Strategies of expert teachers for teaching identification of business opportunities

Jan Nab, Hanno van Keulen and Albert Pilot

Abstract: *The process of opportunity identification is under-emphasized in higher education; and there is a need for validated educational strategies to foster this competence in science students. In a previous study, three strategies were elaborated 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 in opportunity identification. The focus of this validation 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. It was found that expert teachers frequently applied the previously reported strategies feasibly and effectively 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.*

Keywords: *opportunity identification; teaching, strategies; entrepreneurship education*

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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 and 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 and Gaglio, 2002; DeTienne and Chandler, 2004; Corbett, 2005; Muzychenko, 2008), validated 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, validated 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 in which stages or activities in a designed teaching and learning process are planned and/or executed. 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 elaborated. They were grounded in the literature and in empirical evidence and were evaluated in the classroom (Nab *et al*, 2013). 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. It also 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 and Dew, 2005). There are, however, no studies on the explicit use and evaluation of these theories to develop 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, they 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. In a previous study Nab *et al* (2013) proposed three strategies to foster 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 evaluated in the classroom.

The first design strategy devised by Nab *et al* (2013) 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 and 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 and 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 and 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 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 and 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 and 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 and Newby, 1993), such as identifying opportunities, and develop through reflection in action. In addition, students need a 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 and 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 and Oliver, 2000). Authentic learning environments share the essential characteristics of an entrepreneurial environment, but they may be adapted for the purpose of learning (Herrington and Oliver, 2000). In another study (Nab *et al*, 2010) 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 instructor 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 implemented and validated in an evaluation study in the classroom. 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 validate the effectiveness, feasibility (that is, practicability) and robustness of strategies as described by Nab *et al* (2013). Furthermore, the intention is to discover additional strategies to teach opportunity identification, and the implementation of these strategies. Thus the research questions for this study are as follows.

(1) Do expert teachers in entrepreneurship education use the following strategies to teach opportunity identification feasibly and effectively, and how do they implement the strategies? That is, do they: (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 apply feasibly and effectively in teaching opportunity identification, and how do they implement these additional strategies?

Methodology

In this qualitative study participants were selected by purposeful sampling (Patton, 1990). Teachers from one Flemish, one French and seven Dutch research universities and universities for applied sciences were selected on the basis of their acknowledged expertise in teaching entrepreneurship and opportunity identification

to science students. All teachers who were interviewed were responsible for teaching one or more courses and each teacher was asked to suggest other teachers for participation in this study. Interviewing of teachers continued until saturation occurred after nine interviews. 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 (Nab *et al*, 2013) as subjects for the interview questions. First, the interviewer investigated whether the three strategies described were used. If this was confirmed, the feasibility and effectiveness of the strategies were explored in the interview and the teacher's experiences with each strategy were elaborated. Second, the interviewer asked which additional strategies the teacher had used successfully for teaching opportunity identification. Expert teachers were asked if they had used these strategies effectively and feasibly, how they had implemented these strategies and if they had used new methods of implementation.

For the data analysis, the interviews were coded and the three strategies of Nab *et al* (2013) were used as an analytical framework. For analysis of the authenticity of learning, a framework (Nab *et al*, 2010) was used which consisted of a professional working atmosphere, the roles of students, the types of tasks and activities and the role of the instructor and assessment. The interviews were audiotaped and transcribed verbatim, and then segmented into fragments covering an interview question plus answer. 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 considered a design strategy as feasible and effective of the total number of the interviewed expert teachers. Thus, for example, (3/9) means three out of nine teachers used this 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 it was discussed 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 idea was evaluated with regard to innovativeness, feasibility and market potential and subsequently elaborated in a business plan. In two cases the business plan had to be implemented as a student company.

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 used these strategies practically and effectively and in various contexts. In addition, we examined the sub-strategies that were implemented. The results are summarized in Table 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 practised 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,

Table 1. Use of previously described strategies for teaching opportunity identification, and their 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). Allow the 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).

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 explicit

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 is an idea 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 strategy to stimulate knowledge and skills of idea-generation techniques proved feasible and effective in various contexts with different teachers (see Table 1). It can therefore be concluded that this design strategy showed robustness.

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 other 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 proved 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 (Nab *et al*, 2010) for data analysis: simulation of a working atmosphere, the role of students, types of tasks and activities, role of the instructor 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.

In the majority of programmes students fulfilled entrepreneurial roles as initiators of companies or real start-ups. 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

Table 2. Additionally reported strategies for teaching opportunity identification and their sub-strategies.

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 on 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).

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 strategy to stimulate transfer by means of authentic learning was applied 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 implement practically and effectively for teaching opportunity identification. Three additional strategies were reported, as summarized in Table 2.

Additionally reported design strategy 4: challenge students to abandon their routine patterns of problem-solving. This strategy requires that students are 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 full. 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.' (Teacher 4)[1]

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 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 proved to be 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. Opportunities for students to discuss and evaluate their business ideas were organized in all programmes and were 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 providing an incubation period for opportunity identification was a practicable and effective strategy in two cases.

Conclusions

Three strategies for teaching opportunity identification to science students that were proposed in an earlier design study were validated in this study:

(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 1. Our main findings are that these strategies appeared 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:

(1) Challenging students to abandon their routine strategies for problem-solving;
(2) Selecting students on the basis of the quality of their business ideas; and
(3) Providing extended incubation time relating to opportunity identification.

The results of the data analysis regarding these additional strategies are summarized in Table 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. Design strategies have heuristic value for designing educational programmes and can help teachers, developers and designers.

Discussion and limitations

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 is 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 and 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 abilities 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 stimulus 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 this selection method was used to admit students to the course. In both cases it proved 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 and 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 effectiveness – for instance, in raising the self-efficacy of 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 and 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 is accepted that incubation can be part of opportunity identification.

In entrepreneurship education students have relatively little time available for incubation. Courses last for several 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 and 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, on time and with the possibility of use for refinement, is effective in learning (Hattie and 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 effectiveness of this strategy, whereas other variables do better.

In a previous study (Nab *et al*, 2013) 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 are effective in students' learning.

Limitations

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 entirely upon 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 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 practicability and effectiveness of the strategies were questioned in the interviews with expert teachers. The majority of interviewees implemented the previously identified strategies that were validated in this present study and therefore our findings could validly be generalized to a broader range of science and technical studies. Also, the additional strategy of challenging students to abandon their routine ways of problem-solving was reported to be robust 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 with regard to their feasibility and effectiveness.

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 and 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, abilities) 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 mainly 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 is 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 study 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 are not 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 relevance of 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 and Lautenschläger, 2011; Löbler,

2006; Nab *et al*, 2010). 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.

Notes

[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.

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