competition. Our findings are in line with the findings of DeTienne & Chandler (2004). The exercises as described by these authors are included in two of our strategies: on idea generation (strategy 1) and conceptualisation (strategy 2).

This research adds elements of authenticity to previous studies, and provides several sub-strategies to improve idea generation by students.

The **second** design strategy aims at **letting students conceptualise their experiences** of opportunity identification and build their own prototypes and criteria regarding opportunities. In fact, this strategy aimed at a deeper understanding of the concept, meaning that students are able to use the concept to solve problems, relate it to other concepts, rules and generalisation, and, when they use the concept, to learn new material (Baron & Enslay, 2006; Nitko & Brookhart, 2014). This design strategy proved to be feasible in our studies (Chapters 3, 4 and 5) and the expected outcomes were realized in various contexts of entrepreneurship education. Students proved to be able to conceptualise their experiences of opportunities and to develop criteria. They were also able to use these concepts in the identification of opportunities.

Our findings on conceptualisation are consistent with the expectations from cognitive theories on opportunity identification (Ardichvilli et al., 2003; Ward, 2004). These theories provide insight into attributes for learning such as the use of prior knowledge (Chi, 2008), cognitive mechanisms, heuristics and creative abilities. These attributes may also help students gain a deeper understanding of a phenomenon when they discover how to conceptualise their mental actions. This design strategy is in accordance with cognitive theory on experiential learning in opportunity identification (Corbett, 2005), where conceptualisation and reflection are crucial steps in learning. Students should be stimulated to verbalise and collaborate on opportunity identification, in order to stimulate conceptualisation (Table 6.1).

Expert teachers (Chapter 4) differed in opinion on the sub-strategy to separate identification from evaluation of the opportunity. Most teachers preferred to separate these activities, because a premature evaluation will kill idea generation, while others argue that these phases are intertwined and iterative and should be taught as such.

Once the concepts of OI are internalised, the students are more able to identify opportunities, and by re-using these concepts, concepts are extended and refined. The repeated use of mental prototypes further contributes to this process, meaning that tasks have to be repeated and extended over time.

Encouraging students to develop their own criteria for what an opportunity is proved to be a useful way of conceptualising, because it forces the students to evaluate opportunities and,

more importantly, this lets them build mental schemes and procedures that they can apply in forthcoming experiences. In developing criteria, categorisation may play a role, because assigning a concept to a correct category is a powerful element of learning (Medin & Rips, 2005).

The **third strategy** aims at the **transfer of concepts** of opportunity identification to new situations and questions. In this research students proved to be able to transfer concepts and criteria of opportunities to new experiences (Chapters 3 and 5), for example by identifying opportunities or by the application of criteria in giving feedback to peers.

It is a well-known problem that the transfer of competences from the learning situation to professional situations is often limited. Learning is context dependent, and what is learned in one context will not automatically be applied in other situations. In fact, this strategy aims at bridging the gap between what has been learned in the classroom and the application in practical contexts. Therefore, it seems evident that several sub-strategies aim at bringing in elements of authenticity into education, for example by giving students entrepreneurial roles, tasks and activities.

Transfer can be considered as the learners' meaningful use of their mental maps derived in relation to a specific context, in another context (Gilbert, Bulte & Pilot, 2011). Transfer depends on the degree of analogy between the context of learning and the context of application. Three subtypes of transfer have been defined: near, further and far transfer (Gerntner, 1983, 1989; Schwartz, Varma & Martin, 2008). The application of scientific knowledge in the context of entrepreneurship can be seen as far transfer; there are fewer similarities between the two contexts than there are differences.

Transfer of knowledge and skills can be enhanced by bringing in more authentic elements, by setting clearer criteria to be met, by introducing meta-cognitive activities and through assessment (Simons, 1999). If concepts are obtained in 'entrepreneurial' contexts in the classroom, they will mentally be connected to that context. This mental connection will ease the transfer of concepts to new entrepreneurial contexts.

Other sub-strategies (Table 6.1) prescribe the use of feedback and assessment by entrepreneurs that use authentic criteria as in the market. This will stimulate students to elaborate on the demands and criteria of real-world entrepreneurship, and thereby stimulate transfer. In addition, if students provide feedback to peers on authentic questions, this will help them to internalise concepts and criteria.

The role of the teacher has to be complementary with students' activities, and the degree of scaffolding and steering should decrease in guiding students from near to far transfer. This underlines one of the sub-strategies found: teachers should take the role of coach instead of provider of knowledge.

The **fourth** strategy aims at **challenging students to abandon routine problem-solving thinking** and find new ways. In this, routine problem solving must be distinguished from non-

routine problem solving. Routine problems can be solved by the use of fixed procedures and knowledge. No need exists to develop alternative ways of problem solving as long as the present level of competence will suffice. When students are brought into entrepreneurial circumstances of uncertainty and ambiguity, such as opportunity identification (Ardichvilli et al., 2003), they are faced with the ineffectiveness of their routine problem-solving skills. Challenging circumstances force students to reflect on their abilities and a need arises to develop new, creative solutions and knowledge.

This strategy was discovered in the second study (Chapter 3) and confirmed in the interviews with experts (Chapter 4). In this research, the challenge was successfully met in the start-up activities (Chapters 2, 4 and 5). Students worked on open-ended tasks, creating something innovative and planned to bring this to the market, and therefore students felt stimulated to step out of routine problem-solving scripts.

According to the classification of problems by Jonassen (2000) business opportunities can be characterised by many uncertainties and lack of information on how to solve the 'problem'. It fact, an imbalance exists between the demands or goals (opportunity identification) and the competence of students. This is recognised as a challenging factor in theories of challenge, such as the flow theory of Csikszentmihalyi (1990) and the self-determination theory of Deci and Ryan (1985). These theories assume a relationship between levels of challenge and the ability of students. Moreover, Cope (2003) states that entrepreneurs learn from critical incidents that force them to reflect. This author considers learning from critical incidents as higher-order learning (Argyris & Schön, 1978; Mezirov, 1991). Higher-order learning is needed in situations of uncertainty and therefore these situations will challenge students. Scager (2013) defined a three-factor model for challenging high-ability students: a combination of autonomy, complexity and high expectations of the teachers. In this research, these factors were present, as described in the sub-strategies in Table 6.1: complexity in the many aspects of opportunity identification, high expectations from teachers and external assessors, and students had a high degree of autonomy in learning. Other challenging factors appeared to be: working in interdisciplinary teams, deadlines and competition, the task to implement opportunities, and taking students out of their familiar context (Chapters 4 and 5).

The **fifth strategy** on providing an **incubation period** for opportunity identification was reported as an additional strategy by some expert teachers (Chapter 4), and was further investigated in a case study (Chapter 5). This strategy was reported by experts to be effective in two cases. Incubation is described in creativity literature, but is new as a strategy in entrepreneurship education. In most entrepreneurship education students have relatively little time for the identification of opportunities. Courses last for a few weeks only and the process of opportunity identification is compressed into a short period, leaving little time for incubation.

The effects of incubation can be explained by several mechanisms. The concept of incubation is described in creativity literature (Amabile, 1996, p. 101; Nickerson, 1999, p. 417) as a period

in which on a subconscious level one proceeds with cognitive activities that contribute to idea maturation. During incubation, individuals process thoughts subconsciously (Csikszentmihalyi, 1996), while periodically they are thinking about an idea or working to solve a problem. Creative work typically involves periods of incubation, where one is not consciously thinking about the task. This can take away fixations and provide access to knowledge in the long-term memory that can lead to a solution (Finke, Ward & Smith, 1992). Ideas have to be developed after the first discovery or creation and mature in iterative cycles of evaluation and refinement. It can be assumed that incubation acts in a similar way in the opportunity identification process (Hills et al., 1999; Ward, 2004). By providing incubation time, the opportunity identification process is prolonged, and students have more time to discuss and conceptualise their entrepreneurial opportunity.

During the incubation period several sub-strategies support the process of opportunity identification, as listed in Table 6.1. In the case study, incubation created time for iteration of the opportunity, and thereby more conceptualisation and elaboration. This is further strengthened when combined with some form of feedback.

Another explanation may be that, in general, it takes a long time and a great deal of effort to acquire a complex competence (Merriënboer & Dijkstra, 1997) such as opportunity identification. In order to develop this competence, the students need to have knowledge and skills in specific domains and knowledge of the market (Ardichvilli et al., 2003). Students' domain-specific knowledge of science was guaranteed by their grades, but specific market-related knowledge still had to be developed, which might be time consuming for science students. It is doubtful whether this can be achieved in the classroom. Besides, a ten-week course might not be long enough for a competence to fully develop. However, it is not clear from literature how to apply the incubation process in the classroom. Therefore, the influence of incubation on the development of the competence of opportunity identification deserves further empirical study.

This design strategy also prolongs the time span for identification and incubation and in this way supports cognitive processes on opportunity identification. Students will search for ideas earlier, and they are provided with a substantial period for incubation, reflection and refinement.

The **sixth strategy aims at selection and pre-assessment** at the start of the course and it was found to be feasible and to have an indication for functionality in improving the quality of business ideas of students (Chapters 4 and 5). Students were better prepared and brought in a well-considered entrepreneurial opportunity when entering the course. Two forms of pre-assessment have been reported in this dissertation (Chapters 4 and 5) as well as several sub-strategies. The empirical exploration of the viability of this strategy is new for the domain of entrepreneurship education.

In the first case students had to provide an idea and received feedback from teachers and others in their environment. After refinement of the idea, the ideas were presented and assessed in a first course meeting. Finally, all students were admitted to the course. In fact, diagnostic

assessment is used here to identify what knowledge and skills a student has mastered, or has to master. The assessors reported that the quality of business ideas had improved sharply in comparison with previous years (Chapter 5), but it should be mentioned that rival explanations in this situation cannot be excluded.

In a second case, students also had to provide an idea, and to pitch the idea to teachers and entrepreneurs. They were admitted or refused to the course. This was typically a case of summative feedback.

Students in this case can learn from the experience, but do not have the chance to use the feedback for improvement. The assessment aimed at the selection of students that have the potential to become entrepreneurs in the eyes of the assessors. Besides assessing the entrepreneurial opportunity, some less changeable abilities and traits of students were assessed, and for that reason this form of assessment was less suited for improving learning and conceptualisation. From the perspective that the process of opportunity identification is a cognitive learning and social activity (Baron, 2006; Corbett, 2007; Gaglio & Katz, 2001), for the admitted students formative feedback will be more effective than summative assessment (Hattie & Timperley, 2007).

In conclusion, this research adds four design strategies for teaching opportunity identification: transfer the concepts to realistic problems, challenge students to step out of routine problem solving, allow incubation time for opportunities to be identified and apply pre-assessment.
It must be underlined that the design strategies for teaching opportunity identification are coherently implemented and applied in a single course design, which was studied as a complex whole. The application of one single strategy will be less or not at all effective, because the functionality of these strategies depends on the learning outcome of a former strategy (Barab, Squire & Dueber, 2000). Only the synthesis of strategies has an added value in teaching opportunity identification.

Reflecting on the six strategies for teaching opportunity identification, it can be argued that all six strategies are intended to stimulate conceptualisation of the opportunity concept. Idea-generation techniques are meant to create a novelty for a specific situation, which is an important concept of opportunities. The strategy on conceptualisation stimulates the discovery and elaboration of concepts and criteria of opportunities. In transferring the concepts, students further refine and extend these concepts. The strategy to challenge students in finding new non-routine problem solving strategies leads to extension of the repertoire in problem-solving strategies, and deeper understanding of the concept of opportunity. Providing an incubation time for opportunities provides the possibility of sub-conscious elaboration. And finally, pre-assessment and selection on the value of the opportunity should let students think about the concepts behind it. For that reason, this design principle for teaching opportunity identification can be considered to be a **concept principle**.

Design principle for the creation of an authentic learning environment

The second design principle that has resulted from this research describes nine strategies for the creation of an entrepreneurial learning context that supports the process of opportunity identification by students. Each strategy contains several sub-strategies that provide suggestions for implementation in practice. Strategies and sub-strategies are presented in Table 6.2.

These strategies were explored in three successive studies. First, an exploratory study (Chapter 2) resulted in the description of seven strategies. In Chapter 4, expert teachers reported on the use of various authentic contextual elements in teaching opportunity identification. Finally, in Chapter 5, the framework for authentic learning of Herrington and Oliver (2000) was used to extend the number of authentic strategies as reported in Chapter 2, and these strategies were evaluated in combination with strategies for teaching OI. This design principle (with nine strategies) can be considered as a **context design principle,** because it describes the creation of a learning context for the teaching of opportunity identification. Such a detailed description of a context design principle for teaching opportunity identification in entrepreneurship education has not been reported before. This research provides new strategies for designing learning environments that supports the teaching of opportunity identification. Besides, these strategies were evaluated as a coherent set, where other authors provide one or a few strategies and with less detail. The contribution of this dissertation is a theoretically and empirically supported design principle consisting of nine strategies for the development of an entrepreneurial learning context that supports the teaching of opportunity identification.

The findings from this study are both consistent with and extend other studies' findings. Several scholars have mentioned the introduction of authentic elements of entrepreneurship in education, and these resemble the 'authentic learning context' as investigated in our research. Gibb (1993; 1996) advocates 'learning by doing' entrepreneurial tasks. Taatila (2010) argues that entrepreneurial skills are learned via pragmatic real-life development projects. Heriot, Cook, Matthews, and Simpson (2007) brought students out of the classroom, and stimulated students in consultancy assignments, where students evaluate a real-world business problem and must decide on a solution. Keith Sawyer (2006) advocates the use of situated, collaborative knowledge-building activities. The author states that creative collaboration in classrooms aligns with the social nature of innovation in today's economy. Vincett and Farlow (2008) created learning by allowing a small group of students with serious business ideas to actually be entrepreneurs (rather than pretending to be) as they evaluate, optimise, and start running their businesses within the university course structure. Contact with outside stakeholders is strongly emphasised. Heinonen (2007) proposes an entrepreneurial-directed approach to teaching corporate entrepreneurship for Master's level students; this approach includes authentic elements of entrepreneurship in education. In addition, Pittaway and Cope (2007) highlight the role of emotional exposure, situated learning, action-orientation and discontinuity.

This research shows consistency with these theories on authentic learning. To begin with, the nine strategies as presented by Herrington and Oliver (2000) were confirmed in a new

context of entrepreneurship education. These authors developed their framework for IT in education, whereas in this dissertation the strategies were evaluated in another learning domain and context, thereby supporting the findings of Herrington and Oliver. Our findings also show consistency with the findings of other authors on authentic learning (Renzulli, Gentry & Reis, 2004; Rule, 2006). Overall, our research is new in providing a set of empirically supported and promising design strategies for creating a learning environment that includes relevant elements of entrepreneurship that support students' learning process in opportunity identification.

In many publications, experiential learning is presented as an effective pedagogy for entrepreneurship education (Corbett, 2005; Hannon, McBride & Burns, 2004; Heinonen & Poikkijoki, 2006; Kickul, Griffiths & Bacq, 2010; Pittaway & Cope, 2007). According to the theory of experiential learning, individuals can learn much from experience (Kolb, 1984), and so students in entrepreneurship courses should have real-life experiences to learn from. Also, authentic tasks in an authentic context are essential for the acquisition of all sorts of knowledge, including tacit knowledge. Learning also takes place from reflection (Arievitch & Haenen, 2005), where reflection makes the knowledge from experience explicit to the learner. In entrepreneurship and in entrepreneurship education reflection is a relevant issue (Cope, 2003; 2005) and leads to better performance in subsequent experiences. Entrepreneurs often fail to reflect because of time pressure in changing and pressing circumstances. Entrepreneurs show preference for fast information gathering to solve a problem (Sexton, Upton, Wacholz & McDougall, 1997). This corresponds with our findings, because it was also difficult in this research to get students to reflect on their experiences (Chapters 3 and 5). Students did not experience explicit reflection as authentic, while the perception of 'authenticity' by students is essential (Gulikers, 2006). Also because of time pressure, reflection was not achieved as intended. To build up reflection as an authentic activity of education is therefore a challenge for the future research and design of entrepreneurship education.

Experiential learning presents phases in the learning process (Kolb, 1984), but it is a generic model. It is not linked to a specific domain and does not give guidelines for the specific context of entrepreneurship education. This research does provide such detailed heuristics for the development of entrepreneurship education and for teaching opportunity identification and adds these new detailed guidelines to the existing literature on this subject.

In our studies, an authentic and entrepreneurial context that reflects the way knowledge will be used in real life is simulated. This was realised partly by the creation of an entrepreneurial context in the classroom, and on the other hand by stimulating students to enter the world of entrepreneurship. But the last cannot easily be implemented, because markets, resources and competitors are situated outside the classroom: the boundaries of the school system have to be crossed (Korhonen, Komulainen & Raty, 2012) if these elements are wanted for learning. Finally, it must be noted that in this research the context design strategies for authentic learning were coherently implemented, meaning that all strategies were synthesised into a single course design. This is important because isolated strategies do probably not realize their expected outcomes;

but the combination of several strategies in designing an authentic learning environment is (Barab, Squire & Dueber, 2000). This research does not decide which strategies are crucial in a course design and how many strategies should at minimum be implemented. But it can be argued that the synthesis of a larger proportion of the strategies from both the concept and the context design principles is conditional.

TEACHING PHASES AND COURSE DESIGN

Understanding the sequence of concept strategies on opportunity identification

In this dissertation, the various design strategies are presented as separate items, however, from other design studies (e.g. Meijer, 2011) it is evident that the coherence and sequence of strategies also determines their functionality. In this research two design principles are presented: for teaching the concept of opportunity identification and for the creation of an entrepreneurial learning context. Each design principle consists of several strategies that were all implemented into a single course design. This implies that these strategies are in some relation to each other. In this section, we will discuss how these strategies are related to each other, and what it means for the sequence of activities in entrepreneurship education that aims at fostering opportunity identification.

First, the sequence of learning activities for OI is largely explained by a logical, cognitive order, because the learning activities in opportunity identification typically depend on the cognitive result of a former activity and in most learning activities the outcomes of previous activities are used. If this logic is followed, each learning activity takes a natural place in the course design. Here, we evaluate the concept design strategy (for opportunity identification) from this point of view.
An introductory meeting is planned ahead of the course, with the purpose of motivating students and to provide the learning goals and targets to be obtained. The main assignment is provided during the introduction; in all cases opportunity identification is part of the assignment (business plan, consultancy assignment). This is also the proper time to emphasise idea-generation techniques (design strategy 1). Students are trained to acquire idea-generation skills, which they subsequently apply in opportunity identification.

When an initial opportunity has been identified, an incubation time is provided (design strategy 5), where the students have the chance to let their initial ideas mature, alternated with discussing it with others, and feedback from teacher(s) and peers. They will obtain a better understanding of the concepts behind opportunity identification (design strategy 2), and thereafter refine their idea. At the start of the course students present their business opportunity, and they will be assessed (formative or summative) based on the quality of their business opportunity (design strategy 6). Because they work on an open-ended and complex task, where no prescribed solutions are available, students feel challenged to explore new solutions (design strategy 4). During this phase students analyse the opportunities of other students (design strategy 2) and develop criteria for opportunities, so they develop concepts of business opportunities (design strategy 2). Students

will apply the concepts when further refining their opportunity (design strategy 3). The next step is to transfer the concepts that have been learned to practice, in further developing their business ideas (design strategy 3).

Midterm, their primary business ideas are formatively assessed (by entrepreneurs), in order to improve their ideas. At the end, students are assessed as in entrepreneurship, with a chance to further improve their business plan (design strategies 2, 3 and 4). During this process of opportunity identification and evaluation, students are challenged to find new ways to solve problems, under the pressure of high expectations, real-life assessments and deadlines (design strategy 4).

In conclusion, the concept design strategies are related through an order in time, because a learning activity is based on the outcomes of a previous activity. This order of activities is also consistent with phase models for creativity: problem or task identification, incubation, idea generation, idea validation and outcome (Wallas, 1926; Csikszentmihalyi, 1996; Amabile, 1996). These phases are consistent with the phase models for opportunity identification as depicted by Shane and Venkaramatan (2000) and Shook, Priem and McGee (2003). It underlines that opportunity identification is a domain-specific form of creativity (Hills, Shrader & Lumpkin, 1999; Corbett, 2005). Our findings underline the need for a design principle on the sequence of interventions in a course, in accordance with Meijer (2011). Teachers who develop entrepreneurship courses with opportunity identification as a learning subject can find support in applying such a principle.

On the sequence of context strategies

In the educational design an authentic' entrepreneurial context is provided for the development of competence in identifying opportunities by students. Nine design strategies were developed and evaluated for this purpose. For these context strategies, it is less clear how to determine a sequence. The entrepreneurial learning context should be maintained for students throughout the course. The set of design strategies for the creation of an authentic learning environment has limited value when applied only at specific moments. If, for example, assessment is not performed in an authentic entrepreneurial way, students may not prepare themselves properly. Besides, the entrepreneurial context serves several goals in the process of opportunity identification: as a source of information (Baron & Enslay, 2006; Vaghely & Julien, 2010), of feedback, for the acquisition of tacit knowledge, for finding resources, for role modelling (Bosma, Hessels, Schutjens, Van Praag & Verheul, 2012), for knowledge construction (Wenger, 1998), for experience, support and assessment. Students must be able to work in the authentic learning context at their own pace. Gulikers, Bastiaens and Kirchner (2004) found that for authentic assessment it is of importance that students perceive the context as authentic. It can be assumed that this perception can only be achieved if the authentic learning environment is permanently maintained. To conclude, the authentic learning context should be provided permanently during teaching, and the various context strategies should be provided simultaneously. In fact, students strongly contribute to the creation of the learning environment by their activities. Only for some design strategies for creating an authentic learning environment can logical arguments for a more specific timing be given. For example, reflection will follow upon experiences.

Learning phases

Phases in learning by students also determine the sequence of design strategies. Therefore, the sequence of concept principles can be compared with models of learning phases and instructional functions. Smuling, Brants and Pilot (1990) distinguished four learning phases: orientation, acquiring knowledge, application of knowledge, assessment, feedback and continuation of the learning process. The last step is in fact an iteration of the previous phases. Meijer (2011) defined a sequence of teaching-learning activities in authentic chemistry education: 1) orientation, 2) definition of the task, 3) extension of use of knowledge, 4) reflection on thinking process, and 5) reflection and transfer. This sequence can also be recognised in the sequence of design strategies as presented earlier in this chapter.

In the orientation phase, knowledge is acquired, and linked to the profession; specific problem-solving skills are introduced. Also, experiences, which have to be conceptualised, are offered to students. An analogy can be seen with the steps described for concept strategies above. A phase of practicing can be recognised in our course design, where students experience the use of creativity techniques for identification of opportunities. In the sequence of design strategies, an analogy with Kolb's (1984) learning cycle can be recognised, including the phase to reflect on the experiences.

After practicing, formative as well as summative assessments are incorporated in the course design. This provides feedback to students in order to improve their business opportunities. Smuling et al. (1990) also defined conditional functions that have to be fulfilled before the learning process starts: motivating the students, connecting them to the situation, activating pre-knowledge and clarifying the learning goals. In our course design these activities are provided in the 'introduction lecture' and continued throughout the course.

In the course design emphasis was also given to the acquisition of idea-generation skills. This fits within the 4C/ID model by Merriënboer and Dijkstra (1997), who developed this model for the acquisition of complex competences. Four elements are distinguished in this model; one is the training of routine aspects of complex skills. The skill of idea generation must be developed before application to opportunity identification, and this also determines the sequence of learning activities.

The role and activities of the teacher and of external entrepreneurs result from the students' needs in each course stage. For example, feedback on students' achievements can be provided from teachers, entrepreneurs, peers, markets, clients, providers, etc. It means that several stakeholders can contribute to the learning functions at relevant moments during the course sequence (Renzulli et al., 2004).

GENERALISATION

The two design principles (concept and context) proved feasible and showed an indicative functionality in various settings and with various teachers of science education, and therefore proved to be robust. However, our findings are based on research on a specific sample of science students

in higher education in The Netherlands. Given the importance of stimulation of entrepreneurship education, it is an interesting question if our design strategies have value in other domains, other populations of students, or other cultures.

For purposes of generalization or external validity, similarities between the population of this research and other populations have to be estimated. The distribution of gender in our case studies corresponds with the distribution of gender in other higher education science programmes in The Netherlands. This might be an indication that our findings are relevant for the whole population of science students in higher education for The Netherlands. Furthermore, it would be worthwhile to investigate whether our findings have value for technological studies as well, as these programmes also have a predominantly male population and have many similarities with science programs.

The gender proportions in other domains may be different which might cause some limitations for the generalisation of our findings. Studies on gender effects in entrepreneurship education show that women use different processes of opportunity identification (DeTienne & Chandler, 2007). The work of Gonzalez-Alvarez and Solis-Rodriguez (2011) shows that men discover more business opportunities. Without further elaboration on this difference between genders, differences between men and women can be assumed. These differences could influence the implementation of our design principles in other student populations.

Furthermore, the population of science students can be defined by other characteristics or traits. A science master is primarily focused on learning to think analytically and critically. In addition, a distinction can be made between intuitive and analytical individuals in entrepreneurship education (Kickul, Gundry, Barbosa & Whitcanack, 2009); intuitive people are more likely to discover opportunities, while analytical people have more qualities to evaluate and plan for the new venture. In our studies, the analytical style is assumed to be more frequent (Wolf & Kolb, 1984). Educational programmes in other domains may engage students with other characteristics, motivations and talents, and this may influence the learning of opportunity identification. In future studies the population of science students should be analysed in depth with regard to their specific strengths.

Our research was mainly conducted in The Netherlands and any generalisation of our findings to other cultural contexts should be made carefully. For example, McGrath and MacMillan (1992) demonstrated that entrepreneurs from Anglo-Saxon, Nordic and Chinese cultures differed significantly in their psychological characteristics (e.g., beliefs, values, attitudes). It is also likely that demographics (e.g., education, past experiences, abilities) and cognitions (i.e., content and process) vary among cultural contexts. Hence, enterprising individuals may be affected differently by their cultural context. Shook, Priem and McGee (2003) argue that the cultural context may have an impact on all four 'steps' of the venture creation process (i.e., entrepreneurial intent, opportunity search and discovery, the decision to exploit a new venture creation, and opportunity exploitation activities). Thus, cross-cultural research shows that strategies gained mainly from Dutch or European samples may not be generalised to entrepreneurship education in other cultures.

The arguments above indicate, that the content and context design principles from this research

can be generalised to broader learning contexts in the science domain in the Netherlands and probably to other Anglo-Saxian cultures, but serious caution must be used in any generalisation to other domains, student populations and cultures.

LIMITATIONS

The feasibility of design strategies was investigated, as was the degree of functionality of strategies under various circumstances, in different contexts and with various teachers, meaning that robustness of these strategies was shown. Most teachers, in case studies as well as in interviews, applied the previously identified strategies, and this is an indication that our design strategies can be applied in a broad range of science and technical studies. However, it must be emphasized that rival explanations for the expected outcomes (opportunity identification by students) cannot be excluded, and so a causal relation between strategies and students competence on opportunity identification cannot be claimed from this research, because only post-tests were performed. This argues for further experimental research, as will be addressed in the next section.

This research aimed at finding a variety of design strategies, because this is the first and necessary stage in the process to support the design of functional entrepreneurship education.

Some caution must be used for two additional strategies that were discovered later during this research. The additional strategies of 'how to select students' and 'incubation time' were mentioned by two expert teachers in interviews, and later these strategies were also investigated in a single case study. Although these strategies were reported to be feasible and effective by expert teachers, this could be too limited a sample. Among the sub-strategies, there are other examples that were used by only one or a few teachers. Of course, the strategies may help teachers considering a variety of strategies to know the possibilities, but caution must be used in generalising the additional strategies and sub-strategies to other contexts with regard to their feasibility and effectiveness.

In Chapter 4 the interviewees' examples could only be presented as demonstration of their perceived effectiveness. Two remarks about this approach need to be made. First, the conclusions about the effectiveness of the strategies are fully based on the opinions of the interviewees, and no additional methods were used to determine effectiveness. Therefore, the proof of effectiveness in terms of learning to identify opportunities, and students' perception of it, must be incorporated in forthcoming research on the design strategies. Second, when teachers did report effectiveness, it should be realised that their conclusions are bound to the specific learning context of their case.

In two of our studies students' perception of the course, as well as their competence in opportunity identification, were measured. The perceptions of students on their competence to identify opportunities were measured by means of a questionnaire, with scales derived from theories on creativity and opportunity identification. The scales proved to be reliable (Cronbach's Alpha), but it can be seen as a limitation that the issues and items have not been validated with entrepreneurs. Moreover, a questionnaire that measures perception of self-competences relies on self-assessment and is therefore a weak instrument. Although the questionnaires proved reliable

(see Chapters 3 and 5), significant differences between pre- and post-measurements were not found. The lack of significant differences is probably due to the small numbers of participants in the courses. Therefore, more participants or other quantitative measures have to be used to measure these variables more accurately. In order to determine a causal relation between the design strategies and the fostering of students' competence to identify opportunities, effect studies must be performed in a wider context and with larger numbers of participants. This will be elaborated in the next section.

SUGGESTIONS FOR FUTURE RESEARCH

This study has resulted in design principles for teaching opportunity identification and for the creation of an entrepreneurial learning context. The design principles can be considered as a local instruction theory on teaching and learning the competence in opportunity identification (Gravemeijer & Cobb, 2006). The development of design principles as a phase in research can be continued by effect studies (Nieveen et al., 2006) with emphasis on up scaling to a wider context and testing design principles in a wider domain. Because our design principles have been developed and evaluated for the science domain in higher education, future research in other domains and at other levels of education seems logical.

A causal relation was not investigated in this study. Thus, a challenging task for further research is the evaluation of the design principles in learning environments with various degrees of authentic learning, in (semi-) experiential settings and with greater numbers of students, in order to determine the effects of combinations of strategies. Effects studies can be executed from small-scale (semi-) comparative studies to large-scale field experiments and with a shifting focus from exploration to confirmation.

Logically, the next step would be an effectiveness study in an experimental design, but this might raise practical problems. In comparing a control group and experimental group, data of a sufficient number of participants have to be collected and analysed in order to determine a significant difference. As entrepreneurship education mostly works with small groups, this means that data have to be gathered from various courses and thereby variations will be introduced in teaching methods, degree of realization of strategies, different learning contexts, teachers, assessors, etc.

Also a pre- and post-test approach will raise practical problems. By doing a pre-test on opportunity identification, this competence will be influenced and heightened at the beginning of the course, and a significant difference may be more difficult to achieve. Also, in a pre- and post-test approach sufficient numbers of participants have to be available.

A course design based on the reported strategies is complex, and this raises difficulties in experimental design studies, but on the other side this complexity complies with the reality of natural educational settings and for that reason cases should be studied as a whole.

Therefore in this research, a more qualitative approach was chosen in order to attain a rich

description of strategies and forms of realization that can assist educational designers in the development of entrepreneurship education.

In our studies the functionality of design principles were determined by assessing the business ideas and business plans of students by external experts. These opportunities had been identified and evaluated by students for business potential, but were not (yet) exploited in the real market. The real value of opportunities can only be determined over longer periods in the market. In general, the effects of starting a business are measured after a five-year period (Falkäng & Alberti, 2000; Hytti & Kuopusjärvi, 2004). This implies longitudinal investigations on alumni that have chosen a career as an entrepreneur. It must me kept in mind that opportunity identification is a creative process and the results are unique to the moment of creation (Christiaans, 1992), and moreover opportunities undergo continuous adaptations (Sarasvathy, 2001, 2008) what makes them even more difficult to assess. What is innovative now will not be innovative tomorrow, and therefore learning outcomes are time dependent and relative, which makes it very difficult to assess opportunities and to monitor the quality of appraisals. In this research external entrepreneurs and investors were involved as assessors, as they know best what is innovative in a specific market and at a specific moment. But it must be stressed that the assessors' intuition does not provide solid evidence for the real value of business opportunities that can only be determined after exploitation in real markets, and therefore a more longitudinal study of the effects in the market is relevant.

Also, it is worth investigating how many students that have the intention to become entrepreneurs actually choose a career as an entrepreneur, and how their career and competence in opportunity identification develops. The path from student to professional entrepreneur is complex, has many alternative routes (Gibb Dyer, 1994), and many factors are involved in persisting in this career. Therefore, it will be difficult to show the relation between entrepreneurship education and the success of entrepreneurs over time, but interviews with (post) graduates might give an insight.

Another area of interest is feedback and its effect on learning and becoming entrepreneurial. As feedback is one of the most powerful elements of an effective learning environment (Hattie & Timperley, 2007), it is worth investigating what types of feedback teachers, peers and external entrepreneurs use, and what other agents provide feedback (market, clients, etc.). Intuition appeared to play a major role in the assessment of opportunities and in many other entrepreneurial activities. Assessors in education use intuition in the assessment of business plans (Chapters 4 and 5). In particular, an analysis of the intuitive feedback from entrepreneurs can give a better understanding of opportunities, and help in understanding and teaching opportunity identification.

Lastly, the stimulation of reflection by students in entrepreneurship courses deserves more research. Students can learn from reflection on their experiences (Cope, 2003; Kolb, 1984), but entrepreneurship courses are generally characterised by a high degree of dynamics and pressures, similar to entrepreneurship, and provide little time for reflection. Therefore, it is a challenge to foster students' reflection in an authentic manner in entrepreneurship education, in such a way that students see it as natural in becoming an entrepreneur, and as adding to their understanding.

Exploratory research on this topic is necessary, and its results could possibly have impact on the learning of entrepreneurs in the future.

LOOKING FORWARD: IMPLICATIONS FOR ENTREPRENEURSHIP EDUCATION

Awareness and intentions for entrepreneurship should be developed at a young age at primary and secondary school, and this stimulation should be continued in higher education (Joensuu, Viljamaa, Varamäki & Tornikoski, 2013), in order to give students a perspective on an entrepreneurial career. For this reason, many educational institutions are providing courses and programmes that aim at stimulating students to become entrepreneur or to become entrepreneurial. For example, at Utrecht University, where this research was conducted, the University Board has set a target for 2016 that 5% of students must take one or more entrepreneurship courses during their study career (Universiteit Utrecht, 2012), and this intention has implications for university programs.

As described in Chapter 1, three dominant approaches in entrepreneurship education can be discerned, each with different views on learning outcomes, pedagogy and the role of the teacher (Fayolle & Gailly, 2008):

- Making students more entrepreneurial. This type of education typically has a focus on values, beliefs and attitudes associated with entrepreneurship. This conception of EE also has strong connections with modern views of work, employment and learning.
- Stimulating students to create new firms. These activities typically lead to a business plan, and start-up activities.
- Learning about entrepreneurship, where the focus is on conceptual and theoretical understanding of entrepreneurship.

These three approaches to EE are not mutually exclusive but can be seen as a natural progression in entrepreneurship teaching (Blenker et al., 2011).

The identification of opportunities is a core competence for entrepreneurs, and should therefore have central place in all entrepreneurship education. The design strategies from this study offer guidelines to develop new entrepreneurship programmes in the science domain. Strategies for teaching students to identify opportunities can contribute at education for stimulating students to start a new firm, or making students more entrepreneurial. Also an authentic entrepreneurial learning environment can best be applied in education that aims at the stimulation of start-ups as well as at making students more entrepreneurial.

It must be stressed that the selected approach, and corresponding pedagogy, learning environment and contents will influence the competences that students will acquire, and the competences that teachers must possess. And it will also influence the effects of these programmes on society, personal fulfilment, jobs and economics. It implies that higher education institutions and students should make a choice with respect to their intention in entrepreneurship education. In the last decades the focus in higher education has predominantly been on stimulating students

to start new firms, with the business plan as the central activity in education (Gibb, 2005). But more recently the trend is to make students more entrepreneurial, which is a necessary competence in a changing world with more project work and limited access to life-long jobs. It can be argued that every academic should value the ability to identify new opportunities and to develop an entrepreneurial competence profile, in order to generate life-long income. For this reason, educational institutions should emphasize this competence in curricula for reasons of employability of students. Entrepreneurial skills have value for everybody, while the specific competences for firm start-up or for scholarship in entrepreneurship suit a smaller group.

Opportunity identification is a form of creativity and measures to stimulate creativity were used in opportunity identification in relation to authentic tasks and activities. Our strategies to apply idea generation techniques in an authentic learning environment might be useful in other domains.

Opportunity identification is a complex competence and for full development of this competence, students need more than one occasion. Therefore, this competence should be integrated in curricula, and scaffolds for development should be brought in.

In this research, the importance of the context for learning was emphasized, and this has consequences for university programs that stimulate entrepreneurship, not only inside the classroom but also outside the classroom. A climate must be created and shown that stimulates entrepreneurship and that motivates students to join an entrepreneurial career.

Moreover, universities should research their experiences in entrepreneurship education and assess the impact of entrepreneurship education on individuals, communities, society and the economy. Educational research can provide teachers with evidence-informed design rules for the development of entrepreneurial and entrepreneurship programmes.

Considering this growing demand of entrepreneurship courses in higher education during the last decade, a need exists for entrepreneurship teachers (Brush et al., 2003) new as well experienced teachers for professional development programs. They need to have pedagogical knowledge and competences for entrepreneurship education, and on the main subjects and practice of entrepreneurship (Brush et al., 2003). The professionalisation of entrepreneurship teachers in higher education is therefore an important topic: should teachers preferably be experienced entrepreneurs, or should they be teachers with an academic or other qualification?

Many entrepreneurship teachers in higher education have an academic background in business studies, and they can originate from other domains, especially when entrepreneurship programmes are part of non-business programmes such as science. Therefore, specific professional development programmes for entrepreneurship teachers should be offered, as the contents and pedagogy for EE are not available in existing professional development programmes. A substantial component of such a programme should be the underlying theory and applied skills for facilitating the creation and support of entrepreneurship education. Here, pedagogy on entrepreneurial cases and entrepreneurial experiential exercises, developing courses and curricula, performing service activities and advising on student activities should be provided.

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Summary

INTRODUCTION

This thesis describes a research project on teaching science students to identify entrepreneurial opportunities. The Introduction chapter presents an exploration of the topic. Entrepreneurship brings economic growth, innovation, and creates new jobs, and for that reason international and national governments take measures to stimulate entrepreneurship. One of these measures intends to encourage entrepreneurship among students at all levels of education. Educational institutions that plan to develop and to offer new entrepreneurship programs thus need design rules for the development of such education.

The identification of entrepreneurial opportunities is a core competence for entrepreneurs and should therefore be emphasized in education—and more explicitly than has hitherto been the case. Much research has been published on the identification of opportunities by entrepreneurs, however relatively little is known about teaching students to do so. Therefore, this thesis focuses on finding design strategies for teaching students to identify entrepreneurial opportunities.

In this thesis, we use the following definition for the identification of entrepreneurial opportunities: opportunity identification is the creation or discovery of something new that has value to customers and for society and that yields profit for the entrepreneur. There are three theories that explain the identification of opportunities (see chapter 1) and they can be used for the design of education. The three theories are not mutually exclusive, and all have value for educational design.

Domain knowledge and market knowledge as a source of ideas have an important role in theories on opportunity identification. Because students generally have limited market knowledge, but do have domain knowledge, it seems logical to use domain knowledge for opportunity identification. This study was conducted among science students and at teachers who provide entrepreneurship education for science students, because the science domain provides many entrepreneurial opportunities. Learning theories can be connected with the theories on entrepreneurial opportunities, and corresponding instructional theories can be used implicitly or explicitly in the development of entrepreneurship education. In literature, opportunity identification is considered as a form of creativity in the domain of entrepreneurship. This means that theories and instructional models to stimulate creativity can be used when teaching opportunity identification.

The research methods in this research are case studies and educational design research, and these methods contribute to a two-fold yield; it provides a practical solution of an educational demand or problem and contributes to a better understanding and theory of education—in this case, education in opportunity identification.

The results of educational design research are expressed as design principles. A complete design principle includes four elements: a description of the context, a strategy (educational activity), an underlying argumentation or mechanism, and an expected outcome. In this summary, shorter descriptions are presented. If an expected outcome (i.e. opportunity identification) is achieved, the strategy (or combination of strategies) is considered to be functional, or in other words: the strategy does what was expected, without claiming a causal relation.

Design strategies are developed from theory and from practical experience and are then synthesized into a course design. Subsequently, the course design is implemented and an extensive evaluation is performed as to whether the design strategies are implemented as intended and whether the expected outcome is realized. In subsequent cycles of design research, the strategies are refined. If (the combination of) strategies appear to be feasible and functional in various situations, the design is considered to be robust.

This research project has the following research question:

What are design principles for an education that aims at fostering the competence of science students in identifying business opportunities?

Sub-questions that contribute to the main question will be elaborated in the following chapters. A compact overview of the entire research agenda of this thesis is given in the table at the beginning of each chapter (see Table 1.1).

CHAPTER 2: AUTHENTIC COMPETENCE-BASED LEARNING IN UNIVERSITY EDUCATION IN ENTREPRENEURSHIP

Chapter 2 is an exploratory case study on design strategies of successful education in entrepreneurship. These design strategies can assist teachers and developers who want to develop such education. For this purpose, we studied the conceptual design of an entrepreneurship course that has proven to be successful in generating new start-ups. This course that was studied is intended for university informatics students, in order to inform them about entrepreneurship as a professional option and to teach them the competences associated with entrepreneurship knowledge.

In learning of entrepreneurs, the professional context is important. The entrepreneurial learning context is characterized by high degrees of complexity, time pressure, deadlines, uncertainty, a variety of roles, contradictions and problems that are complex, open, unstructured, and poorly defined. The entrepreneur learns in the context in which he or she is operating. For this reason, the environment of a start-up was simulated in the course and elements of entrepreneurship that are relevant for learning are built in. In other words, the course aims to mimic an authentic entrepreneurial environment.

Six design strategies for the creation of an authentic learning environment were drafted from previous studies, and subsequently these were evaluated in this case study. The first design strategy concerns the working atmosphere as in a start-up, which is characterized by high degrees

of autonomy and problem ownership, social climate with strict deadlines, and a low level of organization that requires a lot of improvisation.

A second design strategy states that students should be given the role of problem solver. By this, students learn to solve entrepreneurship problems and get motivated to work on their products and start-up. Students appreciated that they are called upon to make their own decisions.
The third design strategy concerns the kind of tasks and activities on which students work. Students indicated that they have learned most from thinking about the core elements of the product that they want to bring on the market, the development of the software product, and the writing and presentation of their business plan. They felt less stimulated by their activities for a virtual holding of start-ups, when these activities do not contribute directly to the start-up.

A fourth design strategy shows what role the teacher should take in this type of education. The teacher should primarily act as a coach who is in contact constantly, gives feedback and asks questions, but should not be the disseminator of knowledge. The teacher was not perceived as a good entrepreneurial role model, but entrepreneurs as guests in the course were. Only, real entrepreneurs can deliver role modelling.

The fifth design strategy concerns the facilities and infrastructure that are provided to students. The physical environment should simulate the working conditions of entrepreneurship, and various tools and resources for IT entrepreneurship should be available. This strategy could not be evaluated because it was not completely implemented.

The method of authentic assessment is described in the sixth design strategy. During the course, students work on a prototype of a software product and a business plan that has to be presented to a panel of entrepreneurs, financiers, and investors. The panel used assessment criteria as applied in the market: feasibility, potential, market demand, resources, innovation, etc. Students perceived this as an effective method of assessment and strongly appreciated the feedback from the panel.

Five of the strategies were confirmed in the evaluation study, and the strategy on facilities and infrastructure was not evaluated. From the findings in this study three additional strategies were recommended: on collaboration between start-ups, on role modelling by entrepreneurs, and on giving students meaningful multiple roles.

Students reported that they were not strongly involved in other start-ups, and it can be assumed that students can learn from discussing and articulating their business plans.
As the teachers are not perceived as good entrepreneurial role models, entrepreneurs should be involved in education in order to provide good role modelling.

Bringing students in multiple roles will stimulate students to develop different perspectives on a topic from different points of view, which will contribute to a deeper understanding, but therefore it is conditional that students perceive all roles to be authentic and meaningful.

CHAPTER 3: FOSTERING THE COMPETENCE OF SCIENCE STUDENTS IN IDENTIFYING BUSINESS OPPORTUNITIES: A DESIGN RESEARCH APPROACH.

Chapter 3 describes a design study for education in identifying entrepreneurial opportunities. Identifying business or entrepreneurial opportunities is widely regarded as one of the core competences of an entrepreneur and therefore this competence deserves specific emphasis in entrepreneurial education. This study begins with the derivation of design strategies on the basis of theories from the domains of entrepreneurship and educational science. The three main theories about identifying business opportunities (see chapter 1) are explored and clues were sought for the development of design strategies for education. These conceptual design strategies are then further substantiated by educational and instructional theories, and combined with the practical experience of the developers of this new course.
Three design strategies are presented:

1 The first design strategy outlines how idea-generating techniques (creativity techniques) can contribute to the identification of entrepreneurial opportunities. Large similarities exist between creativity and identifying opportunities and therefore creativity techniques can be applied to create entrepreneurial opportunities from the scientific knowledge of students.
2 The second design strategy concerns the conceptualization of entrepreneurial opportunities by students. Students should learn the underlying concepts and aspects of entrepreneurial opportunities to enhance the development of new opportunities and the judgement of opportunities.
3 A third strategy aims at encouraging students to apply the concepts in authentic entrepreneurial tasks or, in other words, a transfer must be made from the learning situation to new professional situations. Students should be able to apply existing concepts, thereby anchoring and expanding the concepts they know.

Based on these three design strategies and other system requirements, a course design was created in a co-design of the course coordinator and the researcher. Prior to this study, several cycles of prototyping the course design were carried out.

The course design was then implemented and evaluated. First, the degree of implementation was determined, because if strategies are not implemented as intended, it is not possible to verify whether the design strategies provide what is expected. Various instruments are used for this part of the research: interviews, observations, notes, and questionnaires. In addition, the functionality of the course with regard to opportunity identification was established with an instrument that determines the degree of innovation and market potential of the ideas, that were developed by the students.

The first design strategy for the use of idea-generating techniques was largely realized in

practice, but a few students, who opted for a consultancy assignment instead of writing a business plan, did not feel encouraged by their assignment to use creativity techniques.
The second design strategy on conceptualizing entrepreneurial opportunities is fully implemented as intended. Students were able to judge and rank the entrepreneurial opportunities of others on the basis of underlying concepts. Concepts of entrepreneurial opportunities were also spontaneously used in other assignments and course meetings.

The third draft strategy on the transfer of acquired concepts in new authentic situations was partly achieved as intended. Students were successful in identifying five entrepreneurial ideas within the scientific domain. In a second task, groups of students were able to develop two entrepreneurial opportunities on the basis of their own knowledge and skills. However, interviews showed that not all students have applied the criteria and concepts learned in the classroom. Students felt especially encouraged by the entrepreneurs who came as a guest speaker.

The conclusion of this study is that the design strategies for teaching opportunity identification are largely realized as intended and that in combination they provided an indication to be functional: after the course, students proved to be able to conceptualize and judge opportunities of others, and based on their artefacts are able to identify opportunities grounded in concepts and their domain knowledge and skills. In the literature, few studies describe teaching strategies as a coherent educational design, and therefore this study complements existing theories.

CHAPTER 4: STRATEGIES OF EXPERT TEACHERS FOR TEACHING IDENTIFICATION OF BUSINESS OPPORTUNITIES

Chapter 4 presents an evaluation study of three previously described design strategies for teaching opportunity identification (Chapter 3) in various contexts. By means of interviews, we examined whether expert teachers apply the three design strategies in their teaching, how they implement these strategies (or which sub strategies they use), and whether additional strategies were used for the same learning objective.

For this study, nine teachers in higher education were selected based on their experience in entrepreneurship education to science students in higher education. Semi-structured interviews were held with the teachers. The previously determined design strategies were used as a framework in the interviews and we studied to what extent the strategies were applied, and what is the perceived feasibility and effectiveness of these strategies. Next, it was further elaborated on whether additional design strategies were used. All interviews were recorded and coded and the reliability of coding was assessed by a second assessor and proved adequate.

The three design strategies previously found that (1) the use idea generating techniques, (2) conceptualization of entrepreneurial opportunities and (3) the transfer of concepts derived from practice, were frequently used by the teachers interviewed. Various sub-strategies were reported for each strategy. According to the opinion of the interviewees, these strategies and sub-strategies were perceived as feasible and effective.

Next, the teachers reported three additional design strategies:

4 Challenge students to abandon routine problem-solving thinking patterns and to discover new solutions in identifying entrepreneurial opportunities. Routine problem solving uses standard procedures and existing knowledge. When students are faced with conditions of uncertainty and ambiguity, they notice that existing patterns fall short and they will look for new potential solutions and opportunities.
5 Give students an incubation period for identifying an entrepreneurial opportunity. Creativity processes often have a stage of incubation in which a person is not actively engaged with the problem but on a subconscious level, thinking nevertheless proceeds and contributes to the maturation of the idea. Because identifying an entrepreneurial opportunity is a creative process, an incubation period can enhance the process of creation and learning.
6 Admit students into the program based on the quality of an entrepreneurial opportunity that they have to think of in advance. If students are previously activated to identify business opportunities, this stimulates their knowledge and clarifies what still needs to be learned. During a period of preparation, students can receive feedback from teachers, fellow students, or persons from their environment, thereby improving their opportunity. At the start of the course, students present their opportunity and may or may not be allowed to participate depending on the potential of their opportunity. Sometimes intuitive factors also play a role in assessment.

For these three complementary design strategies, different sub-strategies have also been reported—albeit at a lower frequency than the previously found and confirmed strategies. But because these (sub) strategies were used and reported to be effective in one or more cases, they provide new possibilities for the development of entrepreneurship education.

The design strategies plus sub-strategies, together with the additional design strategies, offer new instruments for developers and teachers.

CHAPTER 5: AN AUTHENTIC LEARNING ENVIRONMENT IN FOSTERING INFORMATICS STUDENTS' COMPETENCE TO IDENTIFY OPPORTUNITIES

After investigating the characteristics of an authentic learning environment for entrepreneurship education (Chapter 2) and strategies that are effective to teach opportunity identification at students (Chapters 3 and 4), the following question arises: what happens if the previously found strategies are combined into one course design?

The research question of this study is therefore: To what extent can design strategies for authentic learning and for fostering students' competence in opportunity identification be applied coherently in a course design and how can they be applied? Are the strategies realized as intended, and do students' products show that they are able to identify opportunities after a course that

complies with these strategies?

Because the professional environment plays an important role as a source of information in the process of opportunity identification by entrepreneurs, it can be expected that an authentic learning environment in education will contribute to the development of this competence of students. In this study, the previously reported strategies for authentic learning (Chapter 2) were supplemented with authentic learning strategies as have been reported in the literature. This resulted in a set of nine strategies upon which this course was based.

This study was conducted in three steps. First, it was analysed whether a course can be designed that includes (most) design strategies. From course documents, interviews and observations it was concluded that all strategies appeared to be included in the course. The course documents showed that the course was successful and feasible over a period of years. It can be concluded that it is possible to design a course in which all design strategies are included.

Second, we investigated the extent to which the different design strategies were realized as intended. To this end, observations, recordings, and analysis of relevant education sessions were made, and students and teachers were interviewed. In addition, we used two questionnaires: first, to measure how students perceive their educational environment and secondly to determine how students perceive their competence in opportunity identification.

Four out of six design strategies for recognizing entrepreneurial opportunities appeared to be fully realized and two were partially realized. Seven out of nine design strategies for an authentic learning environment were fully realized, and two that were partially fulfilled. It can thus be concluded that the course has largely been realized as intended and that the entire set of design strategies is substantially realized in the course under investigation.

Third, we determined the degree of functionality of the course. Students were assessed at the end of the course and, to this end groups of students had prepared a business plan and a prototype of the software or service they wanted to bring to the market. Both products had to be presented to a forum of entrepreneurs, investors, and an IT journalist. These external assessors used an evaluation form with criteria that are applied in entrepreneurship. This form for scoring entrepreneurial opportunities was developed together with the assessors. The scores of the evaluators were used to determine the effectiveness of education or, in other words, whether the students learned to identify entrepreneurial opportunities. All groups of students were able to identify an entrepreneurial opportunity and to further develop it into a business plan. Students also discovered concepts of opportunities during their learning activities and they applied these concepts in new tasks for the start-up. In answering the research question in this study, it can be concluded that an authentic learning environment in which relevant characteristics of the entrepreneurship practice for learning are included, can be realized as intended. After a course based on these strategies, students' are able to identify entrepreneurial opportunities, as can be concluded from the artefacts they produce.

CHAPTER 6: CONCLUSIONS AND DISCUSSION

This chapter presents the conclusions of this thesis with respect to the central research question. In previous studies we described several design strategies for the creation of an authentic leaning environment, and for the fostering of students' competence to identify opportunities. As explained in the Introduction, strategies that contribute to the same purpose can be assembled into one design principle.

The research results in two design principles for the development of education in the identification of entrepreneurial opportunities. Each design principle includes a number of strategies and sub-strategies.

The first design principle is related to the content, teaching students to identify entrepreneurial opportunities. This design principle includes six strategies:

1) Stimulate the use of idea-generating techniques
2) Stimulate the conceptualization and evaluation of entrepreneurial opportunities
3) Stimulate the transfer of concepts by means of learning through authentic tasks
4) Challenge students to find new ways of problem solving

These strategies were found to be robust under various conditions. Next, two additional strategies were described by some expert teachers:

5) Provide students with an incubation period for the identification of entrepreneurial opportunities
6) Admit students based on the quality of their proposed entrepreneurial opportunity.

For strategies 5 and 6 robustness cannot be claimed from two cases, however strategies 5 and 6 still might give directions for development of entrepreneurship education.

Because most of these strategies stimulate the conceptualizing of entrepreneurial opportunities, this design principle will be considered as the **conceptua**l principle.

Two of the six strategies in this research are described in the literature and this research are in line these earlier findings. The reported strategies also comply with theories on creativity, entrepreneurship, entrepreneurship education, and educational science.

The second design principle provides guidelines for the design of an entrepreneurial learning environment that supports the teaching of opportunity identification. It is assumed that a learning environment that includes essential attributes of entrepreneurship will contribute to students' learning to identify entrepreneurial opportunities. Because the second design principle describes the creation of an authentic learning environment with essential characteristics of entrepreneurship, we call this the **contextual** design principle. The contextual design principle includes nine strategies:

1) Provide authentic learning environment where information is used as in entrepreneurship
2) Give students tasks and activities that have relevance in the real world. These tasks have to provide the opportunity to organize work and must provoke students' need to gain knowledge.

3) Provide access to expert performances and modelling.
4) Ensure that students' elaborate tasks and problems from different perspectives
5) Support the collaborative development of knowledge by students
6) Stimulate reflection in order to develop concepts
7) Promote the articulation of experiences in order to make knowledge explicit
8) Let the teacher coach the student and provide support at critical moments
9) Assess students in an authentic manner, i.e. by entrepreneurs and with criteria as applied in entrepreneurship.

The design strategies and sub-strategies described are specific for entrepreneurship education, and have not been described previously. Although other researchers also called for the integration of authentic elements in education, this is the first empirical research within the field of entrepreneurship education on the use of an authentic learning environment. The findings of this thesis are consistent with existing theories and models of authentic learning.

It can be concluded, first, that this research contributes to the solution of an existing problem in entrepreneurship education with the description of two design principles. Second, this research contributes to a further understanding of teaching and learning in the field of entrepreneurship education. After an overview of these conclusions, the sequence of strategies is discussed. As strategies built on other strategies a logical order can be derived.

The discussion section glances back at the research, retrospectively examining the appropriateness of the methods used and the quality of the design principles tested against criteria from the literature. In this thesis, research design was combined with a number of case studies, and this approach proved successful in the development of robust design principles. Then the generalization of the design principles to other areas of education or to other cultures is discussed. Thereafter, the limitations in this study are remarked upon and suggestions for future research are provided. The discussion ends with recommendations for entrepreneurship education in higher education. Entrepreneurial competences are relevant for all educational institutions that aim at the employability of their students.

Samenvatting Nederlands

INTRODUCTIE

Dit proefschrift beschrijft een onderzoek naar onderwijs dat tot doel heeft bèta-studenten te leren ondernemerskansen te herkennen. Het eerste hoofdstuk beschrijft een verkenning van het onderwerp.

Ondernemerschap brengt economische groei, innovaties en creëert nieuwe banen, en daarom nemen internationale en nationale regeringen maatregelen om ondernemerschap te stimuleren. Eén van deze maatregelen beoogt het stimuleren van ondernemerschap bij studenten en leerlingen op alle onderwijsniveaus. Onderwijsinstellingen hebben daarom behoefte om nieuwe programma's in ondernemerschapsonderwijs te ontwikkelen en aan te bieden, en daarmee bestaat er ook behoefte aan ontwerpregels voor het opzetten van dergelijk onderwijs.

Het herkennen van ondernemerskansen is een van de kerncompetenties van ondernemers, en moet daarom aandacht krijgen in het onderwijs, en wel meer expliciet dan tot nog toe het geval is. Nu is er veel onderzoek bekend over het identificeren van ondernemerskansen door ondernemers, maar er is relatief weinig gepubliceerd over hoe studenten kunnen leren ondernemerskansen te ontdekken. Daarom richt dit proefschrift zich op het vinden van ontwerpstrategieën voor onderwijs dat tot doel heeft studenten te onderwijzen ondernemerskansen te herkennen.

In dit proefschrift hanteren we de volgende definitie voor het herkennen van ondernemerskansen: de identificatie van een ondernemerskans is de creatie of ontdekking van iets nieuws dat waarde heeft voor klanten of voor de maatschappij, en dat winst opbrengt voor de ondernemer. Er bestaan drie theorieën die het herkennen van ondernemerskansen verklaren (zie Hoofdstuk 1) en zij hebben alle hun waarde bij het ontwikkelen van onderwijs. In genoemde theorieën speelt kennis van vakgebied en van markten een belangrijke rol. Omdat in onderwijs studenten over het algemeen weinig kennis van markten hebben en wel van het domein, is het logisch om hun domeinkennis te gebruiken om kansen te leren ontwikkelen. Dit onderzoek is uitgevoerd bij bèta-studenten, omdat het bèta-domein veel mogelijkheden voor ondernemerskansen biedt.

Belangrijke leer theorieën bieden voldoende aansluiting bij de drie theorieën over ondernemerskansen, en bijbehorende instructietheorieën kunnen impliciet of expliciet worden toegepast bij de ontwikkeling van onderwijs in ondernemerschap.

Het ontdekken van ondernemerskansen wordt in de literatuur gezien als een vorm van creativiteit in het domein van ondernemerschap. Dat betekent dat ook theorieën en instructiemodellen om creativiteit te stimuleren ook kunnen worden ingezet in het onderwijs voor het ontdekken van ondernemerskansen.

De belangrijkste onderzoeksmethoden in dit onderzoek zijn case studies en onderwijskundig ontwerponderzoek. De gekozen aanpak leidt tot twee soorten opbrengsten: enerzijds een praktische oplossing van een onderwijskundig probleem of vraag, en anderzijds een bijdrage aan inzicht en theorie, in dit geval over onderwijs in het herkennen van ondernemerskansen. De resultaten van ontwerponderzoek worden uitgedrukt in ontwerpstrategieën. Een volledig ontwerpprincipe bevat de volgende vier elementen: een beschrijving van de context, een strategie (onderwijsactiviteit), een onderliggende verklaring of mechanisme, en een te verwachten uitkomst. In deze samenvatting worden kortere beschrijvingen gegeven. Als de verwachte uitkomst (bijv. het herkennen van ondernemerskansen) wordt gerealiseerd, dan wordt de (combinatie van) strategie(en) beschouwd als functioneel, of in andere woorden: de strategie levert op wat wordt verwacht op basis van de ingebouwde mechanismen, zonder dat er echter een causale relatie wordt geclaimd.

Ontwerpstrategieën worden ontwikkeld vanuit de theorie en vanuit praktische ervaring, en worden vervolgens samengebracht in een cursus ontwerp. Vervolgens wordt de cursus uitgevoerd en er wordt geëvalueerd of de ontwerpregels zijn uitgevoerd zoals bedoeld en of ze een indicatie voor functionaliteit opleveren. In opeenvolgende onderzoeks- en ontwerpcycli worden ontwerpstrategieën telkens bijgesteld, totdat er de ontwerpstrategieën in meerdere situaties uitvoerbaar en functioneel blijken te zijn, en daarmee robuust zijn, of wel de strategieën zijn functioneel onder verschillende omstandigheden.

Dit onderzoek heeft de volgende onderzoeksvraag:

Wat zijn ontwerpprincipes voor onderwijs dat tot doel heeft de competentie van bètastudenten in het ontdekken van ondernemerskansen te bevorderen?

Sub vragen die bijdragen aan de hoofdvraag, komen in de verschillende hoofdstukken aan de orde. Een compact overzicht van het gehele onderzoek van dit proefschrift wordt gegeven in de tabel die aan het begin van elk hoofdstuk is afgedrukt.

HOOFDSTUK 2: AUTHENTIEK LEREN IN ONDERNEMERSCHAPS-ONDERWIJS VOOR BÈTASTUDENTN IN HET HOGER ONDERWIJS

Hoofdstuk 2 is een casestudie waarin exploratief onderzoek werd gedaan naar ontwerpstrategieën van succesvol onderwijs in ondernemerschap. Deze kenmerken worden vervolgens beschreven als ontwerpprincipes voor docenten en onderwijsontwikkelaars die vergelijkbaar onderwijs willen ontwikkelen. Daartoe werd het conceptuele ontwerp bestudeerd van een cursus in ondernemerschap die heeft bewezen succesvol te zijn in het genereren van nieuwe start-ups. Deze cursus is bedoeld voor universitaire studenten informatiekunde, om kennis te maken met ondernemerschap als beroepsoptie en voor het aanleren van competenties die horen bij ondernemerschap.

Voor het leren van ondernemers, is de professionele context van belang. Deze context wordt gekenmerkt door complexiteit, tijdsdruk, deadlines, onzekerheid, een verscheidenheid aan rollen, tegenstrijdigheden en problemen die complex, open, ongestructureerd en slecht gedefinieerd zijn.

De ondernemer moet met deze context kunnen omgaan. Deze omgeving is tevens van belang voor het leren, en daarom wordt in deze cursus de omgeving van een startende onderneming gesimuleerd, waarbij die elementen van ondernemerschap die relevant zijn voor leren in het onderwijs worden ingebouwd. Met andere woorden: in de bestudeerde cursus wordt getracht een authentieke, ondernemersomgeving in onderwijs na te bootsen.

Er werden zes ontwerpstrategieën voor het creëren van een authentieke leeromgeving in ondernemerschapsonderwijs afgeleid uit eerder onderzoek.

De eerste ontwerpstrategie betreft de werkatmosfeer als in een startend bedrijf, die wordt gekenmerkt door een grote mate van autonomie en probleem eigenaarschap, sociale activiteiten zoals in een bedrijf, harde deadlines, en een lage organisatiegraad die veel improvisatie vraagt.
Een tweede ontwerpstrategie geeft aan dat studenten in de rol van probleemoplosser moeten worden gebracht. Studenten leren zo zelf ondernemersproblemen op te lossen, en raken gemotiveerd voor het werk aan hun eigen product en bedrijf, en waarderen het dat zij daarover eigen beslissingen kunnen nemen.

De derde ontwerpstrategie betreft het soort problemen en activiteiten waaraan studenten werken. Studenten gaven aan dat ze het meest hebben geleerd van het nadenken over de kernelementen van het product dat zij op de markt willen brengen, van het ontwikkelen van het software product, en van het schrijven en presenteren van hun business plan.

Een vierde ontwerpstrategie geeft aan welke rol de docent moet aannemen in dit onderwijs. De docent moet zich vooral opstellen als coach, die voortdurend contact houdt, feedback geeft en vragen stelt, en minder als de verspreider van kennis. Docenten werden door de studenten niet als goede rolmodellen voor ondernemerschap beschouwd, maar ondernemers die optraden als gastsprekers in de cursus, wel.

De vijfde ontwerpstrategie betreft de faciliteiten en infrastructuur die studenten wordt geboden. De fysieke werkomgeving moet de werkomstandigheden in ondernemerschap nabootsen: bijv. een eigen werkruimte waar studenten kunnen werken wanneer zij willen, en waar voldoende ICT infrastructuur aanwezig is. Ook moeten verschillende tools en bronnen zoals een ICT ondernemer die heeft, beschikbaar zijn.

De wijze van authentieke toetsing wordt beschreven in de zesde ontwerpstrategie. In de cursus werken studenten aan (prototype van) een softwareproduct en een business plan dat wordt gepresenteerd aan een panel van ondernemers, financiers en investeerders. Het panel gebruikt beoordelingscriteria zoals die in de markt worden gebruikt: realiseerbaarheid, potentie, marktvraag, middelen, innovatie, etc. Studenten vonden dit een effectieve wijze van toetsing, en waardeerden de feedback van het panel.

Vijf van deze strategieën werden bevestigd in deze exploratieve studie, terwijl de strategie over faciliteiten en infrastructuur kon niet worden geëvalueerd. Vanuit de bevindingen van deze studie werden drie nieuwe strategieën aanbevolen. Deze hebben betrekking op samenwerking tussen start-up teams, het bieden van rol modellen door ondernemers, en studenten in verschillende betekenisvolle rollen brengen. Studenten rapporteerden dat zij zich niet erg betrokken voelden bij

andere start-ups, en het mag worden aangenomen dat zij kunnen leren van onderlinge discussies en het verwoorden van hun business plannen.

De docenten werden niet beschouwd als goede rolmodellen van ondernemers. Daarom moeten ondernemers als rolmodellen meer bij het onderwijs betrokken worden. Als studenten in meerdere rollen worden gebracht, dan zal dat de ontwikkeling van verschillende perspectieven vanuit verschillende standpunten stimuleren, en dat zal bijdragen een beter conceptueel begrip. Een voorwaarde daarbij is dat studenten de verschillende rollen als authentiek en betekenisvol ervaren.

HOOFDSTUK 3: STIMULEREN VAN DE COMPETENTIE OM ONDERNEMERSKANSEN TE ONTDEKKEN BIJ BÈTA-STUDENTEN. EEN ONTWERPONDERZOEK.

In hoofdstuk 3 wordt een ontwerponderzoek voor onderwijs in het identificeren van business kansen beschreven. Deze studie begint met het afleiden van ontwerpstrategieën aan de hand van theorieën uit het domein ondernemerschap en uit de onderwijskunde. De drie belangrijkste theorieën over het herkennen van business kansen werden verkend en aanknopingspunten werden gezocht voor het opstellen van ontwerpstrategieën voor onderwijs. Vervolgens werden deze conceptuele ontwerpstrategieën verder onderbouwd met onderwijs- en instructietheorieën. Dit werd gecombineerd met de aanwezige ervaring in onderwijs(ontwerp) bij de ontwikkelaars van een nieuwe cursus.

Er werden drie ontwerpstrategieën geformuleerd.

1 De eerste ontwerpstrategie beschrijft dat idee-genererende technieken (creativiteitstechnieken) kunnen bijdragen aan de identificatie van ondernemerskansen. Er zijn belangrijke overeenkomsten tussen creativiteit en het herkennen van kansen en daarom kunnen technieken voor creativiteit worden ingezet om ondernemerskansen te creëren vanuit bestaande wetenschappelijke kennis.
2 De tweede ontwerpstrategie betreft de conceptualisatie van ondernemerskansen door studenten. Als studenten leren wat de achterliggende concepten en aspecten van ondernemerskansen zijn, kunnen zij die later toepassen in het ontwikkelen van nieuwe kansen of bij beoordeling van ondernemerskansen.
3 Een derde ontwerpstrategie wil bevorderen dat studenten de concepten ook werkelijk gaan toepassen in authentieke ondernemerstaken, of, in andere woorden, er moet een transfer plaatsvinden van de leersituatie naar een zo veel mogelijk reële situatie. Studenten moeten het geleerde kunnen toepassen om zo bestaande concepten uit te breiden en te verankeren.

Op basis van deze drie ontwerp strategieën en eisen van het schoolsysteem is een cursusontwerp gemaakt in co-design tussen cursuscoördinator en onderzoeker. Enkele cycli van prototyping van

het ontwerp zijn uitgevoerd voorafgaand aan deze studie.

Het cursusontwerp is vervolgens uitgevoerd en geëvalueerd. Ten eerste is gekeken naar de mate van implementatie, want als strategieën niet zijn uitgevoerd zoals bedoeld, is het niet na te gaan of de ontwerpstrategieën effectief zijn. Er werden verschillende instrumenten gebruikt voor dit deel van het onderzoek: interviews, observaties, aantekeningen, en vragenlijsten. Daarnaast is de functionaliteit van het onderwijs m.b.t. het ontdekken van ondernemerskansen vastgesteld, met een instrument dat de mate van innovatie en de marktpotentie van het idee vaststelt.

De **eerste ontwerpstrategie** voor het gebruik van idee genererende technieken werd grotendeels gerealiseerd in de praktijk. Studenten die hadden gekozen voor een consultancy opdracht in plaats van het schrijven van een businessplan, voelden zich in hun opdracht niet gestimuleerd om creativiteitstechnieken te gebruiken.

De **tweede ontwerpstrategie** over het conceptualiseren van ondernemerskansen is volledig uitgevoerd zoals bedoeld. Studenten bleken in staat om zelf ondernemerskansen te rangschikken op basis van achterliggende concepten. Studenten bleken ook in staat om ondernemerskansen van anderen te beoordelen aan de hand van zelf ontwikkelde criteria. Concepten van ondernemerskansen werden ook spontaan toegepast in andere cursusonderdelen.

De **derde ontwerpstrategie** over de transfer van de verkregen concepten naar nieuwe authentieke situaties werd grotendeels gerealiseerd zoals bedoeld. Studenten waren succesvol in het identificeren van vijf ondernemersideeën uit het wetenschappelijk domein. In een tweede opdracht bleken groepen studenten in staat om twee ondernemerskansen te ontwikkelen op basis van eigen kennis en competenties. Uit interviews bleek echter dat niet alle studenten criteria en concepten hebben toegepast. Ze voelden zich vooral gestimuleerd door de ondernemers die als gastspreker kwamen.

De conclusie van deze studie is dat de ontwerpstrategieën voor het onderwijs in het herkennen van ondernemerskansen grotendeels werden gerealiseerd zoals bedoeld. Op basis van producten van studenten ,blijkt dat de verwachte uitkomsten van de individuele strategieën worden gerealiseerd: studenten bleken na de cursus in staat on ondernemerskansen van anderen te herkennen en te conceptualiseren, en waren in staat zelf kansen te identificeren op basis van concepten en eigen kennis en competenties. Dit geeft een indicatie dat het ontwerp functioneel is. In de literatuur zijn weinig studies bekend die samenhangende onderwijsstrategieën in een onderwijsontwerp hebben beschreven, en daarmee is deze studie een aanvulling op bestaande studies.

HOOFDSTUK 4: STRATEGIEËN VAN ERVAREN DOCENTEN VOOR ONDERWIJS IN HET HERKENNEN VAN ONDERNEMERSKANSEN

Hoofdstuk 4 schrijft een evaluatiestudie van de drie eerdere gevonden ontwerpstrategieën voor onderwijs in het ontdekken van ondernemerskansen (Hoofdstuk 3), in verschillende contexten. Door middel van interviews werd onderzocht of deze ervaren docenten de drie ontwerpstrategieën

toepassen in hun onderwijs, hoe zij deze strategieën uitvoeren (of welke substrategieën zij gebruiken), en of aanvullende strategieën werden gebruikt voor hetzelfde leerdoel.

Voor dit onderzoek werden negen docenten geselecteerd op basis van hun ervaring met onderwijs in ondernemerschap aan bèta-studenten in diverse instellingen voor hoger onderwijs. Er werden semigestructureerde interviews gehouden met de eerder gevonden ontwerpstrategieën als basis voor het interview, en ook werd gevraagd of er aanvullende ontwerpstrategieën werden gebruikt. Daarbij werd ook de ervaren uitvoerbaarheid en effectiviteit van deze strategieën bevraagd.

De drie eerder gevonden ontwerpstrategieën (a) gebruik van idee genererende technieken, b) conceptualisatie van ondernemerskansen en c) transfer van de verkregen concepten naar de praktijk, werden door de geïnterviewde docenten frequent toegepast en bij elke ontwerpstrategie werden diverse substrategieën gerapporteerd. Volgens de mening van de geïnterviewden waren de aanvullende strategieën en substrategieën uitvoerbaar en effectief.

Daarnaast rapporteerden de docenten drie nieuwe ontwerpstrategieën:

4 Daag studenten uit om hun routinematige probleemoplossende denkpatronen los te laten en nieuwe oplossingen te bedenken bij het vinden van ondernemerskansen. Routinematige denkpatronen maken gebruik van vaste procedures en bestaande kennis. Als studenten worden geconfronteerd met omstandigheden van onzekerheid en onduidelijkheid merken ze dat bestaande denkpatronen te kort schieten en gaan op zoek naar nieuwe oplossingsmogelijkheden of ondernemerskansen.
5 Geef studenten een incubatieperiode voor het ontdekken van een ondernemerskans. Creativiteitsprocessen kennen vaak een fase van incubatie. Dit is een periode waarin een persoon niet actief met het probleem bezig is. Maar op een onderbewust niveau gaan denkactiviteiten door en dragen bij aan de rijping van het idee. Omdat het identificeren van een ondernemerskans een creatief proces is, kan een incubatieperiode bijdragen aan verbetering van het leerproces.
6 Selecteer studenten op basis van de kwaliteit van een ondernemerskans die zij van te voren moeten bedenken. Als studenten worden eerder geactiveerd om ondernemerskansen te ontdekken, stimuleert dit hun voorkennis en maakt hen duidelijk wat ze nog moeten bijleren. In de periode van voorbereiding kunnen zij feedback krijgen van docenten, medestudenten, of personen uit de naaste omgeving, om daarmee hun ondernemerskans verbeteren. Bij aanvang van de cursus presenteren studenten hun ondernemerskans en worden al dan niet toegelaten op basis van het potentieel van de ondernemerskans.

Voor deze drie aanvullende ontwerpstrategieën werden ook verschillende substrategieën gerapporteerd, weliswaar met een lagere frequentie dan de eerder gevonden en bevestigde strategieën. Omdat volgens docenten deze (sub)strategieën in een of meer casus effectief werden toegepast, bieden zij nieuwe mogelijkheden voor ontwikkeling van onderwijs in ondernemerschap.

De eerder geëvalueerde ontwerpstrategieën plus substrategieën, samen met de aanvullende

ontwerpstrategieën bieden nieuwe didactische instrumenten aan ontwikkelaars en docenten, en dragen bij aan de theorie over ondernemerschapsonderwijs, in het bijzonder aan het onderwijs in het ontdekken van ondernemerskansen.

HOOFDSTUK 5: ONDERWIJS IN HET HERKENNEN VAN ONDERNEMERSKANSEN IN EEN AUTHENTIEKE LEEROMGEVING

Nadat is onderzocht wat de kenmerken zijn van een authentieke leeromgeving in ondernemerschapsonderwijs (Hoofdstuk 2) en welke strategieën effectief zijn om studenten te leren ondernemerskansen te ontdekken Hoofdstukken 3 en 4), is de volgende onderzoeksvraag vraag:

In welke mate kunnen de eerder gevonden ontwerpstrategieën voor de creatie van een authentieke leeromgeving en het voor onderwijs in het identificeren van ondernemerskansen, worden geïntegreerd in één cursusontwerp?

Omdat in het proces van herkenning van kansen door ondernemers de omgeving een belangrijke rol speelt als bron van informatie en kennis, mag worden verwacht dat zo'n authentieke leeromgeving in onderwijs bijdraagt aan het de ontwikkeling van deze competentie bij studenten. De eerder gevonden strategieën voor authentiek leren (Hoofdstuk 2) werden aangevuld met strategieën voor authentiek leren die in de literatuur zijn gerapporteerd.

Dit onderzoek is in drie stappen uitgevoerd. Allereerst is gekeken of een cursus ontworpen kan worden waarin de (meeste) ontwerpstrategieën zijn opgenomen. Daarvoor werden documenten over de cursus bestudeerd en gesprekken gevoerd met docenten. Het bleek dat alle strategieën in de cursus waren opgenomen. Uit documentatie bleek dat de bestudeerde cursus succesvol was in het genereren van nieuwe start-ups en uitvoerbaar was over een periode van jaren. Het is dus mogelijk een cursus te ontwerpen waarin alle ontwerpstrategieën zijn opgenomen.

Ten tweede werd onderzocht in welke mate de verschillende ontwerpstrategieën werden uitgevoerd zoals bedoeld. Daartoe zijn observaties uitgevoerd, opnamen gemaakt en geanalyseerd van relevante onderwijsbijeenkomsten, en interviews gehouden met studenten en docenten. Tevens zijn er twee vragenlijsten gebruikt: ten eerste om te meten hoe studenten de onderwijsomgeving hebben ervaren, en ten tweede om vast te stellen wat studenten vinden van hun competentie in het herkennen van ondernemerskansen.

Van de zes ontwerpstrategieën voor het herkennen van ondernemerskansen bleken er vier volledig geïmplementeerd en twee gedeeltelijk. Van de negen ontwerpstrategieën voor een authentieke leeromgeving bleken er zeven geheel geïmplementeerd en twee gedeeltelijk. Er kan dus worden geconcludeerd dat de het onderwijs grotendeels is uitgevoerd zoals bedoeld en dat de hele set ontwerpstrategieën substantieel is gerealiseerd in de bestudeerde cursus.

Ten derde werd vastgesteld of studenten aan het einde van de cursus in staat waren een ondernemerskans te identificeren en uit te werken. Studenten werden aan het eind van deze cursus getoetst. Daartoe hadden studenten in groepjes een business plan voorbereid, en een prototype

gemaakt van de software of dienst die zij als bedrijf willen aanbieden. Studenten presenteerden beide producten voor een forum van ondernemers, investeerders en een IT journalist. Deze externe beoordelaars gebruikten een beoordelingsformulier met criteria zoals die in de ondernemerswereld worden gebruikt. Dit formulier was samen met de beoordelaars ontwikkeld voor het scoren van ondernemerskansen. De scores van de beoordelaars werden in dit onderzoek gebruikt om de functionaliteit van het onderwijs vast te stellen: of wel zijn studenten in staat ondernemerskansen te identificeren. Alle groepen studenten bleken in staat om een ondernemerskans te identificeren en verder te ontwikkelen tot een businessplan. Tevens ontdekten studenten zelf concepten van kansen in hun activiteiten, en pasten deze concepten toe in nieuwe taken voor de start-up. Als antwoord op de onderzoeksvraag in deze studie kan worden gesteld, dat een authentieke leeromgeving waarin relevante kenmerken van de ondernemerspraktijk voor leren zijn opgenomen, kan worden gerealiseerd zoals bedoeld. Na een cursus die is gebaseerd op deze ontwerpstrategieën, waren studenten in staat ondernemerskansen die studenten identificeren, zoals blijkt uit de artefacten die zij hebben geproduceerd.

HOOFDSTUK 6: CONCLUSIES EN DISCUSSIE

Dit hoofdstuk presenteert de conclusies van dit proefschrift met betrekking tot de centrale onderzoeksvraag. In de voorafgaande studies zijn ontwerpstrategieën beschreven voor de creatie van een authentieke leeromgeving, en voor het stimuleren van de competentie van studenten in het identificeren van ondernemerskansen. Zoals beschreven in de Introductie, kunnen strategieën die die bijdragen aan het zelfde doel, worden samengebracht onder één ontwerp principe. Het onderzoek resulteert daarmee in twee ontwerpprincipes voor het ontwikkelen van onderwijs in het herkennen van ondernemerskansen. Elk ontwerpprincipe bevat op zijn beurt weer een aantal strategieën en substrategieën.

Het eerste ontwerpprincipe heeft betrekking op de inhoud, n.l. studenten leren ondernemerskansen te ontdekken. Dit ontwerpprincipe telt zes strategieën:

1 Stimuleer het gebruik van idee-genererende technieken
2 Stimuleer conceptualisatie en evaluatie van ondernemerskansen
3 Stimuleer transfer van concepten door middel van authentieke taken
4 Daag studenten uit nieuwe manieren van probleem oplossen te vinden

Deze strategieën bleken robuust te zijn onder verschillende omstandigheden. Vervolgens werden er twee aanvullende strategieën beschreven door ervaren docenten.

5 Geef studenten een incubatieperiode voor het ontdekken van ondernemerskansen
6 Laat studenten toe op basis van de kwaliteit van hun ondernemerskans.

Hoewel robuustheid niet kan worden geclaimd voor deze twee strategieën, kunnen zij desondanks aanwijzingen geven bij de ontwikkeling van ondernemerschapsonderwijs.

Omdat veel van deze strategieën het conceptualiseren van ondernemerskansen willen stimuleren, noemen we dit ontwerpprincipe het concept principe.

Dit onderzoek naar het conceptuele ontwerpprincipe geeft vier nieuwe en empirisch ondersteunde strategieën voor het ontwerp van onderwijs in het leren herkennen van ondernemerskansen. Van de zes strategieën uit dit onderzoek, staan er twee beschreven in de literatuur, en dit onderzoek in lijn met deze eerdere bevindingen. De gevonden strategieën sluiten aan bij de verschillende theorieën over creativiteit, ondernemerschap, ondernemerschapsonderwijs en onderwijskunde.

Het tweede ontwerpprincipe geeft richtlijnen voor het ontwerpen van een ondernemers-onderwijsomgeving die het leren herkennen van ondernemerskansen ondersteunt. Voor het ontdekken van kansen door ondernemers is de werkcontext van groot belang m.n. voor het verkrijgen van informatie die tot kansen kan leiden. Daarom is aangenomen dat een leeromgeving waarin die kenmerken van ondernemerschap zijn opgenomen, ook zal bijdragen aan het leren ontdekken van ondernemerskansen. Het tweede ontwerpprincipe beschrijft de inrichting van een authentieke leeromgeving met essentiële kenmerken van ondernemerschap, en daarom noemen we dit het context ontwerpprincipe. Het context ontwerp principe kent negen strategieën:

1 Creëer een authentieke werkomgeving waarin informatie wordt gebruikt zoals in ondernemerschap
2 Geef studenten taken en activiteiten die relevantie hebben in de echte wereld. Deze taken moeten gelegenheid bieden om het werk te organiseren en moeten bij studenten de noodzaak oproepen om kennis te vergaren.
3 Laat studenten zien en ervaren hoe expert-ondernemers het ontdekken van kansen aanpakken
4 Zorg er voor dat studenten taken en problemen vanuit verschillende perspectieven beschouwen
5 Ondersteun het gezamenlijk ontwikkelen van kennis door studenten
6 Bevorder reflectie om abstracties te ontwikkelen
7 Bevorder het verwoorden van ervaringen om daarmee ervaringskennis expliciet te maken
8 Laat de docent studenten coachen en ondersteunen op kritische momenten
9 Toets studenten op een authentiek wijze d.w.z. door ondernemers en met criteria zoals die in ondernemerschap gelden.

De beschreven strategieën en substrategieën zijn specifiek voor ondernemerschapsonderwijs, en zijn niet eerder beschreven. Hoewel ook andere onderzoekers hebben gepleit voor de integratie van authentieke elementen in het onderwijs, is dit een van de eerste onderzoeken binnen het domein van ondernemerschapsonderwijs over het gebruik van een authentieke leeromgeving. De bevindingen van dit proefschrift stemmen overeen met bestaande theorieën en modellen voor authentiek leren.

Er kan worden geconcludeerd dat dit onderzoek een bijdrage levert aan de oplossing van een bestaande vraag uit de onderwijspraktijk in de vorm van twee ontwerpprincipes en daarnaast een bijdrage levert aan kennisvorming in het domein van onderwijs in ondernemerschap. Vanuit de gevonden ontwerpprincipes wordt vervolgens de volgorde van strategieën besproken en worden hiervoor suggesties gedaan.

In de discussie wordt terug geblikt op het onderzoek. Zo wordt retrospectief de geschiktheid

van de gebruikte onderzoeksmethoden besproken en wordt de kwaliteit van de ontwerpprincipes getoetst aan criteria uit de literatuur. In dit proefschrift is ontwerponderzoek gecombineerd met een aantal case studies, en deze aanpak bleek succesvol in het ontwikkelen van robuuste ontwerpprincipes. Vervolgens wordt besproken in hoeverre de gevonden ontwerpprincipes kunnen worden gegeneraliseerd naar andere domeinen van onderwijs of naar andere culturen. Daarna worden de beperkingen in dit onderzoek besproken en worden er suggesties gedaan voor vervolgonderzoek. De discussie eindigt met een aantal aanbevelingen voor onderwijs in ondernemerschap in het hoger onderwijs, want ondernemerschapscompetenties zijn relevant voor alle onderwijsinstellingen die de werkgelegenheid van studenten van belang vinden.

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Curriculum Vitae

Jan Nab werd geboren op 27 juni 1951 in Ede, en groeide op in Wageningen. Hij behaalde zijn HBS-B diploma op het Wageningsch Lyceum in 1968. Jan studeerde Biologie aan de Universiteit Utrecht, waar hij in 1976 afstudeerde.

Hij begon als wetenschappelijk onderzoeker in de biochemie van de mondholte aan faculteit Tandheelkunde aan de Universiteit Utrecht. Vervolgens deed hij vervangende dienstplicht bij de Stichting Biowetenschappen en Maatschappij in Leiden, waar hij werkte als wetenschapsvoorlichter en eindredacteur van een populairwetenschappelijk tijdschrift. Daarna werkte Jan als directie-assistent bij het Integraal Kankercentrum Rotterdam, waar hij tevens eindredacteur was van een medisch tijdschrift.

Van 1984 -1997 was Jan coördinator van opeenvolgende nationale projecten voor de beperking van dierproeven in het wetenschappelijk onderwijs. Deze projecten werd uitgevoerd bij Stichting Film en Wetenschap en later bij de vakgroep Proefdierkunde van de faculteit Diergeneeskunde in Utrecht. Jan werkte hierin mee aan de totstandkoming van onderwijsvideo's, films, computersimulaties en interactieve media voor de vervanging van dierexperimenten in het onderwijs. Hij was tevens docent voor het thema alternatieven voor dierproeven.

In opdracht van Eurogroup for Animal Welfare leidde Jan van 1992 tot 1993 een EU-project, met als doel de invoering van Europese wetgeving voor dierexperimenten in Portugal, Italië, Griekenland en Spanje.

Vanaf 1993 was Jan tevens werkzaam in onderwijsontwikkeling in het hoger onderwijs. Hij was stafmedewerker curriculumvernieuwing bij de faculteit Diergeneeskunde in Utrecht. Bij deze faculteit werd hij later projectleider voor het gebruik van ICT in het onderwijs. Van 1998 tot 2001 was Jan medewerker curriculumvernieuwing bij de faculteit Farmacie in Utrecht.

In 1998 werd Jan onderwijskundig adviseur bij het IVLOS aan de Universiteit Utrecht, later het Centrum voor Onderwijs en Leren. Zijn specialisatie is cursus- en curriculumontwikkeling, en de ontwikkeling van leerlijnen voor het hoger onderwijs. Hij werkte mee aan vele vernieuwingsprojecten in bachelor- en masterprogramma's.

Naast zijn advieswerk werkte Jan sinds 2007 aan zijn proefschrift.

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Als onderwijskundig adviseur was ik betrokken bij onderwijs in ondernemerschap. Studenten waren enthousiast en betrokken, en haalden het beste uit zich zelf. Ik werd nieuwsgierig naar het geheim van dit onderwijs. Toen het idee werd geopperd om een promotieonderzoek te wijden aan dit onderwerp, wist ik onmiddellijk: dit wil ik doen. Deze kans diende zich aan en heeft uiteindelijk geleid tot dit proefschrift, maar zonder de hulp van velen was het niet gelukt.

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Het management van het IVLOS / Centrum voor Onderwijs en Leren bleef vertrouwen in een goede afloop, en heeft mij op vele manieren gesteund bij de afronding van mijn proefschrift.

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Jan Nab

Dit proefschrift beschrijft hoe ondernemerschapsonderwijs kan worden vormgegeven, en richt zich vooral op onderwijs in het identificeren van ondernemerskansen.
Studenten kunnen leren ondernemerskansen te herkennen, door ze achterliggende concepten te laten ontdekken en te laten toepassen. Daarnaast beschrijft dit proefschrift hoe een stimulerende leeromgeving voor ondernemerschaps-onderwijs kan worden vormgegeven. Zo'n leeromgeving bevat essentiële elementen van ondernemerschap, die van belang zijn bij het leren.
De resultaten van dit proefschrift zijn van belang voor opleidingen in het hoger onderwijs die hun studenten willen onderwijzen in het herkennen van ondernemers-kansen. Studenten leren zo hun eigen werk te creëren.