





Developing entrepreneurial competencies

An action-based approach and classification in entrepreneurial education

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Division of Management of Organizational Renewal and Entrepreneurship Department of Technology Management and Economics CHALMERS UNIVERSITY OF TECHNOLOGY Gothenburg, Sweden 2013

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An Action-Based Approach and Classification in Education

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Cover:

Three students at Chalmers School of Entrepreneurship presenting their real-life project Velit Biologics (project name at that time was SB101) to the teachers, their class and to external invited guests and experts. From left: David Henricson Briggs, Alexander Lagerman and Pille Pihlakas. Photo taken in December 2011 by Viktor Brunnegård.

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Developing Entrepreneurial Competencies: An Action-Based Approach and Classification in Education MARTIN LACKÉUS

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ABSTRACT

A question within entrepreneurial education that never seems to go out of fashion is "Can entrepreneurship be taught?". To address this question, this thesis adopts the view that becoming entrepreneurial requires direct experience, and explores how learning-by-doing can be put to use in entrepreneurial education through actionbased approaches. Action-based approaches are frequently advocated for but more seldom used due to costbased and systemic challenges. The field lacks a theoretically grounded definition and classification of actionbased entrepreneurial education, and conceptual discussions on the topic of learning-by-doing-*what* in entrepreneurial education are rare. Challenges to assess entrepreneurial education have also contributed to a dominance of cognitive approaches in entrepreneurial education, despite their inability to develop entrepreneurial competencies.

The main purpose of this thesis has been to increase our understanding of how action-based entrepreneurial education can develop entrepreneurial competencies. An empirical setting suitable for this purpose was identified, qualified and described through extensive study of various educational environments in Europe and United States. A two-year entrepreneurial education program in Sweden was found to constitute a "paradigmatic case" of action-based entrepreneurial education, defining a "venture creation approach" and justifying a single case study approach. Thirteen students from this program were studied in their two-year process of developing entrepreneurial competencies. They were studied using an interpretation framework for entrepreneurial competencies developed for the purpose, an experience sampling based "mobile app" and through quarterly interviews.

The study is still on-going, but analysis of empirical data has so far revealed 17 different kinds of events that could be linked to the development of entrepreneurial competencies. According to preliminary findings, some links are stronger than others, such as interaction with outside world leading to build-up of entrepreneurial self-efficacy, marketing skills and uncertainty tolerance. Based on this, four classes of activities that trigger such events have been proposed, constituting an attempt to establish a classification and definition of action-based entrepreneurial education. These four classes could help practitioners in action-based entrepreneurial education to compare different pedagogical approaches and subsequently decide on which activity to opt for in any given teaching situation. They could also help researchers focus more on relevant aspects of action-based entrepreneurial education, removing differentiation that is irrelevant for the purpose.

In order to explain how these four classes of activities develop entrepreneurial competencies, a causal relationship has been proposed to exist between the four classes of activity, the emotional events they trigger and the resulting development of entrepreneurial competencies. If such a causal relationship exists, it opens up for a new approach to assessment in entrepreneurial education, focusing on the frequency, strength and variety of emotional events of certain kinds. These events could thus be viewed as indirect proxies for developed entrepreneurial competencies, which is an educational outcome difficult to assess directly. In addition to the assessment implications of these findings, an "actionable knowledge" approach has been proposed, where a focus on human action / activity bridges between traditional teacher-centric and progressive learner-centric approaches to education. It could contribute with new perspectives in a century-long debate in general education impacting the domain of entrepreneurial education.

Keywords: Entrepreneurship education; enterprise education; entrepreneurial competencies; learning; education; emotional events; longitudinal case study; venture creation; value creation

LIST OF PUBLICATIONS

This thesis is based on the following papers:

- i. Lackéus, M., Lundqvist, M., Williams Middleton, K. 2013. How Can Entrepreneurship Bridge Between Traditional and Progressive Education? Presented at *ECSB Entrepreneurship Education Conference* in Århus, Denmark, 29-31 May 2013.
- Lackéus, M., Williams Middleton, K. 2012. Venture Creation Programs Bridging Entrepreneurship Education and Technology Transfer. *Accepted for publication in Education + Training*.
- Lackéus, M. 2013. Links between Emotions and Learning Outcomes in Entrepreneurial Education. Presented at *Nordic Academy of Management* conference in Reykjavik, Iceland, 21-23 August 2013.

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Martin Lackéus

Göteborg, November 8, 2013

To my wife, Karin

&

To our children

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1. Introduction

1.1 Entrepreneurial education

A question within entrepreneurial education that never seems to go out of fashion is "Can entrepreneurship be taught?". Many argue that there is enough evidence that entrepreneurship can be taught (Kuratko, 2005, Gorman et al., 1997, Pittaway and Cope, 2007a). Others argue that entrepreneurs are primarily born, not made (Nicolaou and Shane, 2009). Some opt for a middle way, claiming that certain aspects of entrepreneurship cannot be taught, such as self-confidence, persistence and energy levels (De Faoite et al., 2003). Others connect the question to assessment in education, stating that the difficulty lies primarily in measuring the effects of entrepreneurial education (Martin et al., 2013, Henry et al., 2005b).

In the domain of entrepreneurial learning there is no similar polarized discussion on the corresponding question "Can entrepreneurship be learned?". Instead a multitude of empirically grounded frameworks and models are proposed on how entrepreneurship is learned by individuals pursuing entrepreneurial endeavors (Rae and Carswell, 2001, Rae, 2005, Minniti and Bygrave, 2001, Cope, 2005, Politis, 2005, Pittaway and Thorpe, 2012). Consensus among entrepreneurial learning scholars is that the only way to become entrepreneurial is through direct experience, i.e. learning-by-doing or direct observation. The entrepreneurial learning domain is however largely disconnected from the educational arena, and primarily studies on-the-job learning; learning from the experience of operating a company.

1.2 Action-based entrepreneurial education

This thesis adopts the view that becoming entrepreneurial requires direct experience, and explores how learning-by-doing can be put to use in entrepreneurial education through actionbased approaches, often labeled "learning *through* entrepreneurship" (O'Connor, 2012). If entrepreneurship can be informally learned it can also be formally taught (Lange et al., 2011, Drucker, 1985). Action-based approaches are frequently advocated for but more seldom used due to cost-based and systemic challenges (Mwasalwiba, 2010). The field of entrepreneurial education lacks a theoretically grounded definition and classification of action-based entrepreneurial education, instead often defining it through "laundry list" enumeration of a large amount of pedagogical approaches (See for example Mwasalwiba, 2010, Kuratko, 2005, Jones and Iredale, 2010). Conceptual discussions on the topic of learning-by-doing*-what* in entrepreneurial education are rare.

1.3 Developing entrepreneurial competencies

The ultimate goal of all entrepreneurial education is to develop some level of entrepreneurial competencies among learners in terms of knowledge, skills and/or attitudes. Entrepreneurial competencies are in this thesis defined as knowledge, skills and attitudes that affect the willingness and ability to perform the entrepreneurial job of new value creation; that can be measured directly or indirectly; and that can be improved through training and development, see Table 1. The definition of "entrepreneurial" used in this thesis is based on Bruyat and Julien (2001), proposing that entrepreneurship can be viewed as a dialogic system consisting of

the two entities *individual* (subject) and the *new value created* (object), where a *process* of interacting with the surrounding *environment* over time profoundly changes both of these entities. Some important challenges within action-based entrepreneurial education that I will focus on in this thesis are the lack of assessment tools for action- and emotion-based entrepreneurial competencies, and the vagueness of what activities to focus on in a learning-by-doing approach. I posit that these challenges have contributed to a dominance of cognitive approaches in entrepreneurial education, despite their inability to develop entrepreneurial competencies (Lautenschläger and Haase, 2011).

1.4 Research aim and contribution

The main purpose of this thesis is to increase our understanding of how entrepreneurial competencies can be developed through action-based entrepreneurial education. To focus the research, three Research Questions have been articulated: RQ1) How can entrepreneurial competencies be operationalized and measured? RQ2) What activities could contribute to development of entrepreneurial competencies in entrepreneurial education? and RQ3) How can these activities develop entrepreneurial competencies in entrepreneurial education?

A qualitative comparative case study approach has been applied, consisting of semi-structured individual interviews, focus group interviews, analysis of secondary sources and relating to various domains of literature. An abductive approach has been used, labeled as "systematic combining" by Dubois and Gadde (2002), stressing theory *development* rather than the theory *generation* approach proposed in the 'grounded theory' approach (Corbin and Strauss, 1990). Two major units of analysis have been selected, studying ten particularly action-based entrepreneurial education programs as well as thirteen individual students in one of the studied programs.

In this thesis I will propose a classification of action-based entrepreneurial education consisting of four activity classes of creation. The four classes could help practitioners in action-based entrepreneurial education to compare different pedagogical approaches and subsequently decide on which activity to opt for in any given teaching situation. I will also propose an explanation of how these four activity classes can develop entrepreneurial competencies. Based on this a new approach to assessing entrepreneurial education is proposed. A new approach to bridging between traditional and progressive education is also proposed, potentially alleviating a century-long debate leading to emphasis on pedagogical approaches that are easy to test (Löbler, 2006) and marginalizing entrepreneurial education.

1.5 Outline of the thesis

First the theoretical background of entrepreneurial education is described in Chapter 2, culminating in a framework for learning-by-doing and an instructional design example from literature. Chapter 3 outlines methodological considerations, and Chapter 4 describes the three appended papers. Chapter 5 proposes four activity classes of action-based entrepreneurial education along with a description of how these activities make people more entrepreneurial. In Chapter 6 additional propositions are presented and discussed. In chapter 7 conclusions from this thesis are made. Chapter 8 discusses future work.

2 Theory

In this chapter, I will present literature on general entrepreneurial education, on action-based entrepreneurial education and its theoretical roots, and on development of entrepreneurial competencies. Based on this I will outline a theoretical framework for learning-by-doing, as well as provide an illustrative example. To facilitate the discussion on these and related themes, a facilitating framework is outlined in Table 1. This framework will be elaborated on throughout the thesis to illustrate the contribution of this thesis. Relevant references will be given in subsequent versions of this table, as this first table is primarily presented to supply an overview.

Entrepreneurial What are they?		How to develop?	How to assess?
knowledge /	Mental models,	Lectures	Summative tests
thought /	declarative knowledge	Reading literature	Reports - oral/text
know-what /			
cognition			
skills /	Marketing, strategy,	Lectures	Summative tests
action /	resource acquisition,	Reading literature	Reports – oral/text
know-how /	opportunity identification,	Case based teaching	Jobs taken / done
conation	learning, interpersonal	Learning-by-doing	
	skills		
attitudes /	Passion, self-efficacy,	Learning-by-doing	Pre/post surveys
emotion /	identity, proactiveness,		
know-why /	perseverance, uncertainty		
affect	tolerance		

2.1 Entrepreneurial education

Entrepreneurial education is a term encompassing both enterprise education and entrepreneurship education, two terms that are often causing confusion (Erkkilä, 2000). In Europe, enterprise education has been defined as focusing more broadly on personal development, mind-set, skills and abilities, whereas entrepreneurship education has been defined to focus more on the specific context of setting up a venture and becoming self-employed (QAA, 2012, Mahieu, 2006). In United States, the only term used is entrepreneurship education (Erkkilä, 2000).

Erkkilä (2000) has defined United States and United Kingdom as leaders in the entrepreneurial education trend. In United States the first entrepreneurship class was held in 1947 (Katz, 2003). In United Kingdom Allan Gibb has been a key scholar leading the development in the field for decades. Entrepreneurial education has seen worldwide exponential growth in higher education institutions (Kuratko, 2005), and was in 2001 offered at around 1200 business schools only in United States (Katz, 2008). This growth is often explained by entrepreneurship being seen as a major engine for economic growth and job creation (Wong et al., 2005), and as a response to the increasingly globalized, uncertain and complex world we live in (Gibb, 2002). Today entrepreneurial education has become an important part of both industrial and educational policy in many countries (Hytti and O'Gorman, 2004). Besides the usual economical and job

growth related reasons to promote entrepreneurial education, there is also increasing emphasis on the effects it can have on learners' perceived relevancy and thus motivation to engage in educational activity, particularly among low achievers (Surlemont, 2007, Deuchar, 2007, Mahieu, 2006). Motivation is a key driver for learning in entrepreneurial education (Hytti et al., 2010, Kyrö, 2008) as well as in general education (Boekaerts, 2010) where entrepreneurial approaches could alleviate problems of student boredom causing high dropout rates (Fredricks et al., 2004, Mahieu, 2006).

With very few exceptions, focus of research in entrepreneurial education has been on postsecondary levels of education (Gorman et al., 1997), which is surprising given that childhood and adolescence is considered to be an ideal age for acquiring basic knowledge and positive attitudes towards entrepreneurship (Peterman and Kennedy, 2003). This lack of research is also surprising given the immense policy pressure on educational institutions to integrate entrepreneurial education in pre-university education (European Commission, 2012b). Following a rapidly developing trend starting as late as in 2003, most countries in the European Union now have launched national strategies for entrepreneurial education in general schooling (ibid). There is today very limited available empirical research outlining to what extent and with what results entrepreneurial education has been diffused in pre-university education.

2.1.1 Three approaches in entrepreneurial education

Entrepreneurial education is often categorized into three approaches (Johnson, 1988, O'Connor, 2013, Heinonen and Hytti, 2010, Scott et al., 1998). Teaching "about" entrepreneurship means a content-laden and theoretical approach aiming to give a general understanding of the phenomenon. Teaching "for" entrepreneurship means an occupationally oriented approach aiming at giving budding entrepreneurs the requisite knowledge and skills. Teaching "through" means a process based and often experiential approach where students go through an actual entrepreneurial learning process (Kyrö, 2005). This approach is often termed action-based entrepreneurial education, and will be discussed more in-depth in a separate part of this theory section, since it is the approach of primary interest in this thesis.

How entrepreneurial education is carried out in practice varies substantially, primarily depending on which definition is used (Mwasalwiba, 2010), but also depending on what underlying educational paradigm is applied (Ardalan, 2008). In general, the definitions used seem to get more and more narrow (i.e. business and start-up focused) the higher up in the educational system one looks (Johannisson et al., 1997, Mahieu, 2006). The actual coursework is often based on personal experience rather than systematic approaches (Fayolle and Gailly, 2008), and is often centered around letting students create a business plan (Honig, 2004).

2.1.2 Entrepreneurial education interacting with society

Entrepreneurial education at post-secondary levels is often expected to take part of the regional entrepreneurial ecosystem. (Mwasalwiba, 2010, Gorman et al., 1997). Common activities, often termed "outreach", include assisting local entrepreneurs, interacting with student clubs, inviting alumni and experts, visiting networking events, conducting student consulting and participating in business plan competitions (European Commission, 2008, Mwasalwiba, 2010, Rice et al., 2010). Less common activities include interaction with incubators and technology

transfer offices for university commercialization purposes (Moroz et al., 2010, Nelson and Byers, 2010). Hynes and Richardson (2007) outline several benefits of outreach arrangements for students, faculty, researchers and stakeholders outside university. Two terms frequently used in conjunction to outreach activities are "third mission" and "the entrepreneurial university" (Etzkowitz, 2003, Rothaermel et al., 2007, Etzkowitz and Leydesdorff, 2000).

Many outreach activities are extra-curricular due to difficulties in integrating them into formal courses and programs (Botham and Mason, 2007). A notable exception to this is a "venture creation approach" (Ollila and Williams-Middleton, 2011), i.e. when entrepreneurial education is formally integrated with commercialization entities at the university. This constitutes an exception from the prevailing norm that the formation of spinoffs based on university research is managed by technology transfer offices or similar entities, without integration to entrepreneurial education (Shane, 2004). Some programs applying a venture creation approach have shown interesting outputs in terms of both student learning and student-led venture creation (Barr et al., 2009, Hofer et al., 2010, Meyer et al., 2011, Thursby et al., 2009, Lundqvist and Williams Middleton, 2008). Two such programs that have yielded significant financial value and generated hundreds of new jobs are Chalmers School of Entrepreneurship at Chalmers University of Technology in Sweden (Lundqvist, in press) and the TEC program at North Carolina State University in United States (Barr et al., 2009). Research on this kind of integrated environments is in a nascent stage, but seems to be an environment well suited to study entrepreneurial competency development first-hand as ventures are started by inexperienced individuals (for an example, see Williams Middleton, 2013). This research opportunity is one of the basic tenets of this thesis.

At pre-university level interaction between entrepreneurial education and the surrounding society is not well researched. Some exceptions outline substantial benefits of external engagement in terms of increased motivation for learners, increased school attachment and strengthened self-confidence (Surlemont, 2007, Nakkula et al., 2003, Jamieson, 1984). A widespread model is Young Enterprise (Dwerryhouse, 2001) where adolescents run a company for 8 months, followed by voluntary liquidation.

2.1.3 Educational traditions impacting entrepreneurial education

Löbler (2006) has stated that "the constructivist paradigm serves as a theoretical base for entrepreneurship education" (p.31). This way of positioning entrepreneurial education in the progressivist and constructivist end of an educational philosophy continuum resonates with a century-long debate between traditional versus progressivist / constructivist education (Tynjälä, 1999, Labaree, 2005). The traditional approach to education has been positioned as emphasizing national curriculum, standardized tests, inert knowledge and a search for "what works" (Egan, 2008, Tynjälä, 1999, Biesta, 2007). The progressivist approach has been positioned as learner focused, process-based and socially situated (Tynjälä, 1999, Jeffrey and Woods, 1998). In general the traditional approach is preferred in education mainly due to its easiness to verify what has been learned through testing (Von Glasersfeld, 2001, Labaree, 2005, Löbler, 2006). For the learners this has resulted in an increased focus on measurable cognitive skills, at the expense of more behavioral and affective (i.e. non-cognitive) skills that

are more difficult to measure with standardized test scores but crucial on the labor market, such as entrepreneurial skills. This on-going narrowing of the curriculum in general education is an important challenge to the domain of entrepreneurial education. This unfortunate trend could be counterbalanced if assessing the development of non-cognitive skills were made easier, which is an aim of this thesis.

I posit that developing a classification of action-based entrepreneurial education requires a high level of awareness around these overarching issues in education, since entrepreneurial education always is delivered within an educational system. Much discussion around entrepreneurial education is being held without reference to the century-long debate in general education. Articles contrasting between a "traditional" and an "entrepreneurial" way of teaching are frequent in entrepreneurial education literature, but almost always without reference to the overarching debate in general education. Instead it is positioned as an entrepreneurial education specific problem. The usual way of illustrating the differences is by showing a table with two columns contrasting traditional teaching with entrepreneurial teaching, advocating for a paradigmatic change to entrepreneurial teaching (Gibb, 1993, Johnson, 1988, Ollila and Williams-Middleton, 2011, Cotton, 1991, Kyrö, 2005, Kirby, 2004). Standardized, content focused, passive and single-subject based curriculum in traditional education is contrasted with an individualized, active, process-based, collaborative and multidisciplinary approach in entrepreneurial education. In line with this, entrepreneurial education scholars often discredit traditional business schools for their silo structures and detachment from real life, stating that it is not a suitable place for entrepreneurial education or entrepreneurial extracurricular activities (Hindle, 2007, Binks et al., 2006, Wright et al., 2009, Tan and Ng, 2006). Some also claim that formal education in general suppresses entrepreneurial attitudes (Löbler, 2006, Gorman et al., 1997, Chamard, 1989), supported by studies showing for example that entrepreneurial characteristics were found at 25% of kindergarten children but only at 3% of high school students (Kourilsky, 1980).

The common solution to this debate has so far been to treat entrepreneurial education as a separate topic, giving a small amount of teachers some degree of autonomy over which pedagogical approaches to apply. But with increasing policy pressure on entrepreneurial education to become an integrated part of the entire educational system, this is not a long-term solution. On one side embedding entrepreneurial education is promoted by policymakers, on the other side the trend towards more standardized curriculum and test based educational systems is increasingly excluding entrepreneurial education. This paradox is evident in the Swedish school system today (Falk-Lundqvist et al., 2011).

Some scholars in education have recently proposed a "third way" bridging between traditional and progressive education (Egan, 2008, Hager, 2005), in the form of integrative approaches drawing from both dualist positions of traditionalism and progressivism. This strategy has not yet reached the domain of entrepreneurial education. This thesis can be viewed as an attempt to explore a "third way" strategy drawing both on traditional and entrepreneurial teaching by building on knowledge based value-creating activity as a foundation for both teaching and learning. Such an "actionable knowledge" approach could bridge between knowledge domains and meaningful emotional action-taking, and form a more hands-on basis for assessing development of competencies by assessing concrete actions taken, see Table 2. It could for example lead to learners asking themselves "For whom is this knowledge valuable today?", and also lead to teachers assessing learners by asking "Who did you interact with?". Facilitating assessment of action-based approaches can also be a means to make such approaches more common in education, see Table 2. We will now turn to specific literature on action-based approaches in entrepreneurial education.

General/	Easy to measure		Difficult to measure
Entrepreneurial	Common in education		Less common in education
knowledge /		• • •	-
thought /			
know-what /			
cognition			
skills /	•	<u>\</u>	
action /			- - - -
know-how /			
conation			
attitudes /		``	
emotion /			
know-why /			
affect		1 1 1	

Table 2. Levels of difficulty in measuring competencies, and intention of this thesis to facilitate assessment (dotted line).

2.2 Action-based entrepreneurial education

The action-based approach has been given many different labels in entrepreneurial education literature. Rasmussen and Sörheim (2006) call it action-based entrepreneurship education, defining it as learning-by-doing. Others label it action learning (Leitch and Harrison, 1999), active approach (Henry et al., 2005a), experiential learning (Cooper et al., 2004, Kuratko, 2005), experiential education (Honig, 2004), learning-by-doing (Tan and Ng, 2006, Cope and Watts, 2000) or reflective practice (Neck and Greene, 2011). It would however be a mistake to assume that they are all equal synonyms. In fact, they have very different origins both in terms of theory and practice. They all illustrate the need for entrepreneurial education scholars to draw from the more general domain of learning. It is outside the scope of this thesis to describe various movements in the domain of experiential and action learning, but some important scholars that I discuss further in the papers appended to this thesis are John Dewey, Reg Revans, David Kolb and Peter Jarvis. As an example, a definition is given by Hoover and Whitehead (1975): "Experiential learning exists when a personally responsible participant(s) cognitively, affectively, and behaviorally processes knowledge, skills, and/or attitudes in a learning situation characterized by a high level of active involvement." (p.25).

When action-based entrepreneurial education is discussed it is often done by naming a myriad of different activities that can be undertaken in educational settings (See for example Mwasalwiba, 2010, Kuratko, 2005, Jones and Iredale, 2010). Activities typically include case studies, simulations, business plan creation, film and drama production, project work,

presentations / pitching, games, competitions, setting up real-life ventures, study visits, role plays, interviews with entrepreneurs, internships, mentoring, etcetera. There seems to be a lack of classification schemes within action-based entrepreneurial education, forcing scholars to define it through enumeration. A classification for such activities could thus prove to be useful in this domain.

Since many action-based approaches in entrepreneurial education draw on extra-curricular university-based entrepreneurial ecosystems (Rice et al., 2010, Mwasalwiba, 2010), it is important to emphasize that this thesis focuses on in-curricular action-based activities and approaches in credit giving entrepreneurial education, thus excluding purely extracurricular entrepreneurial activities. This thesis also focuses on the actual activities performed by the learners in an educational setting, since experience does not require learners to take action themselves apart from showing up. It could suffice to be present in a community of practice to experience events that one can learn from, for example being an observer participant in a study visit. The activity-based perspective of this thesis is in line with John Dewey's "learning-by-doing" approach¹, asking questions such as "learning-by-doing *what*?", or "teaching by letting learners do *what*?". Here I regard action and activity as a bridge between teaching and learning, since action-based entrepreneurial education always includes a teacher that designs, orchestrates, or triggers the activities that the learners then learn from doing.

2.2.1 Theoretical foundations of action and activity

Having outlined some perspectives in the rather weak literature base on action-based entrepreneurial education, I will now outline some theoretical and psychological approaches to human action / activity outside the domain of entrepreneurial education. These perspectives will later be used to build a theoretical model of learning-by-doing, as well as to propose a classification of action-based entrepreneurial education. Some key perspectives of these two sections are summarized in Table 3.

The study of human action has been labeled "praxeology" by von Mises (Mises, 1949), rooted in Greek philosophy where praxis means action. According to von Mises, praxeological principles are universally valid for all human actors and all actions (Callahan, 2005), since they are part of our mental structure. Von Mises (1949) defines human action as "purposeful behavior", or "the ego's meaningful response to stimuli and to the conditions of its environment" (p. 11). He states that all human action requires some degree of uneasiness as an incentive to reach a more desirable state, as well as an expectation that taking action will alleviate the felt uneasiness. The ultimate end of any human action is always the satisfaction of some desires of the acting person. The distinction between psychology and praxeology is that the latter does not "seek to identify the motivations, thoughts, and ends that give rise to particular purposes and choices" (Selgin, 1988, p. 23), but only asserts that "all acts of choice have meaning to the individual choosers in terms of *some* goal or purpose" (ibid). For the purpose of this thesis, praxeology puts focus on the mandatory coupling of meaning and action, implying that all activities in action-based entrepreneurial education need to have a purpose

¹ John Dewey did not label his approach to learning as "learning by doing", this widespread labeling has been done by interpreters of his work.

meaningful to the learner. According to Kyrö (2008), praxeology also leads to a very different view on learning and education more in line with social constructivism than with the currently prevailing educational paradigms of behaviorism and cognitivism. Kyrö (ibid) states that this implies that a competency based approach is the most appropriate type of structure for action-based entrepreneurial education. This approach has been chosen as a main tenet of this thesis, and I will elaborate on the competency approach further in a separate section.

Another theoretical framework for understanding human activity is activity theory (Jonassen and Rohrer-Murphy, 1999). This theory was pioneered by Russian researchers Vygotsky, Leont'ev and Luria in early 20:th century. In activity theory, human activity is broken down into subject, object and mediating tools. Subjects undertake activities using tools to achieve an objective, which is then transformed into a valuable outcome, see Figure 1. This is done in a socially situated context of rules, community and division of labor (Uden, 2007). In activity theory the learning that occurs when humans act is labeled "internalization" (Arievitch and Haenen, 2005, p.159). The valuable outcome, often termed "artifact creation", is labeled "externalization" (Miettinen, 2001, p.299). Here we view artifacts as anything created by human art and workmanship, in accordance with a definition by Hilpinen (2011). For the purpose of this thesis, activity theory connects human actions both to the learning they trigger and to the valuable artifacts they result in, see Table 3. The learning dimension of activity theory was the original focus of Vygotsky when he proposed a tool-mediated view on learning as a reaction to the predominant acquisition-based model of learning in solitude explored by Piaget and others, where prepackaged knowledge is transmitted to passive recipients (Kozulin, 2003, Kozulin and Presseisen, 1995). The artifact creation dimension was developed much later (See Engeström, 1999).

Activity theory emphasizes change, contradictions and development rather than stability (Haigh, 2007). These contradictions trigger learning and "are the driving force of change and development" (Engeström, 2009, p.55). Activities exploiting such contradictions can be labeled entrepreneurial activities (Murphy et al., 2006), and thus lead both to valuable outcomes and to learning. Further, activity theory and social constructivism are complementary approaches (Holman et al., 1997, Jones and Holt, 2008). According to some scholars, activity theory provides an appropriate framework for analyzing constructivist learning environments (Jonassen and Rohrer-Murphy, 1999, Uden, 2007), making it a theory also appropriate for the study of entrepreneurial education with its theoretical roots in constructivism (Löbler, 2006). Activity theory also has many similarities to Deweyian pragmatism with its focus on human action and interaction (Miettinen, 2001).

In the field of entrepreneurship a few scholars have used activity theory. Jones and Holt (2008) analyzed new venture creation and suggested that activity theory "provides more depth to the analysis of the sense-making activities undertaken by nascent entrepreneurs" (p. 69). In a study on entrepreneurial learning, Taylor and Thorpe (2004) claimed that "activity theory perspectives regard learning as taking place within the relationships or networks in which a person is engaged", and thus complement Kolb's (1984) "fundamentally cognitive theory of experiential learning" (p.203-204). Ardichvili (2003) used activity theory to study an

opportunity identification course, stating that it "makes it possible to overcome the dualism between individuals and their social environment" (p. 8). Deignan (2010) used activity theory to analyze potential tensions between enterprise education and the surrounding university context.

In this thesis, activity theory has served as an inspiration to consider various tools that can mediate entrepreneurial learning, i.e. mental models, tools and rules-of-thumb from the entrepreneurship literature as well as from the entrepreneurial community that learners get familiar with and then apply in their process of entrepreneurial learning-by-doing, ultimately making them develop entrepreneurial competencies.



Figure 1. The structure of a human activity system (Engeström, 1987, p.78).

2.2.2 Psychological foundations of action and activity

The will and tendency to take action has been considered one of three faculties of the human mind, where the two other are thought / cognition and emotion (Hilgard, 1980). How these three faculties interplay is the subject of much research in psychology, studying antecedents to action as well as outcomes of action. According to Bandura (1989), people "act on their thoughts and later analyze how well their thoughts have served them in managing events" (ibid, p.1181). But recent research in cognitive neuroscience has shown that the formerly assumed primarily cognition based decision making processes of human action rather are as dependent on emotions as on cognitive thought processes (Lakomski and Evers, 2010). Morris et al (2002) showed in a study on advertisements that emotions even can dominate over thoughts in predicting action. On outcomes of action, Baumeister et al (2007) state that an action or event leads to an emotional reaction that stimulates reflective thought and in turn results in a revised prescription for future actions. Thus, psychology literature suggests that both cognition and emotion play important roles in connection to human action, and must therefore be considered also in action-based entrepreneurial education. The formerly neglected role of emotions has been pointed out by some entrepreneurial education scholars, suggesting that emotional events have "a prominent role to play in how entrepreneurs learn" (Cope, 2003, p.434), and that "the affective construct actually rare in entrepreneurship research, should take a more explicit place in learning and teaching" (Kyrö, 2008, p.46). Dirkx (2001) states that emotions are key to attributing meaning to our learning experiences, thus making emotions a central part of action-based entrepreneurial education since praxeology links action to meaning. Studying students' experienced emotions has been chosen as a major perspective in this thesis in order to explore motives around entrepreneurial action and their impact on development of entrepreneurial competencies.

Schumpeter has outlined three main motives for entrepreneurial action; the will to found a private kingdom, the will to win and conquer, and the joy of creating (Goss, 2005). In terms of what can motivate students to act creatively, Pekrun's (2006) control-value theory of achievement emotions stipulates that student motivation and enjoyment is enhanced through actions that are perceived as both controllable and valuable. Thus, action-based entrepreneurial education where students get to create a valuable outcome through challenging yet manageable processes can increase students' levels of enjoyment and motivation, factors that are crucial in entrepreneurial education (Hytti et al., 2010).

 Table 3. Summarizing key aspects of action and activity based on the tripartite division of mind (Hilgard, 1980)

Part of mind	Some key aspects		
Cognitive /	• Informs decisions to act and course of action (Bandura, 1989)		
Thoughts	• Primary focus of education and of learning outcomes assessment (Löbler, 2006)		
	• Primary focus of Kolb's (1984) theory of experiential learning (Taylor and Thorpe, 2004)		
Conative /	• Triggers both learning and value creation (Arievitch and Haenen, 2005; Miettinen, 2001)		
Actions	• Triggers emotional reactions and reflective thoughts (Baumeister, 2007)		
	• Leads to the creation of artifacts which in turn spurs motivation and learning (Goss, 2005)		
Affective /	• Informs decisions to act and course of action (Lakomski and Evers, 2010; Morris et al., 2002)		
Emotions	• Triggers action through a feeling of uneasiness (von Mises, 1949)		
	• Links action with meaning (Dirkx, 2001)		
	• Neglected in entrepreneurship research, plays a key role in learning (Cope, 2003; Kyrö, 200		

2.3 Development of entrepreneurial competencies

Competence/y/ies is a set of terms with widespread use in the human resource development domain, where they are used in assessment of people's job performance (Moore et al., 2002). Sanchez (2011) defines competencies as "a cluster of related knowledge, traits, attitudes and skills that affect a major part of one's job; that correlate with performance on the job; that can be measured against well-accepted standards; and that can be improved via training and development" (ibid, p.241). These terms also have regional variations in interpretation, with differences in emphasis between United Kingdom and United States (Mitchelmore and Rowley, 2010). To alleviate the confusion, Moore et al. (2002) have proposed *competence* to relate to an area of work, *competency* to relate to the behaviors supporting that area of work, and *competencies* to relate to the attributes underpinning these behaviors. They also relate behavior to both ability and willingness to act, leaning on Burgoyne (1989) who defines competency as "the willingness and ability to perform a task" (p. 57).

2.3.1 Entrepreneurial competencies

Combining the two terms *entrepreneurial* and *competencies*, we get a concept that varies substantially in its meaning and interpretation. Still, scholars have found value in using the concept of entrepreneurial competencies. Man et al. (2002) see it as a higher-level characteristic that reflects the "total ability of the entrepreneur to perform a job role successfully" (ibid, p.124). Johannisson (1991) has proposed a framework consisting of five levels of learning; (1) Know-what, or knowledge; (2) Know-when, or insight; (3) Know-who, or social skills; (4) Know-how, or skills; (5) Know-why, or attitudes, values and motives. Based on this framework he calls for more contextual approaches in entrepreneurship teaching, involving qualified experience and social networks through action learning. Another influential scholar is Bird, who (1995) has explored various "laundry lists" of entrepreneurial competencies mainly derived from management theories.

For the purpose of this thesis, a knowledge, skills and attitudes (KSA) based framework for entrepreneurial competencies has been developed, see Table 4. This framework is a developed version of a framework for learning outcomes in entrepreneurship education proposed by Fisher et al. (2008), which in turn leans on a general training evaluation framework proposed by Kraiger et al. (1993) consisting of cognitive, skill-based and affective learning outcomes. Such a KSA approach is in line with the tripartite division of mind outlined earlier in Table 3, and is also in line with the definition of experiential learning outlined earlier (Hoover and Whitehead, 1975, p.25).

Main theme	Sub themes		
Knowledge	Mental models (Kraiger et al., 1993)		
	• Declarative knowledge (Kraiger et al., 1993)		
	• Self-insight (Kraiger et al., 1993)		
Skills	Marketing skills (Fisher et al., 2008)		
	Opportunity skills (Fisher et al., 2008)		
	• Resource skills (Fisher et al., 2008)		
	• Interpersonal skills (Fisher et al., 2008)		
	• Learning skills (Fisher et al., 2008)		
	• Strategic skills (Fisher et al., 2008)		
Attitudes	• Entrepreneurial passion (Fisher et al., 2008)		
	Self-efficacy (Fisher et al., 2008)		
	• Entrepreneurial identity (Krueger, 2005, Krueger, 2007)		
	Proactiveness (Sánchez, 2011, Murnieks, 2007)		
	• Uncertainty / ambiguity tolerance (Sánchez, 2011, Murnieks, 2007)		
	Innovativeness (Krueger, 2005, Murnieks, 2007)		
	Perseverance (Markman et al., 2005, Cotton, 1991)		

2.3.2 Measuring entrepreneurial competencies

A specific aspect of a competencies approach is its emphasis on measurability. Some definitions of competencies include measurability, others do not (Moore et al., 2002). Measuring competencies is problematic, requiring multiple methods and approaches that to a varying degree are subjective. Bird (1995) lists 17 potential methods for assessing

entrepreneurial competencies, such as diaries, observation, archival data, critical event interviewing, role set ratings, cases, think aloud protocols and job shadowing. In the domain of entrepreneurial education an often advocated approach to assess the degree of competencies developed in an entrepreneurship course or program is the use of pseudo-randomized experiments with pre- and post measurements on treatment and control groups (Martin et al., 2013). The measurement instruments are often survey-based and try to capture the prevalence of entrepreneurial knowledge, skills and attitudes before and after an educational treatment. This kind of approach has however been heavily criticized by scholars in education. Olson (2004) claims that "the more simple cause-effect relations so important to the physical and biological sciences are largely inappropriate to the human sciences, which trade on the beliefs, hopes, and reasons of intentional beings." (p. 25). Biesta (2007) states that "education cannot be understood as an intervention or treatment because of the noncausal and normative nature of educational practice and because of the fact that the means and ends in education are internally related." (p. 20). This thesis represents an approach to outcome assessment that differs from these traditional randomized experiment approach, in that it explores what entrepreneurial competency development can be tied to emotionally laden experiences caused by an actionbased entrepreneurial education program. Such an approach can lead to measuring the prevalence of emotional events as a valid proxy for developed entrepreneurial competencies, instead of trying to measure the competencies themselves, which has shown to be both subjective and questionable.

2.3.3 Developing entrepreneurial competencies through education

The ultimate goal of all entrepreneurial education is to develop entrepreneurial competencies among students / learners. Various initiatives have varying emphasis on knowledge, skills and attitudes respectively. There is also a variety in focus of initiatives in terms of educating about, for or through entrepreneurship as outlined previously. Many initiatives apply a narrow definition of entrepreneurship (QAA, 2012, Mahieu, 2006, Fayolle and Gailly, 2008) focusing primarily on opportunity identification, business development, self-employment, venture creation and growth, i.e. learning about or for becoming an entrepreneur. Fewer initiatives apply a broader definition focusing on personal development, creativity, self reliance, initiative taking, action orientation, i.e. becoming entrepreneurial. What definition and approach is used profoundly affects educational objectives, target audiences, course content design, teaching methods and student assessment procedures, leading to a wide diversity of approaches (Mwasalwiba, 2010). Nevertheless, many scholars state that there is only one way to learn to become entrepreneurial, and that is by learning through own experience. Cope leans on a variety of scholars (Minniti and Bygrave, 2001, Dalley and Hamilton, 2000, Young and Sexton, 1997, Gibb, 1997) when stating that there seem to be no shortcuts, it "can only be acquired through learning-by-doing or direct observation" (Cope, 2005, p.381). This is also the position adopted by this thesis, impacting study design and empirical data collection, focusing on environments that apply action-based approaches.

Research on what to let students do more explicitly in action-based entrepreneurial education is in a very early stage. Entrepreneurial education literature is full of "laundry lists" of actionbased activities, but very few theorize or conceptualize beyond the division of activities into about / for / through, or beyond dividing learning environment features into traditional or entrepreneurial as outlined previously, leaving educators wanting to adopt action-based approaches with primarily anecdotal information and general recommendations. Literature on entrepreneurial education is replete with single case studies outlining what one particular team of educators did and how it worked for them, but without a deeper decontextualization, categorization or contrasting to other relevant educational environments within or outside the entrepreneurial domain. One exception is found in a study by Pittaway and Cope (2007b), who propose that educators should try to build in opportunities for students to learn from emotional and risk-laden events and processes by letting them resolve uncertain, complex and ambiguous situations, preferably in authentic settings. Their recommendation is adopted by this thesis, exploring what emotional events lead to development of entrepreneurial competencies, and also exploring what could trigger these emotional events.

2.4 A theoretical framework for "learning-by-doing"

Given that learning-by-doing is so central to explaining how entrepreneurial competencies are developed, I will now outline a theoretical framework for learning-by-doing based on activity theory, see Figure 2. It will be used to point out some aspects of developing entrepreneurial competencies central to this thesis.



Figure 2. A theoretical framework for learning-by-doing based on activity theory.

Vygotsky has stated that all learning originates from social interaction (Vygotsky, 1978). According to activity theory, social interaction can be interpreted as the interaction between subject and object, see Figure 1. In learning-by-doing the subject is the learner taking action together with objects consisting of other humans, see Figure 2. This interaction is based on a shared set of mediating "artifacts", such as shared tools, rules, processes, knowledge, signs, ideas etcetera. The term "artifact" can be broadly defined as anything created by human art and workmanship (Hilpinen, 2011). Therefore, for the purpose of simplifying this framework, in the term "artifacts" I also include the community within which action takes place, its rules and its processes for division of labor as stipulated by activity theory, see Figure 1. Further, according to Vygotsky, shared human activity leads to meaningful outcomes, i.e. "externalization of activity into artifacts" (Miettinen, 2001, p.299). Creation of new artifacts is thus a natural outcome of human activity. In line with previously used definition of artifacts, this too can consist of tools, rules, processes, knowledge, signs and ideas etcetera. Finally, according to Vygotsky, human interaction also leads to construction of new mental abilities, defined as a learning process of "internalization of activity and gradual formation of mental actions" (Arievitch and Haenen, 2005, p.159). This too can be described as a process resulting in construction of mental tools, rules, processes, knowledge, signs and ideas, for future use in new activity. Also illustrated in Figure 2 are the concepts of surface and deep learning. Surface learning has been defined as memorization and acquisition of facts, whereas deep learning has been defined as abstraction of meaning and a process of interpreting experience (Jarvis, 2006).

Given that motivation, meaning and engagement are key factors in entrepreneurial education (Hytti et al., 2010, Kyrö, 2008, Surlemont, 2007, Deuchar, 2007), I will now point out three such aspects / processes of learning-by-doing visible in this framework. The first aspect is the process of (inter-)action, which according to praxeology is always connected to meaning. The second aspect is the process of internalization triggering deep learning. Deep learning is by definition meaningful to learners, which leads to increased motivation. This cannot always be said about surface learning approaches common in education also positioned in the framework. The third aspect triggering motivation is the process of producing valuable outcomes in terms of new artifacts generated through shared activity. Drawing on Pekrun's (2006) control-value theory outlined previously, these artifacts can lead to varying levels of motivation depending on to what extent they are being perceived as valuable to the creators and to external stakeholders in a wider community. In essence, learning-by-doing can be regarded as an emotional and motivation laden process, where motivational levels depend on (1) what actions are taken, (2) what learning occurs and (3) what value is created. I further hypothesize based on this theoretical framework for learning-by-doing that these three processes of motivational triggering can reinforce each other in certain circumstances, such as when the value creation process resonates with certain deep values, goals and beliefs held by the learner. An example is the process of becoming entrepreneurial studied by Williams Middleton (2013) in a venture creation program setting, where students assumed an entrepreneurial identity through social interaction with a community, acting "as if" they were already entrepreneurs and assigning meaning to themselves through the use of storytelling towards key internal and external stakeholders.

2.4.1 Connecting learning-by-doing to wide definitions of being entrepreneurial

This framework for learning-by-doing also allows us to connect wide definitions of being entrepreneurial to the process of learning-by-doing. Mahieu (2006) has described the entrepreneurial culture promoted by OECD since 1989 as consisting of qualities such as habits of "learning, curiosity, creativity, initiative, teamwork and personal responsibility" (ibid, p.63). I will now connect these habits to the framework outlined here. A learning-by-doing approach as framed above fosters habits of learning by default through its deep learning component. It also promotes initiative and responsibility, since it encourages people to take initiative to inter-*action* of the kind that leads to meaningful outcomes, sometimes even valuable to a wider community (i.e. taking responsibility). It is inherently teamwork based, and if the outcome is both novel and valuable to others it also fulfills what commonly is defined as creativity (Amabile and Khaire, 2008). From this I theoretically infer that learning-by-doing is a central approach to making people more entrepreneurial. The remainder of this thesis discusses if and how it can also be validated empirically.

2.4.2 An example: Galperin's framework for action-based teaching

An exception to the lack of robust advice for teachers in the domain of learning-by-doing is the "systemic-theoretical instruction" approach proposed by Piotr Galperin (Haenen, 1996), based on primarily activity theory and decades of research resulting in over 800 works (Arievitch and Haenen, 2005). The six-stage teaching approach contains the following steps (ibid, p.131):

- 1. Motivational stage actions to be learned introduced, connected to relevant goals.
- 2. **Orienting stage** a "cheat schema" outlining a complete framework for actions.
- 3. Material stage learning by taking action in actual practice or through simulation.
- 4. **Overt speech stage** Transferring actions taken into oral speech, linking action with thought and facilitating generalizing in a social setting of "communicated thinking".
- 5. Covert speech stage Inner dialog reflecting on previous stages "in the head".
- 6. **Mental stage** The action takes place in abbreviated form, has been transformed into a partly subconscious scheme or mental phenomenon, as a cognitive tool being "kept in mind".

This approach resonates with many teaching practices advocated in the domain of entrepreneurial education. It is also more explicit than many situated learning theories in its emphasis on cognitive tools such as "cheat sheets", in its emphasis on social and verbal interpretation of actions taken and in its final stages where internalization of actions into mental thought occurs. Rambusch (2006) considers Galperin's theory to be "a necessary and long missing link between sociocultural learning theories and traditional, more cognitivist approaches to learning." (ibid, p. 1998). I posit that Galperin's approach constitutes a rare and robust framework for action-based entrepreneurial education.

3 Methodology

Due to the perceived lack of systematic exploration into action-based entrepreneurial education, a qualitative and explorative multiple case-study approach was used (Yin, 2008), aligning with methodological recommendations (Edmondson et al., 2007). Two major methodological phases can be distinguished in this thesis. The first phase consisted in identifying a suitable empirical setting where action-based entrepreneurial education could be studied in detail. In this first phase, entrepreneurial education programs were chosen as the unit of analysis, aiming to qualify a small selection of programs relevant and worthwhile in terms of strong action orientation and consistent as well as significant development of entrepreneurial competencies. The second phase was conducted with individual students from one of these programs as the chosen unit of analysis, aiming at understanding their process of developing entrepreneurial competencies.

3.1 Phase 1: Qualifying the empirical environment: Venture creation programs

Employing an appropriate sampling strategy is key to any research design. The strategy applied in this thesis has been the extreme case sampling strategy (Flick, 2009, p.122), a strategy often applied when a certain phenomenon is rare enough to merit single case study research designs (Yin, 2009, p.47). Aiming to identify the extreme cases to study in this phase, a selection process was initiated by specifying an initial definition of a particularly action-oriented approach to entrepreneurial education. The most action-based approach to entrepreneurial education conceivable at the outset of this study was to study when students are required to create a real-life venture, a process that arguably requires more than a single course, i.e. focusing on entrepreneurial education *programs* rather than *courses*. The conception of a Venture Creation Program (VCP) was developed, allowing for a purposeful sample. The preliminary definition used for sampling purposes was:

Entrepreneurship or business educations at a higher education level with the on-going creation of a real-life venture as their primary learning vessel and thus part of formal curriculum, with intention to incorporate or in some other way indicate future operative status

This resulted in a mere 18 VCPs having been identified so far, and more VCPs being discovered occasionally. The initial population was analyzed through email/telephone contact to determine a refined VCP population. Ten of these programs were then studied using ten sensitizing concepts developed by reviewing literature on VCPs. Key individuals at these programs were selected for interviews, which were recorded and transcribed. Documentation and public data found online or provided by the interviewees was used to supplement the interview data. A two-day focus-group of program directors/key colleagues was also held with 14 of the identified 18 programs in June 2012 (in Gothenburg, Sweden), providing additional in-depth data. Presentations were video recorded and participants produced written material during the meeting on key themes identified through the initial interviews, including: program objectives, background, key partners, achievements, challenges and funding. Written participant feedback from the meeting confirmed "venture creation programs" as a productive and surprisingly unusual common denominator.

This phase resulted in three conference papers, one of which was decided to be submitted for publication and is included in this thesis (appended paper 2). A general methodological outcome of this phase was that the empirical setting of Chalmers School of Entrepreneurship at Chalmers University of Technology (Gothenburg, Sweden) can be regarded as one of the most mature and comprehensive VCPs out of the 18 identified, thus justifying a single case study approach as employed in phase two of this thesis. The first phase thus qualified Chalmers School of Entrepreneurship as a "paradigmatic case", i.e. a case with metaphorical and prototypical value deemed to be central for human learning (Flyvbjerg, 2006, p.232):

No standard exists for the paradigmatic case because it sets the standard. Hubert Dreyfus and Stuart Dreyfus (1987) saw paradigmatic cases and case studies as central to human learning. In an interview with Hubert Dreyfus, I therefore asked what constitutes a paradigmatic case and how it can be identified. Dreyfus replied: "Heidegger says, you recognize a paradigm case because it shines, but I'm afraid that is not much help. You just have to be intuitive. We all can tell what is a better or worse case—of a Cézanne painting, for instance. But I can't think there could be any rules for deciding what makes Cézanne a paradigmatic modern painter. . . . In fact, nobody really can justify what their intuition is." "

The Chalmers School of Entrepreneurship case has attracted significant interest previously among researchers and policymakers outside Gothenburg (See for example Berggren, 2011, Lindholm Dahlstrand and Berggren, 2010, Hofer et al., 2010, European Commission, 2012a, Rasmussen and Sørheim, 2006). Public data has also shown that it is the most effective university incubator in Sweden (Lundqvist, in press), having generated 27% of all revenue in 2010 among ventures started at 17 Swedish university incubators 1995-2005. These figures support the methodological choice of focusing on this case in the second phase of this study.

From a methodological standpoint it can be questionable when a researcher opts for studying the entrepreneurship program that he or she is deeply involved in, as is the case in phase two of this thesis. It is common in entrepreneurial education research that scholars apply a convenience based sampling strategy, studying their own environment. For these reasons the resource intensive first phase outlined above, resulting in qualifying Chalmers School of Entrepreneurship as a relevant object of study, is of particular importance in this thesis. Building on this, I posit that the three years spent getting to know the 18 identified VCPs worldwide were well spent, establishing the trustworthiness and wider relevancy of the next phase in this study outlined below. It has also been concluded (see paper 2) that VCPs in general, and Chalmers School of Entrepreneurship in particular, provide unique access to nascent stages of entrepreneurial processes, allowing for observation of entrepreneurial competence development as it is taking place, instead of through hindsight. This constitutes a rare "clinical" laboratory environment (Schein, 1993) of high relevancy in research on entrepreneurial competence development primarily, but also on related issues such as technology transfer, general entrepreneurship issues and general education / learning issues.

3.2 Phase 2: Exploring entrepreneurial competency development

In this still on-going phase, a longitudinal design has been applied, following 13 students since September 2012 and ongoing. These students are all following the action-based master program at Chalmers School of Entrepreneurship, Chalmers University of Technology, Sweden. This program is known for its active and hands-on approach, requiring student teams to start a real-life venture based on a technology supplied by external inventors at or outside the university. This specific program applies and defines the "venture creation approach" outlined by Ollila and Williams Middleton (2011) and described previously in this thesis.

11 out of the 13 students in this study work with intellectual property developed by university researchers, corporate researchers or individual inventors outside university, aiming to commercialize it through starting a venture. The remaining two students follow a sister program studying early-stage commercialization but with a project work rather than venture creation based approach. Five of the students were included in the study when they initiated their second year of the master program, and eight of the students have been followed from the start of the two-year master program.

A mixed-methods approach has been applied, using both quantitative and qualitative research methods. A quantitative approach has been developed to capture emotions as they occur through a mobile survey in an experience sampling method (ESM) approach (Morris et al., 2012, p.266), and a qualitative approach has been used to reveal underlying mechanisms through semi-structured interviews, primarily searching for connections between strong emotions and learning outcomes.

3.2.1 Quantitative approach: mobile survey engine

In the quantitative part of this phase, students are equipped with a mobile app in their smartphones connected to a mobile survey engine, and are asked to momentarily register every strong positive and negative emotion they experienced related to their educational experience, and rate it according to the circumplex model of affect (Russell, 1980, Posner et al., 2005), i.e. to rate valence and activation for each event deemed worthy of registering. They are asked to quantitatively rate the following two questions from 1-7 in a likert scale manner each time they make a report; Q1: "How do you feel? (1=very sad/upset versus 7=very happy/contented)", and Q2: "How intensely do you feel this? (1=not at all versus 7=very intensively)". The students are also encouraged to write a sentence or two on why they feel like they do in each app report produced.

The mobile app also contains a possibility to report critical learning events, since this kind of events constitutes an important source of both emotions and learning according to Pittaway and Cope (2007b) as outlined in the theory section. The app probes for six different kinds of critical learning events. These critical learning event reports are also coupled with an opportunity for the students to write a sentence or two about the reason for the critical learning event occurring.

3.2.2 Qualitative approach: Semi-structured interviews

The app-based measurements are followed up with quarterly individual interviews aiming to uncover links between strong emotions and resulting entrepreneurial learning outcomes. A semi-structured approach has been applied, using an interview template with themes covering learning and themes covering emotions. In addition to the semi-structured parts, each interview also includes a discussion around app reports deemed to be particularly interesting from a research perspective, aiming to guide the discussion to interesting events having occurred between interviews. All interviews are recorded and some of them have been transcribed verbatim. To date 40 interviews have been conducted, and an additional 24 interviews are planned in the year to come.

3.2.3 Data analysis: Coding procedure

All data collected in this second phase will be coded in the qualitative data analysis software package NVIVO, using two coding frameworks – one framework for sources of emotions and one framework for entrepreneurial learning outcomes. So far six interviews have been coded, resulting in appended paper 3 on links between strong emotions and developed entrepreneurial competencies. Each framework consists of 9 and 15 sub-themes respectively. The coding framework for sources of emotions is based on an article by Arpiainen et al. (2013), where the author of this thesis is a co-author (an article not appended to this thesis). This article outlines main sources of strong emotions in two entrepreneurship education programs in Finland and Namibia and one entrepreneurship education course in Estonia, see Table 5. The coding framework for entrepreneurial learning outcomes is based on the entrepreneurial competencies framework outlined in the theory section, see Table 4, and has been further developed for the purpose of this study, see Table 6, which also constitutes the operationalization part of the answer to RQ 1 of this thesis – "how can entrepreneurial competencies be operationalized and measured?".

During the coding process more codes are added when the coding frameworks do not capture important dimensions in the data. This kind of coding is called "open coding", and is a method suitable for developing theory or creating new theory (Corbin and Strauss, 1990). After the interviews are coded, a coding matrix is produced using functionality for this in the NVIVO software package. In the third appended paper this matrix has tentatively been used to identify salient connections between emotions and learning outcomes in the data. Although it is based on transcribed interviews with only three out of the 13 respondents in this study, interesting links between emotions and learning outcomes have already surfaced, outlined in Figure 3 and explained in detail in the appended paper. This is methodologically promising.

Main themes	Sub themes used for coding in NVIVO	
New kind of learning environment	Uncertainty and confusion	
	Theory versus practice	
	Support from outside of the learning environment	
Collaborative learning	Team-work experience	
	Time pressure	
	Individual differences between the students	
Challenging tasks	Overcoming knowledge and skills gaps	
	Interacting with outside world	
	Leadership and managing people	

Main theme	Sub themes	Primary source	My interpretation when coding data
Knowledge	Mental models	(Kraiger et al., 1993)	How to get things done without resources, risk and probability models.
	Declarative knowledge	(Kraiger et al., 1993)	Basics of accounting, finance, technology, marketing, risk
	Self-insight	(Kraiger et al., 1993)	Knowledge of personal fit with entrepreneurship career
Skills	Marketing skills	(Fisher et al., 2008)	Conducting market research, assessing the marketplace, Marketing products and services, Persuasion, getting people excited about your ideas, Dealing with customers, Communicating a vision
	Opportunity skills	(Fisher et al., 2008)	Recognizing and acting on business opportunities, Product development skills
	Resource skills	(Fisher et al., 2008)	Creating a business plan, including a financial plan, Obtaining financing
	Interpersonal skills	(Fisher et al., 2008)	Leadership, motivating others, Managing people, Listening, Resolving conflict
	Learning skills	(Fisher et al., 2008)	Active learning, Adapting to new situations, coping with uncertainty
	Strategic skills	(Fisher et al., 2008)	Setting priorities (goal setting) and focusing on goals, Defining a vision, Developing a strategy, Identifying strategic partners, Risk management
Attitudes	Entrepreneurial passion	(Fisher et al., 2008)	"I want". Need for achievement
	Self-efficacy	(Fisher et al., 2008)	"I can"
	Entrepreneurial identity	(Krueger, 2005, Krueger, 2007)	"I am / I value". Deep beliefs, role identity, values, axiology
	Proactiveness	(Sánchez, 2011, Murnieks, 2007)	"I do". Action-oriented, initiator, proactive
	Uncertainty / ambiguity tolerance	(Sánchez, 2011, Murnieks, 2007)	"I dare". Comfortable with uncertainty and ambiguity, adaptable, open to surprises,
	Innovativeness	(Krueger, 2005, Murnieks, 2007)	"I create". Novel thoughts / actions, unpredictable, radical change, innovative, visionary, creative, rule breaker
	Perseverance	(Markman et al., 2005, Cotton, 1991)	"I overcome".

Fable 6. Elaborated framework for	r entrepreneurial	competencies used	as coding framework	in NVIVO.
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Figure 3. Links between emotions and learning outcomes based on coding matrix.

No	Paper	Authors	Status	Subject / relevance	Method	My role
1	How can Entrepreneurship bridge between Traditional and Progressive Education?	Lackéus, M., Lundqvist, M., Williams Middleton, K.,	Presented at ECSB 3E, 2013	Develops main theoretical conceptions used in this thesis. Outlines a tools approach that was a precursor to the activity classification outlined in this thesis kappa. Thereby indirectly addresses RQ2 and RQ3.	Conceptual paper	First author, presen- tor.
2	Venture Creation Programs – bridging Entrepreneurship Education and Technology Transfer	Lackéus, M., Williams Middleton, K.	Accepted for publi- cation in Education + Training.	Outlines empirical setting. Explores venture creation programs as an instance of action-based entrepreneurial education. Uncovers what activities contribute to development of entrepreneurial competencies, thus addressing primarily RQ2	Empirical research paper. Multiple case study design.	Equal author.
3	Links between Emotions and Learning Outcomes in Entrepreneurial Education	Lackéus, M.	Presented at NFF 2013.	First test of developed methodology in second phase of this study. Uncovers how activities develop entrepreneurial competencies, thus addressing primarily RQ1 and RQ3.	Empirical research paper. Multiple case study design.	Sole contri- butor and presen- tor.

4 Summary of appended papers

4.1 "How can Entrepreneurship bridge between Traditional and Progressive Education?"

In this paper we argue that the "fault line" between traditional and progressive education starts in the domain of philosophy of science, passing through general educational philosophy and its century-long battle for control over instructional design practices, and ends up in the entrepreneurial education domain. This paper then asks the question: How can entrepreneurship contribute with cognitive tools that bridge between traditionalist and progressivist educational perspectives? Cognitive tools are defined by Egan (2008) as "the things people think with, not the things they think about".

The analysis has yielded five dualisms that are described more in-depth. Attempting to bridge and balance between these dualisms we end up with five resulting questions: How can entrepreneurship contribute with cognitive tools that...

-simplify a complex, multidisciplinary and holistic constructivist learning environment?
-preserve the concrete and individual aspects in a social learning environment?
-inject more content and linearity into an iterative learning process?
-facilitate detached reflection in an emotional and action-oriented learning environment?
-absorb more theoretical knowledge into an experiential learning environment?

These five resulting questions are tested on two candidates for cognitive tools that can mediate learning; value creation and entrepreneurship as a method. Both of these candidates seem to be quite constructive means to balance between traditional and progressive education. For researchers this opens up for new opportunities to consider entrepreneurship theory and practice as pedagogical cognitive tools in general education. For practitioners this can serve as inspiration for trying out some of the vast array of tools, models and concepts from the entrepreneurship domain in general education. Further inquiry into the entrepreneurship domain can surface more cognitive tools of potential use.

Research that leverages profoundly on theory from both entrepreneurship and education is scarce. This specific attempt has potential to lead to a flexible yet criteria based "third way" between the rigidity of traditional education and the vagueness of progressivism. It also holds potential to bridge the gap between advocated and applied pedagogy in the field of education, where desired pedagogical approaches often are not used in practice due to the higher cost of such approaches and their misalignment to the conventional educational systems and paradigms.

4.2 "Venture Creation Programs – bridging Entrepreneurship Education and Technology Transfer"

The article explores how university-based entrepreneurship programs, incorporating real-life venture creation into educational design and delivery, can bridge the gap between entrepreneurship education and technology transfer within the university environment. Based on a literature review and snowball sampling over a two-year period, 18 entrepreneurship education programs were identified as applying a venture creation approach. Ten of these programs were selected for case study, including interviews and participatory observation during a two-day workshop. Empirical findings were iteratively related to theory within entrepreneurship education and technology transfer.

The article identifies the bridging capabilities of venture creation programs (VCPs) across five core themes, illustrating the potential benefits of closer collaboration between entrepreneurship education and technology transfer in a university environment. A definition for 'venture creation program' is tested empirically. These programs are shown to be sophisticated laboratory environments, allowing for clinical research towards the understanding of entrepreneurship and technology transfer processes. Findings identify practical benefits of combining entrepreneurship educators and technology transfer activities, such as increased value creation through not only new firms, but also an entrepreneurially equipped graduate population. VCPs allow for 'spin-through' of innovative ideas in the university environment, while simultaneously contributing to entrepreneurial learning.

This article presents findings from the first multiple case study into entrepreneurship educations specifically designed to develop real-life venture as part of the core curriculum. Findings provide basis for investigating the value of integrating entrepreneurship education and technology transfer at the university.
4.3 "Links between Emotions and Learning Outcomes in Entrepreneurial Education"

This paper investigates links between strong emotions and entrepreneurial learning outcomes in an action-based entrepreneurship education program. Students' own experiences were assessed during their participation in a master level university program where they were expected to start a real venture as formal part of curriculum. An explicit focus on emotions in action-based entrepreneurship education is unusual in previous research, but can trigger new insights on antecedents to entrepreneurial learning outcomes. It also represents a novel approach to assessing learning outcomes of entrepreneurial education. A longitudinal design was applied following three students during nine intensive months. Students were equipped with a mobile app-based survey engine in their smartphones, and were asked to momentarily register emotions and critical learning events related to their educational experience. These app-based measurements were followed up quarterly with semi-structured interviews to uncover links between strong emotions and resulting entrepreneurial learning outcomes. Links were identified by using software analysis package NVIVO and theoretical as well as open coding of data.

Findings indicate a large number of links between strong emotions and entrepreneurial learning outcomes. Some links seem stronger than others. Three sources of emotions that seem to be particularly linked to entrepreneurial learning outcomes are interaction with outside world, uncertainty and ambiguity in learning environment and team-work experience. These sources of emotion seem to be linked to formation of entrepreneurial identity, increased self-efficacy, increased uncertainty and ambiguity tolerance and increased self-insight. Strong emotions induced by action-based entrepreneurial education seem to primarily impact attitudinal learning outcomes. These findings represent a novel approach to assessing learning outcomes within entrepreneurial education. They also represent early empirical evidence for three seemingly effective design principles of entrepreneurial education. Educators aiming to develop entrepreneurial competencies should try to design a learning environment ripe of uncertainty and ambiguity where students frequently are able and encouraged to interact with the outside world in a working environment characterized by a team-based approach. This study also represents an attempt to open the "black box" of entrepreneurial learning, since it has been possible to uncover some of the mechanisms behind the links observed between emotions and learning. Important limitations of this study include a small number of interviewees, unknown transferability of results to other contexts and learning environments, risk for individual bias in the data coding procedure and a lack of established theoretical frameworks for strong emotions and learning outcomes within the domain of entrepreneurship education.

5 Towards a classification of action-based entrepreneurial education

Some common purposes of classifications are to improve the actions of practitioners (Lamp, 2011), to reduce cognitive load on individuals by removing differentiation that is irrelevant for the purpose (Jacob, 2004), and to establish stable and meaningful relations between classes (ibid). In this thesis, a proposed classification of approaches to action-based entrepreneurial education represents an answer to RQ2, in that it outlines four different classes of activity that can develop entrepreneurial competencies in entrepreneurial education, see Figure 4. This classification scheme can also be regarded as a tool for distinguishing between different activities in terms of degree of motivation for the learner as well as in terms of complexity for the teacher. This can help scaffolding educators' judgment of which class of activity to opt for in any given teaching situation depending on purpose, ability, resource access, interest and context. In this classification I posit that the further you get into the classification questionnaire (further down in Figure 4), the higher the potential student motivation and engagement, but unfortunately also the higher the teaching complexity.



Figure 4. Classification of action-based entrepreneurial education in two levels.

This attempt to classify action-based entrepreneurial education activities is based on extensive study of venture creation programs, an educational format containing most of the example activities outlined in Figure 4. It is thus a classification that draws on all three appended papers as well as the empirical and theoretical perspectives outlined there. Although this study could

be argued to be well positioned to outline a classification of this kind, it remains to evaluate its usefulness and validity among practitioners and scholars. Below the different classes are outlined and connected to the appended papers.

5.1 The creation approach - defining action-based entrepreneurial education

The first level classification is an attempt to determine if any given approach to entrepreneurial education should be classified as action-based or not. Building on the previously outlined theoretical framework for learning-by-doing (see Figure 2), the creation of new human artifacts has been chosen as the differentiating factor in this classification scheme. As activity is always coupled with meaning, and frequently also with an outcome meaningful to the creator(s), this gives action-based approaches an inherently higher level of meaning and consequently motivation to the learner than non action-based approaches. This aligns with one of Schumpeter's three basic motives for entrepreneurial action – the joy of creating (Goss, 2005). Indeed, in the third paper appended to this thesis (see p.13 and 15), the joy of creating is vividly described by some respondents. This classification level thus results in a proposed definition for action-based entrepreneurial education; educational approaches where the learners get to create new artifacts through activity. As stated before, "artifact" can in turn be defined as anything created by human art and workmanship (Hilpinen, 2011).

Some examples of activities in a creation approach include opportunity mapping, project work in teams, case based teaching, role play, drama / film pedagogy without external audience, simulations, games, interviews / meetings with external stakeholders and business plan creation without external stakeholders involved. Some examples that are not regarded to be action-based approaches are lectures, guest lectures, group or class discussions, study visits, literature study and standardized tests.

5.2 The value creation approach

The first of three questions in the second level classification captures those approaches where the newly created artifacts are considered valuable by stakeholders outside the creators, i.e. people apart from the learners and the teacher. Here, the teacher is included as one of the creators, for two reasons. The first reason is to acknowledge that it is an educational activity triggering the creation of artifacts, orchestrated and thus co-created by a teacher. The second reason is that such a distinction excludes all activities where artifacts are created solely to please the teacher – a traditional model in education but one that arguably does not create as high levels of motivation and meaning for the learners as if their work is appreciated by "real world" stakeholders. Indeed, in the third appended paper (see p.13 and 15) respondents emphasize "making others think it is interesting" and "that [external] people trust you" as being a source of high levels of motivation. In Schumpeterian terms (Goss, 2005), a value creation approach could also be attributed primarily to the joy of creating, but on a higher level of meaningfulness. Also in the second appended paper the centrality of creating value to external stakeholders is identified as a key characteristic of VCPs (see table 4 in appended paper no 2).

Some examples of activities in a value creation approach include business model canvas generation (Osterwalder, 2004), pitching an idea to external stakeholders, co-creation with partners, traineeships / internships, drama / film pedagogy involving an external audience and customer development methodology (Blank, 2005).

5.3 The venture creation approach

The second question in level two classification captures approaches where learners are expected to organize the value creation activities into a social, corporate or start-up venture. As an example, Neck and Greene (2011) outline a real-world venture creation course at Babson College consisting of a "limited duration business start-up" (p.63), stating that such approaches are becoming more commonplace at business schools. A similar approach in secondary level education is Young Enterprise, where pupils create a company that runs for eight months, "after which it will go into voluntary liquidation." (Dwerryhouse, 2001, p.155). Integral to venture creation approaches are activities such as business planning, financial accounting, market analysis, marketing and human resource planning (ibid). Another approach that fits into this class is the "venture creation approach" presented in the theory section (2011). In this classification I would however put such an approach primarily in the next class of sustainable venture creation, see below.

In entrepreneurial education a focus on creating a business plan is a very common focus (Honig, 2004). All to often however, "most if not all business plans fail upon first contact with the assumed customers" (Jones and Penaluna, 2013). Most business plan courses consist primarily of desk-based guesswork (ibid), and are thus more in line with a creation approach than with a venture creation approach, since such work does not create value to external stakeholders. Instead the business plan becomes primarily a deliverable to the teacher.

In appended paper two, a respondent points out that it is the iterative doing around the business plan that is important (see page 9 of appended paper no 2). I posit that it is this very process of iteration with external stakeholders that creates the high levels of commitment and emotional ownership among learners possible to reach at this level of action-based entrepreneurial education and reported in the second appended paper. One reason that the doing around a business plan often is neglected is that it involves a relatively high degree of complexity compared to just producing a plain desk based business plan. This complexity has however quite recently been alleviated through some new practice-oriented tools, such as Customer Development (Blank, 2005), Business Model Generation (Osterwalder, 2004) and Lean Startup (Ries, 2010), tools that in this thesis are classified as value creation tools, i.e. as precursors to venture creation. From a Schumpeterian point of view, the venture creation approach can activate two of the three main motives for entrepreneurial action – both the joy of creating and the will to conquer and win (Goss, 2005), since a venture can be regarded as a vehicle for competing on a market rather than just creating one-off value for any random external person or organization.

To conclude this class, some examples of activities in a venture creation approach include business plan writing involving external stakeholders, the young enterprise approach (Dwerryhouse, 2001), venture creation courses, entrepreneurial community collaboration (competitions, incubators, student clubs etc.), financial projections for a venture and applications of legal frameworks for venture creation.

5.4 The sustainable venture creation approach

A marginal but for this thesis relevant approach is the sustainable venture creation approach. It could be argued if the value of such a class merits its own class in this classification, but in the early stage of this study it was evident that many VCPs illustrated a magnitude of real-life content that very few entrepreneurial education programs have. In the second appended article the moment is described when students reach a "tipping point" (see p. 10), which is when students realize that the venture they are working on might actually become a real company. This transforms the venture from being a school project to feeling real. This moment has shown to have a dramatic positive impact on learners' motivation, engagement and effort. In the definition of a VCP this was captured through the phrase "with an intention to incorporate". Many examined potential VCPs were excluded based on this part of the definition of a VCP. I posit that real-life venture creation intention is crucial in spurring a particularly high level of motivation and engagement among learners. However, it also represents a teachability challenge in that it induces a wide variety of complexity and challenges that for many educational institutions are currently impossible to manage for legal or other reasons. This could contribute to explaining the scarcity of VCPs. From a Schumpeterian point of view the sustainable venture creation approach opens up for the third of the motives for entrepreneurial action, i.e. the will to create a kingdom. This aspect is touched upon in the third appended paper (see p.13), when students claim to be able to "take over the world".

There are very few examples of a sustainable venture creation approach. This study has revealed 18 programs worldwide that exemplify this approach to a varying extent. Ten of them are described in the second appended paper (see for example table 2 in paper two). The approach has also previously been outlined by Ollila and Williams Middleton (2011), but without the prefix "sustainable".

6 Discussion

It is no easy feat to linearly present a thesis resulting from an iterative process of systematic combining and matching between theory and empirical phenomena (Dubois and Gadde, 2002) as is the case here. The frameworks and propositions outlined in this thesis have not emerged through pure induction, nor through pure deduction, which poses challenges both in presenting the evidence base and in outlining a repeatable process for replicating the results. They have rather evolved following several years of in-depth immersion into action-based entrepreneurial education, where the author has assumed different roles, such as entrepreneurial education student (2000-2001), nascent entrepreneur (2001-2003), successful entrepreneur (2004-2008) and finally the role of nascent researcher (2009-2013). Still, this discussion will be presented in a semi-linear way partly constructed for the purpose of this thesis, to facilitate external evaluation of propositions made, see Table 7.

Proposition	How general understanding of development of entrepreneurial competencies could be increased	How it addresses the three research questions RQ1-3	Appended papers covering this proposition
P1: Entrepreneurial competencies can be operationalized through a tripartite framework (see Table 1, Table 4 and Table 6)	• Widens the scope of entrepreneurial competencies to include all three faculties of the human mind, in contrast to the traditionally cognitively biased perspective	 A direct response to RQ1 Helps responding RQ2 and RQ3 by specifying the desirable outcome 	The methodological foundation of paper 3. Was developed through the study reported in paper 2.
P2: Action-based entrepreneurial education can be classified into four classes (see Figure 4)	 Could help teachers comparing different pedagogical approaches Could help researchers focus on more relevant aspects 	 A direct response to RQ2. Helps responding RQ3 by specifying classes of activities that trigger emotional events. 	All three papers are precursors to this classification, covering different classes.
P3: There is a causal relationship between actions, triggered emotions and developed entrepreneurial competencies (see Figure 5)	 Emotional events can be regarded as a proxy between action-based activities and developed entrepreneurial competencies Studying links between emotional events and learning can open up the "black box" of entrepreneurial learning 	 A direct response to RQ3. Was uncovered through the response to RQ1 given in the methodological development phase 	The primary focus of paper 3.
P4: Assessing / evaluating entrepreneurial education can be done indirectly by measuring emotional events (see Table 2, Table 8 and Table 9)	• An event-based view on developing and assessing entrepreneurial competencies can evolve, which could be a more productive basis for further research as well as for practice (see Table 8)	• A consequence of the response to RQ3 given by P3.	Mentioned in paper 3 as a future possibility.
P5: An "actionable knowledge" approach can bridge traditional and progressive education (see Figure 6)	• Puts the development of entrepreneurial competencies into a wider context of general education.	• One of a few responses to RQ2 and RQ3, and is thus connected to P2.	The primary focus of paper 1.

Table 7 Main propositions of this thesis and their	connection to nurnose researc	h questions and annended naners
Table 7. Main propositions of this thesis and then	connection to purpose, researd	in questions and appended papers.

A basic tenet in this endeavor to increase our understanding of how entrepreneurial competencies could be developed has been to study emotional events, following

recommendation from key scholars in the field of entrepreneurial education (Cope, 2005, Pittaway and Cope, 2007b, Kyrö, 2008) and supported by research in psychology (Baumeister et al., 2007, Dirkx, 2001). This first resulted in a framework for entrepreneurial competencies emphasizing emotions as well as actions in addition to the usual focus on cognition, see proposition 1 in Table 7. Empirical work outlined in appended papers 2 and 3 and theoretical work outlined in appended paper 1 subsequently resulted in articulating the previously proposed classification of activities that trigger emotional events, see proposition 2 in Table 7. Next step was to search for connections between emotional events and developed entrepreneurial competencies, outlined in appended paper 3 and resulting in proposition 3 in Table 7. This work then led to stating that actions, emotions and developed entrepreneurial competencies are causally linked, see proposition 4 in Table 7. Finally a need to bridge between traditional and progressive education through the developed frameworks and propositions was contemplated, resulting in proposition 5 in Table 7. I will now discuss these five main propositions.

6.1 P1: Entrepreneurial competencies can be operationalized through a tripartite framework

As outlined in the method section, an entrepreneurial competencies framework has been developed in this study. Coupled with an emotional events framework it has shown capable of interpreting large amounts of qualitative data into a limited number of categories of developed entrepreneurial competencies, thus allowing for measurement of developed entrepreneurial competencies. Appended paper 3 shows that the developed framework captures a high proportion of the situations discussed by the interviewees. Three open codes were added in the process; autonomy, self-esteem and other aspects. A future consideration needed is whether to add these open codes into a future version of theoretical coding framework. Autonomy has been discussed as an entrepreneurial competency in previous literature (See for example Shane, 2004, p.159, and Aouni and Surlemont, 2009, p.434). Self-esteem could be regarded as part of entrepreneurial identity (Markowska, 2011), but might still merit its own category in a future version of an entrepreneurial competencies framework. Revising and clarifying the entrepreneurial competencies framework developed through this study and presented in this thesis is a work that needs to continue, and will impact inter-rater reliability substantially in future work.

6.2 P2: Action-based entrepreneurial education can be classified into four classes

The classification framework proposed in Figure 4 is in fact a mixture between a classification and a categorization. Classification theory is a subject where librarians and information system designers are at the forefront of research. In this field there is a constant debate between proponents of subjective value-based flexible *categorization* and proponents of objective rule-based systematic *classification* (Mai, 2011). Categorization is argued to be a flexible process of context dependent grouping resulting in fuzzy boundaries where any entity can belong to multiple categories, whereas classification is a systematic and rigorous process resulting in mutually exclusive and non-overlapping classes (Jacob, 2004).

The classes proposed in Figure 4 are neither mutually exclusive nor non-overlapping. Even though the questions posed are designed to be yes/no questions, there is room for interpretation. One example is the venture creation approach proposed by Ollila and Williams Middleton (2011). It is an approach which contains aspects of creation, value creation, venture creation as well as sustainable venture creation. Another example is Young Enterprise (Dwerryhouse, 2001), which some could argue is a good example of a venture creation approach. Still, there are critics of this approach stating that it employs a too narrow approach to entrepreneurship, instilling a view of entrepreneurship in adolescents as being about financial reporting and making money (Otterborg, 2011, Smålandsposten, 2013). Here we then have an approach that is largely about venture creation, but allegedly with a too weak emphasis on creation and value creation. Should we then view Young Enterprise as an instance of "merely" creation, i.e. that the focus is primarily creation of artifacts that will please the teacher, or can we view it as venture creation albeit with some problematic issues attached to it? We can conclude that a classification might solve some confusion issues and help in making sense of action-based entrepreneurial education, but will probably spur new questions.

6.3 P3: Actions, triggered emotions and developed entrepreneurial competencies are causally linked

In an attempt to answer RQ3 concerning how the action-based activities outlined in Figure 4 develop entrepreneurial competencies we will now turn to the emotional events that they might trigger as well as the resulting development of entrepreneurial competencies. The first appended paper conceptually explores how value creation can foster learning, outlining for example that both success and failure to create value can trigger reflection (p. 9 in appended paper no 1). However, none of the appended papers specifically focuses empirically on triggers to emotional events. Therefore at this stage we need to explore conceptually how the four proposed classes of action-based activities can be seen as triggering emotional events. Further investigation needs to be conducted exploring this also empirically.

This study has revealed 17 emotional types of events that to varying extent can be linked to development of entrepreneurial competencies, see third appended paper (p. 12). Conceptually, I posit that the four classes of action-based activities in entrepreneurial education can trigger at least the emotional events shown in Figure 5. For example, creating value to external stakeholders must reasonably trigger events of interaction with outside world, which has shown to often be emotional as outlined in appended paper 3. Also, the frequency, strength and variety of emotional events will probably increase the further down we get in the classification model illustrated in Figure 4, as assumption based both on theory outlined previously and on empirical data in appended paper that supports this (see for example p.15 in third appended paper). Further, the third appended paper empirically outlines links between emotional events and developed entrepreneurial competencies. This means that emotional events can be regarded as a proxy between action-based activities and developed entrepreneurial competencies, see Figure 5. Thus, I posit that action-based activities trigger emotional events, which in their turn lead to development of entrepreneurial competencies.

The empirical exploration of this kind of linkages has not been done previously in entrepreneurial education to my knowledge. From a theoretical perspective the crucial role of emotions in learning has however been discussed previously. Kort et al. (2001) have proposed a model of how emotions impact learning. Pekrun et al. (2011) have developed a survey instrument to measure achievement emotions in order to explore how they impact learning in educational settings. Still it is a neglected field of educational research (Pekrun, 2005). Getting back to the proposed framework for learning-by-doing (see Figure 2). I posit that it is the internalization / deep learning process that is fuelled by strong emotions, and thus leads to build-up of an entrepreneurial cognitive toolbox which directs future actions taken. Dirkx (2001) states that emotions not only impede or motivate learning, but also play a central role in "our ways of knowing" and invite "a deeper understanding of ourselves" (p.64). Still, proposition 3 is based on early stage assumptions and hypotheses in need of further work, both theoretically and empirically. The measurement of emotions is also a field replete with methodological challenges (Pekrun et al., 2011, Ortony and Turner, 1990). Here, the experience sampling method used in this study, as well as its more recent variation labeled Ecological Momentary Assessment have been positioned as methods for avoiding "retrospective distortion of data" (Stone et al., 2003, p.28).



Figure 5. Emotional events as a proxy between action-based activities and developed entrepreneurial competencies

6.4 P4: Entrepreneurial education can be assessed by measuring emotional events

The causality proposed in Figure 5 opens up for new approaches to evaluation and assessment in entrepreneurial education, a topic of interest to policymakers, researchers and educators. Instead of trying to measure the evasive and subjective entrepreneurial competencies (Bird, 1995), I propose that we could measure emotional events, i.e. take advantage of the uncovered proxy between action-based educational activities and developed entrepreneurial competencies. We could for example measure the frequency, kind and magnitude of emotional events of the kinds uncovered in the third appended paper (see p. 12 in third appended paper). More frequent and stronger emotional events of certain kinds could then indicate a more effective entrepreneurial education intervention. This is illustrated in Table 8 together with the previously proposed activities to develop entrepreneurial competencies. In this table, entrepreneurial skills are split up in two parts, illustrating that some aspects of skills are more cognitive based and others are more non-cognitive based (action and emotion oriented) and thus more difficult to assess with traditional assessment methods.

Entrepreneurial	What are they?	How to develop?	How to assess?
knowledge /	Mental models,	• Lectures	Summative tests
thought /	declarative knowledge	Reading literature	• Reports – oral/text
know-what /			
cognition			
skills /	Marketing, strategy	• Lectures	Summative tests
action /	skills	Reading literature	• Reports – oral/text
know-how /		Case based teaching	
conation	Resource acquisition,	Actionable knowledge	• Jobs taken / done
	Opportunity	approach	• Pre/post surveys
	identification, learning,	Artifact creation	 Valuing artifacts
	interpersonal skills	Value creation	• Measuring (emotional)
attitudes /	Passion, self-efficacy,	• Venture creation	activity of specific kinds
emotion /	identity, proactiveness,	Sustainable venture	• Measuring value created
know-why /	perseverance,	creation	during/after
affect	uncertainty tolerance	• Trigger emotional	 Measuring value
		events	creation attempts
		• Interaction with outside	 Reports – oral/text
		stakeholders	
		• Team-based work	
		• Uncertain setting	

Table 8. My contribution (in bold) to our understanding of how to develop and assess entrepreneurial competen	cies.
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Given that measurability is what makes an educational approach viable on a wider scale (Löbler, 2006), a more robust approach to evaluation and assessment may allow for a stronger emphasis on action-based approaches in entrepreneurial education, and thus lead to a changed focus among entrepreneurial education providers towards more effective active approaches than the passive ones currently widely applied (Mwasalwiba, 2010). It could also provide progressive and constructivist educators with new measurement tools currently in short supply, thus increasing the possibility to bridge the debate in education outlined previously through an action-based approach coupled with new measurement instruments, see Table 2. After all, the

debate around educational traditions is to a large extent tied to the measurability of competence development (Labaree, 2005, Löbler, 2006), currently a huge advantage to passive behaviorist approaches. I posit that an action-based approach to not only development but also assessment of entrepreneurial competencies represents a new kind of "third way" in an educational system where an increasing number of educators are currently struggling to integrate entrepreneurial methods and tools, both across the curriculum and at primary, secondary and tertiary levels of education (Gibb, 2011, Smith, 2008, Mahieu, 2006). A detailed outline and examples of proposed assessment approaches is outlined in Table 9.

How promising the idea of measuring activity might seem, significant challenges remain before such an approach could be realized. New quantitative measurement instruments take many years to develop, validate and put to practical use. While Table 9 gives some rough ideas of what could be measured, the detailed craftwork to develop hypotheses to items and scales that can then be tested on hundreds or preferably thousands of participants in education is a daunting task. It should probably also be complemented by more traditional measurement employing a pre / post research design as outlined in the theory chapter, as well as benefit from drawing on previous work in assessment of creativity and divergent thinking (Plucker and Runco, 1998), which for example stipulates that "both quantity and quality of creative achievement should be included as outcome variables" (p. 37).

Measurement approach	Examples	Value / validity
Valuing artifacts	Portfolio assessment in art schoolsBusiness plan evaluation	Artifact creation can develop entrepreneurial competencies.
Measuring emotional activity	 Measure number of interactions with outside world Measure/assess perceived uncertainty in learning environment, through for example surveys Measure/assess levels of trust reached in teamwork Assess (number and kinds of) opportunities for applying theory in real-life situations Measure/assess (number of) opportunities for managing other people in shared activity 	Some emotional events have shown to lead to the development of entrepreneurial competencies
Measuring value creation (attempts)	 Measure number of external stakeholders contacted and/or met by the learner Measure number of external stakeholders willing to engage above a certain threshold Measure / assess tangible value learners created that was appreciated by external stakeholders 	When value creation is attempted and/or achieved together with external stakeholders it leads to development of entrepreneurial competencies
Learner reports – oral / text	 Written reflection on action and / or emotion, individual / group Oral reflection on action and / or emotion, one-on- one / group / plenum Storytelling, where the learners' actions and emotions are used as the basis for a story told by the learner 	When learners are asked to reflect on their action/activity and/or the emotions that are connected to them, it leads to internalization of tools, methods, knowledge, i.e. development of entrepreneurial competencies

 Table 9. Assessment approaches proposed in this thesis, some examples and value/validity.

6.5 P5: An "actionable knowledge" approach can bridge traditional and progressive education

This thesis has addressed the need to bridge between traditional and progressive education, both in general and entrepreneurial education. This theme was explored conceptually in appended paper 1, and has resulted in a set of questions that could guide further work, as well as in a framework outlining the similarities in dualistic challenges inherent in philosophy of science, educational philosophy, entrepreneurial education and entrepreneurship, see Figure 6. A general principle has been proposed in this thesis labeled "actionable knowledge", where action / activity bridges between these dualisms by letting learners find and act on the answer to the question "for whom is this knowledge valuable today?". By finding use for acquired knowledge immediately through interaction with external stakeholders as opposed to the usual teacher assertion "you will have use for this knowledge in 15 years from now", high levels of motivation could be triggered, fuelling the learning process. I propose labeling this an "altruistic paradox", stipulating that we get more motivated by creating value for others today than by creating value for ourselves in a distant future. Perhaps we are not as individualistic as we are being told to assume. In line with this, political writer George Gilder has proposed three entrepreneurial virtues; giving, humility and commitment (Spinosa et al., 1999), and has even proposed that profit is an index of the altruism of an investment (Gilder, 2013). Critics of Gilder have stated that labeling capitalism as altruism is nothing but a "subtle shuffling of words" (Himmelstein, 1981). Still, regarding entrepreneurship as a knowledge-based process of creating value to others could help bridging between traditional and progressive education.

Building on the "actionable knowledge" approach, the five questions from appended paper 1 could now be restated as: What *actions / activities* (instead of cognitive tools) in entrepreneurial education can...

-simplify a complex, multidisciplinary and holistic constructivist learning environment?
-preserve the concrete and individual aspects in a social learning environment?
-inject more content and linearity into an iterative learning process?
-facilitate detached reflection in an emotional and action-oriented learning environment?
-absorb more theoretical knowledge into an experiential learning environment?

This thesis has identified some candidate answers to these questions, such as reducing complexity through use of new kinds of value creation tools discussed in chapter 5, through Sarasvathy's effectuation logic capable of preserving individual aspects in a social learning environment as discussed in appended paper 1 (see p. 10), and in other ways outlined in appended paper 1. These different approaches could be seen as variations of an "actionable knowledge" approach. Still, significant work remains in exploring answers to these five questions grounded in the framework outlined in Figure 6, as well as defining and empirically testing such an "actionable knowledge" approach, leaning on altruistic value creation acts but still to be defined properly, is a proposition with bridging implications but as of now not explored to any significant extent. There might also exist other frameworks and propositions of similar kinds not yet identified in this study.

Discussion

POSITIVISM TRADITIONAL EDUCATION TRADITIONAL EDUCATION SCIENTIFIC METHOD		INTERPRETIVISM PROGRESSIVE / CONSTRUCTIVIST EDUCATION ENTREPRENEURIAL EDUCATION ENTREPRENEURIAL METHOD	
Science as Learning as Entrepreneurship education as A method to	Simplicity reductionist standardized single-subject harness nature	Complexity holistic localized and child-centered multidisciplinary unleash human nature	(Deshpande, 1983; von Bertalanffy, 1972) (Tynjälä, 1999) (Cotton, 1991) (Sarasvathy and Venkataraman, 2010)
Scientist regards Learning as Entrepreneurship education as A method for the	Individual reality a concrete structure individual work know-that objective	Social reality a social construction social interaction / storytelling know-who and know-how intersubjective	(Cunliffe, 2011) (Jeffrey and Woods, 1998; Egan, 2008) (Cotton, 1991) (Sarasvathy and Venkataraman, 2010)
Science process Learning activities with Entrepreneurship education as A method that is	Content linear product focus content linear	Process iterative process focus process iterative	(Cunliffe, 2011) (Jeffrey and Woods, 1998) (Cotton, 1991) (Sarasvathy, 2001)
Science should be A classroom where Entrepreneurship education as A method that is	Detached dispassionate / value free learner is passive absolute detachment transaction based	Attached meaning-making /value-bound learner is active and emotional emotional involvement commitment based	(Cunliffe, 2011; Lincoln and Guba, 1985) (Tynjälä, 1999; Egan, 2008) (Gibb, 1987) (Sarasvathy and Dew, 2005)
Science about Learning focusing on Entrepreneurship education with A method for	Theory objective reality inert knowledge emphasis on theory observation & "law" discovery	Practice lived experience practical experiences emphasis on creation action & co-creation	(Weber, 2004) (Tynjälä, 1999; Egan, 2008) (Ollila and Williams Middleton, 2011) (Sarasvathy and Venkataraman, 2010)
Figure 6. Five different dualisms cutting across four different literature domains.			

7 Conclusions

The main purpose of this thesis has been to increase our understanding of how action-based entrepreneurial education can develop entrepreneurial competencies. Initially, an empirical setting suitable for this purpose was identified, qualified and described through extensive study of various educational environments in Europe and United States. A two-year entrepreneurial education program in Sweden was found to constitute a "paradigmatic case" of action-based entrepreneurial education, defining a "venture creation approach" and justifying a single case study approach. Thirteen students from this program were studied in their two-year process of developing entrepreneurial competencies. They were studied using an interpretation framework for entrepreneurial competencies developed for the purpose, an experience sampling based "mobile app" and through quarterly interviews.

The study is still on-going, but analysis of empirical data has so far revealed 17 different kinds of events that could be linked to the development of entrepreneurial competencies. According to preliminary findings, some links are stronger than others, such as interaction with outside world leading to build-up of entrepreneurial self-efficacy, marketing skills and uncertainty tolerance. Based on this, four classes of activities that trigger such events have been proposed, constituting an attempt to establish a classification and definition of action-based entrepreneurial education. These four classes could help practitioners in action-based entrepreneurial education to compare different pedagogical approaches and subsequently decide on which activity to opt for in any given teaching situation. They could also help researchers focus more on relevant aspects of action-based entrepreneurial education, removing differentiation that is irrelevant for the purpose.

In order to explain how these four classes of activities develop entrepreneurial competencies, a causal relationship has been proposed to exist between the four classes of activity, the emotional events they trigger and the resulting development of entrepreneurial competencies. If such a causal relationship exists, it opens up for a new approach to assessment in entrepreneurial education, focusing on the frequency, strength and variety of emotional events of certain kinds. These events could thus be viewed as indirect proxies for developed entrepreneurial competencies, which is an educational outcome difficult to assess directly. In addition to the assessment implications of these findings, an "actionable knowledge" approach has been proposed, where a focus on human action / activity bridges between traditional teacher-centric and progressive learner-centric approaches to education. It could contribute with new perspectives in a century-long debate in general education impacting the domain of entrepreneurial education.

Some important limitations of this thesis include a limited number of student interviewee data transcribed so far, unknown transferability of results to other contexts and learning environments, risk for individual bias in data coding procedures and a lack of suitable theoretical frameworks for strong emotions and learning outcomes within the domain of entrepreneurship education. There is also a need for establishing stronger empirical linkage between educational activities and emotional events. Finally, the value of the proposed classification needs to be verified externally through extensive peer and practitioner review.

8 Future work

This thesis has proposed an operationalization of entrepreneurial competencies, four classes of action-based entrepreneurial education, a causal linkage explaining how learners become entrepreneurial through experiencing emotional events, a new perspective on assessing entrepreneurial education and an "actionable knowledge" approach to bridging between traditional and progressive education. These propositions now need to be tested further empirically as well as through attempts to publish the remaining appended papers and future papers outlining classes, linkages, assessment perspectives and bridging approach.

Interest from practitioners and other researchers to engage has been raised during the course of this study, and will be addressed in further work. One replication study has been initiated on primary level education in Sweden, and two more replication studies in Sweden are under discussion on secondary and tertiary level education. The app-based experience sampling methodology developed in this thesis has also been replicated in an ongoing Danish study on university students, and will be followed up as it progresses.

Empirical work remaining includes transcribing some additional 30 interviews waiting for transcription and subsequent data analysis, in order to corroborate findings presented in this thesis. Further interview waves with the 13 students that are followed longitudinally also need to be conducted, five of whom have now graduated. Three of the five "graduated" student ventures are still up and running, two of which are managed by the former students taking part in this study. These two former students are now "proper" entrepreneurs running their own ventures in a still very early and uncertain stage, allowing for transformation of this part of the study from the domain of entrepreneurial education to entrepreneurial learning should it be deemed interesting. The data analysis toolbox also needs to be developed further, consisting of primarily coding frameworks but also other procedures for analyzing data.

The study on venture creation programs reported in the second appended paper has resulted in an emerging global network of likeminded educators occasionally interacting at conferences and electronically. This represents another opportunity for collaborative research projects where cross-cultural studies and comparison studies can be conducted. This is however not the primary focus of my work as planned at the moment, since the coming years primarily need to be focused on corroborating the findings from this thesis based on data already or soon collected but not yet sufficiently analyzed.

An interesting link to explore in future work is the link between the development of entrepreneurial competencies and its assessment, drawing on and potentially also developing the domain of formative assessment. Formative assessment has been defined as a teacher- or learner-directed feedback process that establishes where learners are in their learning, where they are going and what needs to be done to get them there (Black and Wiliam, 2009).

To summarize future work, it will need to be focused on corroborating the findings presented in this study, rather than expanding into new kinds of findings and studies.

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Appended paper 1

How can Entrepreneurship Bridge Between Traditional and Progressive Education? Martin Lackéus, MORE department, Chalmers University of Technology MORE department, 412 96 Gothenburg, Sweden +46 736 551818, martin.lackeus@chalmers.se, www.entrepreneur.chalmers.se Mats Lundqvist, MORE department, Chalmers University of Technology Karen Williams Middleton, MORE department, Chalmers University of Technology

Questions we care about (Objectives). In this paper we argue that the "fault line" between traditional and progressive education starts in the domain of philosophy of science, passing through general educational philosophy and its century-long battle for control over instructional design practices, and ends up in the entrepreneurial education domain. This paper then asks the question: How can entrepreneurship contribute with cognitive tools that bridge between traditionalist and progressivist educational perspectives? Cognitive tools are defined by Egan (2008) as "the things people think with, not the things they think about".

Approach. First we outline theory within the domains of entrepreneurship and education. We describe entrepreneurship as a method, as well as some cognitive tools that mediate learning. We then outline five main dualisms that span the entire proposed "fault line", and create a conceptual framework around these five dualisms. Finally we discuss two possible ways in which entrepreneurship can contribute with tools that bridge and balance these dualisms, and propose some implications for research and practice.

Results. The analysis has yielded five dualisms that are described more in-depth. Attempting to bridge and balance between these dualisms we end up with five resulting questions: How can entrepreneurship contribute with cognitive tools that...

- 1.simplify a complex, multidisciplinary and holistic constructivist learning environment?
- 2. preserve the concrete and individual aspects in a social learning environment?
- 3. ...inject more content and linearity into an iterative learning process?
- 4.facilitate detached reflection in an emotional and action-oriented learning environment?
- 5.absorb more theoretical knowledge into an experiential learning environment?

These five resulting questions are tested on two candidates for cognitive tools that can mediate learning; value creation and entrepreneurship as a method. Both of these candidates seem to be quite constructive means to balance between traditional and progressive education.

Implications. For researchers this opens up for new opportunities to consider entrepreneurship theory and practice as pedagogical cognitive tools in general education. For practitioners this can serve as inspiration for trying out some of the vast array of tools, models and concepts from the entrepreneurship domain in general education. Further inquiry into the entrepreneurship domain can surface more cognitive tools of potential use.

Value / originality. Research that leverages profoundly on theory from both entrepreneurship and education is scarce. This specific attempt has potential to lead to a flexible yet criteria based "third way" between the rigidity of traditional education and the vagueness of progressivism. It also holds potential to bridge the gap between advocated and applied pedagogy in the field of education, where desired pedagogical approaches often are not used in practice due to the higher cost of such approaches and their misalignment to the conventional educational systems and paradigms.

Keywords: Entrepreneurship, Education, Cognitive tools, Dualisms, Value creation, Learning

Introduction

According to many scholars, entrepreneurship and enterprise education is preferably delivered using a learner-centered, multidisciplinary, process-based and experiential approach (Cotton, 1991, Gibb, 1987, Mwasalwiba, 2010). This is well aligned with progressive and constructivist learning environments, where social interaction, co-construction of knowledge, social immersion and collaborative learning are emphasized (Jonassen, 1999, Tynjälä, 1999, Woods, 1993). These conceptions of what constitutes effective education have however had substantial difficulties reaching a wider adoption in educational practice, both within and outside of entrepreneurship (Neergaard et al., 2012, Labaree, 2005, Mwasalwiba, 2010). The prevailing paradigm in most educational institutions rather emphasizes standardized tests, individual work, and detached theorizing (Jeffrey and Woods, 1998). The persistence of a more traditional view is exemplified through the 'No child left behind' act passed in 2001 in United States, putting increasing pressure on nation-wide standardized testing (Heckman, 2006). This culture of measurement seems to have strong positivist connotations, in that it leans on the belief that intelligence, learning and knowledge can be quantitatively measured, an increasingly questioned proposition (Gould, 1996, Rushton and Juola-Rushton, 2008, Biesta, 2007). A result of this situation is widespread problems with learners' motivation, frequent school dropout (Fredricks et al., 2004) and a view that educational institutions to some extent fail to be relevant in today's society (Binks et al., 2006).

In this paper we argue that the "fault line" between traditional and progressive education indeed starts in the domain of philosophy of science with the binary opposition between positivism and interpretivism, passing through general educational philosophy and its century-long battle for control over instructional design practices (Labaree, 2005), and ends up in the entrepreneurial education domain with its scholars advocating an approach that just does not seem to be able to reach widespread adoption due to paradigmatic challenges in education (Mwasalwiba, 2010, Ardalan, 2008). This kind of dualistic problem in learning and education has previously been addressed by Hager (2005), who instead recommends "a holistic integrative emphasis that aims to avoid dualisms such as mind/body, theory/practice, thought/action, pure/applied, education/training, intrinsic/instrumental, internal/external, learner/world, knowing that/knowing how, process/product, and so on" (p. 663).

In line with Hager's recommendation, Egan (2008) proposes the use of cognitive tools as a "third way" in education, where the first two ways are represented by traditionalism and progressivism respectively. These cognitive tools are defined by Egan as "things that enable our brain to do cultural work" (ibid, p. 40), and "the things people think with, not the things they think about" (ibid, p.14). Egan has been heavily inspired by Vygotsky and his description of the role mediation plays in learning (Egan and Gajdamaschko, 2003), such as more experienced humans (teachers and parents), symbols (written language) or in recent time learning mediated by information technology, as explored extensively by Jonassen (2002).

Recently, Sarasvathy and Venkataraman (2011) proposed that entrepreneurship could be regarded as a generic method for creating potentially valuable change by unleashing human potential, and contrasted this to the scientific method designed to harness mother nature. This was building on Sarasvathy's (2001) work on 'effectuation', i.e. the iterative process of entrepreneurially creating some kind of effect based on the resources at hand and acquired along the way, mirroring how expert entrepreneurs work. We posit that this generic entrepreneurial method has potential to offer tools that humans think with (and not only think about), in line with Egan's proposed cognitive tools, and thus can become a valuable contribution to the "third way" in education. This paper thus asks the question: How can

entrepreneurship contribute with cognitive tools that bridge between traditionalist and progressivist educational perspectives?

This paper proceeds as follows. First we outline some relevant theory within the domains of entrepreneurship and education. We describe entrepreneurship as a method, as well as some cognitive tools that Egan has proposed to mediate learning. We then outline five main dualisms that span the entire proposed "fault line", from philosophy of science through education to entrepreneurial education and entrepreneurship as a method, and create a conceptual framework around these five dualisms. Finally we discuss possible ways in which entrepreneurship can contribute with tools that balance these dualisms, and propose some implications for research and practice.

Theory

Defining entrepreneurship

Entrepreneurship today is a fragmented concept. However, for the purpose of this article, the definition proposed by Bruyat and Julien (2001) is described briefly and will later serve as a basis for analysis. They use a constructivist approach and propose a definition incorporating not only the entrepreneur, but also the new value created, the environment within which it takes place, the entrepreneurial process itself and the links between these constructs over time. They not only agree with Gartner (1988) that "Who is an entrepreneur?" is the wrong question. They also argue that that studying the entrepreneur in isolation is inherently wrong, as it is not solely from the entrepreneur that entrepreneurship occurs. Entrepreneurship is as much about the change and learning that the individual entrepreneur experiences by interacting with the environment as the change and value creation the entrepreneur causes through his/her actions. Regardless of if the process results in a start-up¹, the change and learning for the individual can be substantial in an entrepreneurial process. This definition has implications for our discussion here, since it proposes learning for the individual as an inherent and core outcome of an entrepreneurial process alongside new value creation.

Entrepreneurship as a method

Sarasvathy and Venkataraman (2011) argue that viewing entrepreneurship as a subset of economics or any other sub-domain entails the risk of committing a logical category mistake, i.e. to allocate "concepts to logical types to which they do not belong" (Ryle, 1949)(p.17). Instead they propose that we should "reformulate entrepreneurship as a method of human action, ... a powerful way of tackling large and abiding problems at the heart of advancing our species." (Sarasvathy and Venkataraman, 2011). They propose that a dominant logic for the entrepreneurial method is "effectuation", a concept developed by Sarasvathy (2001) through observing how expert entrepreneurs think and act. Effectuation is described as an iterative process of decision making and active commitment seeking that results in creation of new value, where each iteration is started with questions such as "Who am I?", "What do I know?" and "Whom do I know?" (Sarasvathy and Dew, 2005). Sarasvathy and colleagues position effectuation as an alternative to an objectivist, linear, transaction and causal logic based scientific method aiming to uncover general "laws" (Sarasvathy, 2001, Sarasvathy and Dew, 2005, Sarasvathy and Venkataraman, 2011, Venkataraman et al., 2012). They emphasize the subjectivist and constructivist nature of the entrepreneurial method, and specify

¹ Here we recognize 'start-up' to include not only the creation of a new firm, but also the adoption of a new product or project within an existing organization, or a new social impact initiative that is driven by a self-sustaining economic base (i.e. none philanthropic).

the intersubjective as a key unit of analysis, i.e. emphasizing social relations between people as more useful for decision making when operating under uncertain conditions. Thus they recognize that individuals operating under uncertainty in a process of emergence utilize knowledge learned through the constructivist and progressivist principles outlined in this paper.

Entrepreneurship and enterprise education

The domain of entrepreneurship and enterprise education is as fragmented as its underlying domain of entrepreneurship, due to the challenge of defining entrepreneurship (Mwasalwiba, 2010). This profoundly affects educational objectives, target audiences, course content design, teaching methods and student assessment procedures, leading to a wide diversity of approaches. The term "enterprise education" builds upon a broader conceptualization of entrepreneurship, aiming to help people adopt a more enterprising attitude, i.e. opportunityoriented, proactive, flexible and open to change, uncertainty and risk (Mahieu, 2006). The term "entrepreneurship education" is perceived more narrowly, aiming to give people the knowledge and skills needed to become self-employed and develop a new business. Despite the differentiating desired outcomes of entrepreneurship and enterprise education, there is increasing consensus among scholars in the field that if the objective is to generate individuals capable of practicing entrepreneurship, then a preferred entrepreneurial pedagogy is learner centered, interdisciplinary, process-based, co-creation oriented, experiential and socially situated (Mwasalwiba, 2010, Gibb, 2011, Kyrö, 2008, Cotton, 1991, Gibb, 1987, Ollila and Williams-Middleton, 2011). Frequently mentioned underlying theoretical concepts for this kind of pedagogy are social learning (Bandura, 1997), situated learning (Lave and Wenger, 1991), experiential learning (Kolb, 1984), action learning (Revans, 1971) and emotional intelligence (Goleman, 1995). Advocated entrepreneurship education pedagogy fits well within the constructivist educational paradigm. There is however considerable gap between preferred and applied pedagogy, often due to the higher cost of active approaches and their misalignment to the conventional educational systems and paradigms (Mwasalwiba, 2010, Ardalan, 2008).

The battle between traditional and progressive education

According to Egan (1996), the battle between traditional and progressive education cannot be understood without taking into account the three main goals of education; achieving social cohesion, diffusing inherently valuable knowledge and facilitating growth of the individual mind (Egan, 2008). These three goals are in many ways conflicting. For example, it can be seen as contradictory to have a standardized curriculum while also allowing for full heterogeneity and adaptation to individual needs. And it is not obvious what knowledge is ultimately valuable for society, or for the individual. In this battle between competing positions, traditional education has been the predominant approach for a more than a century, which emphasizes social cohesion and knowledge diffusion. A main reason for this dominance, according to Labaree (2005), is that in the end utility won over romanticism, with a message more appealing to people in power and with far more convincing quantitative test results proving the behaviorist approach proposed by Edward Thorndike. On one side of this debate stood policymakers and school management, with power over administrative and curriculum structures, opting for a standardized curriculum, dissemination of inert knowledge to passive learners in a knowledge focused linear manner emphasizing individual results through the summative test measures applied (Egan, 2008, Tynjälä, 1999). On the other side stood teachers and professors of education arguing for a learner focused and process-based curriculum supporting active and emotional learners, emphasizing meaning generated through

practical experiences involving social interaction (Tynjälä, 1999, Jeffrey and Woods, 1998). To date, the focus has been on what learners "need" rather than on what they might "like" (Labaree, 2005), and it has resulted in a widespread "increasing score, declining interest" problem among learners, causing policymakers to act in many countries, ironically by increasing pressure on testing and standardization (Egan, 2008)(p. 91).

Cognitive tools as a "third way" in education

Learning can be mediated by a variety of tools. Leo Vygotsky proposed three main categories of mediation tools; material tools, psychological tools and other human beings (Kozulin and Presseisen, 1995). Feuerstein (1990) stipulates three main criteria for effective mediated learning; purposeful rather than incidental interaction, possibility for the learner to identify underlying principles and infusion of meaning into the interaction. These three criteria make mediated learning incompatible with behavioristic approaches according to Kozulin and Presseisen (1995).

Jonassen (Jonassen, 2003) has explored the use of cognitive tools for problem solving through scaffolding the students' problem representation. These cognitive tools are often computer based and include techniques such as semantic networks, expert systems and systems modeling tools. Computers are here often regarded as part of the students' cognitive apparatus, i.e. they think *with* the computer. The rationale for this kind of mediation is that it decreases the cognitive load and makes possible solutions more transparent (Simon, 1978).

In what has been labeled Imaginative Education (IE), Egan (1997, 2003, 2005, 2008) has proposed an extensive range of cognitive tools that mediate learning for example by infusing humor and emotions into the learning situation; by using storytelling to create a sense of meaning and purpose; by leveraging on emotionally charged binary opposites and extremes to give shape and meaning to events; by telling stories about the heroes behind important theorems and axioms; and by being open to anomalies. The school days can be divided so that in the morning learners focus on knowledge acquisition and in the afternoon they focus on socially connected projects where the knowledge is put to use through these cognitive tools (ibid, p.147). The IE approach has spurred a global movement with thousands of educators applying these tools. Research by psychologist Harris (2000) supports this approach, showing that imagination is important for cognitive development and learning, and plays an important role for developing emphatic and social skills (Kind and Kind, 2007). Quantitative research has also shown that the IE based storytelling approach can yield significantly better results on knowledge specific tests without taking more time in class (Hadzigeorgiou et al., 2012), and at the same time significantly increase learner engagement. According to Egan (2008), the way cognitive tools truly can bridge between traditional and progressive education is when they are put to work deeply within domains of knowledge in a way meaningful to the learner. Procedures, methods and tools need to be deeply tied into knowledge domains in actual possession by the learner, which requires substantial effort and dedication from both teachers and learners. This approach thereby constitutes a flexible yet criteria based "third way" between the rigidity of traditional education and the vagueness of progressivism (ibid, p. 143).

Based on this review of theory we will now attempt to construct a conceptual framework.

Conceptual framework

The literature reviewed above contains many two-column tables contrasting positions. It also contains frequent contrasting formulations, outlining one phenomenon by relating it to its corresponding opposing position. These contrasts were used to create a framework. In order to

construct such a framework cutting across these very different domains, one needs to be relatively flexible and selective in selection and interpretation of words and meaning. This then becomes a major limitation of such a framework, since theory developed in one domain cannot easily be transferred to another domain without risk of losing its trustworthiness. Still, the similarities in use of words, phrases and meaning have at times been striking when reviewing these disparate strands of literature.

We have focused this framework on five main dualisms. They could probably be more, or less, or structured differently, but these five dualisms constitute one way to present some seemingly common traits of the "fault line" cutting across the reviewed literature. The scholars chosen as references in this framework are far from the only ones that state these views, they could be regarded as relatively representative of their respective fields. The five dualisms identified are presented in figure 1 and discussed below.



Figure 1. Five different dualisms cutting across four different literature domains.

Simplicity versus complexity

Deshpande (1983) describes an objective worldview as being outcome-oriented and reductionist, and contrasts it to the subjective worldview being process-oriented and holistic. This resonates with the contrasting views between on the one hand the reductionist Cartesian view that any complex phenomenon can be reduced to and understood through its smallest

and most simple parts, and on the other hand a systems view where holistic understanding is needed in an increasingly complex and interdisciplinary world, a theory originating from the domain of biology (Von Bertalanffy, 1972). Similar discussions can be found in general and entrepreneurial education, where a focus on standardized and single-subject curriculum is contrasted with a localized and multidisciplinary approach in entrepreneurial and constructivist education (Tynjälä, 1999, Cotton, 1991). Jonassen (1999) states that there can indeed be a great range of complexity in setting up a constructivist learning environment, but also asserts that it is a pedagogical approach particularly suitable for ill-defined and complex tasks. In their work on entrepreneurship as a method, Sarasvathy and Venkataraman (2011) state that "the phenomenon of entrepreneurship exhibits heterogeneity along several dimensions and across every aspect of research" (p. 127). They contrast the harnessing of mother nature with the unleashing of human nature, which could also be interpreted as on two different ends of the simplicity versus complexity continuum, i.e. harnessing for simplifying the human use of natural resources versus unleashing the complexity and heterogeneity of human nature for value creation purposes.

Individual versus social

Cunliffe (2011) states that the subjectivist approach is to perceive reality as a social construction, which is contrasted to the objectivist view that reality is a concrete given. In education the social dimension also plays an important role in progressive and entrepreneurial education (Egan, 2008, Jeffrey and Woods, 1998, Cotton, 1991), and is frequently contrasted to the individually focused information-processing approach in traditional education. In entrepreneurship as a method, a similar dualism can be found in that the scientific method focuses on the objective while the entrepreneurial method focuses on the intersubjective, i.e. the relational aspects between people (Sarasvathy and Venkataraman, 2011).

Content versus process

In the content versus process dualism the words used are indeed similar. According to Cunliffe (2011), the conception of time and progress differs between subjectivism and objectivism, being iterative in subjectivism and linear in objectivism. Jeffrey and Woods (1998) report about a product focus among Ofstede evaluators representing traditional education values, whereas teachers prefer a process focus, being more oriented towards progressive education values. Cotton (1991) states a similar dichotomy between focus on content in traditional education versus focus on process in entrepreneurial education. In entrepreneurship as a method the iterative learning techniques of effectuation are contrasted to the linear and static processes of causation (Sarasvathy, 2001).

Detached versus attached

This is an area of rather binary opposition. Science has traditionally put high value on the disinterested pursuit of truth, while more recent qualitative research methods focus more on the meaning-making activities of individuals (Cunliffe, 2011). Guba and Lincoln (1985) position positivist approaches as value-free inquiry, contrasting them to value-bound naturalistic approaches. In the domain of general and entrepreneurial education there is frequent emphasis on the importance of emotionally involved and active learners, which stands in contrast to the passive and detached learners they depict in traditional learning environments (Gibb, 1987, Tynjälä, 1999, Egan, 2008). Emotionality also plays an important role in effectuation. It is described as a process of searching for commitment rather than establishing contractual relations, which is done by leveraging on people's docile and partly altruistic behavior in their search for meaningful activities (Sarasvathy and Dew, 2005).

Theory versus practice

The theory-practice gap is one of the truly classical dichotomies in our society. Lewin (1951) has stated that there is "nothing as practical as a good theory" (p.346), aimed as a scepticism towards measurement-based psychology research not taking theory enough into account. But the use of theory is very different in the fields of education, entrepreneurship and management compared to fields such as medicine and law (Nuthall, 2004, Khurana et al., 2004). One main issue is what view of knowledge is used, and in what fields we can even produce and publish relevant propositional "expert" knowledge at all (Kennedy, 1999). Some even state that being relevant to society is one of the main challenges to business schools or even to education in general (Binks et al., 2006, Pfeffer and Fong, 2002, Tushman et al., 2007, Tynjälä, 1999). Mandl et al. (1996) state that the inert knowledge taught at universities frequently cannot be transferred to the complex real-life problems prevalent in many ill-defined domains. Epistemologically these differing views on knowledge could be regarded as mirrored through the dichotomy between the positivist view that there is an objective reality and the interpretivist view that knowledge is constructed through lived experience (Weber, 2004). The centrality of lived experience is frequently discussed in the domain of entrepreneurial education. Ollila and Williams Middleton (2011) report from an experiential learning environment focusing on venture creation, where learning outcomes emerge from real experiences when learners co-create knowledge together with their educator. They contrast this to more conventional approaches where the emphasis is upon theory, content and expert knowledge transferred to passive learners. The discourse on entrepreneurship as a method also contrasts action and co-creation against universal theories, models and laws (Sarasvathy and Venkataraman, 2011), and it is further proposed that we introduce some playfulness into reasoning around theory versus practice by regarding experience as a theory, in a nonteleological manner, i.e. action without a final known cause (Sarasvathy and Dew, 2005).

Discussion

We have now constructed a framework containing a set of five dualisms that all seem to be distinctly present in one way or another in at least four quite different domains, possibly also present in more domains not covered in this paper. We will now consider some possibilities to balance and bridge between their outlier positions. Jarvis (2006) and Hager (2005) state that resolving dualisms such as mind/body, thought/emotion, theory/practice, are crucial to our understanding of human learning, so this endeavour seems worthwhile. Indeed, as Chen et al. (2010) state, "interaction between two forces of *yin* and *yang* would creatively evolve myriad objects and things." (p.181). One could even argue that this kind of interaction is the primary task of universities, judging from educational philosopher Whitehead (1967):

The justification for a university is that it preserves the connection between knowledge and the zest of life, by uniting the young and the old in the imaginative consideration of learning. The university imparts information, but it imparts it imaginatively. At least, this is the function which it should perform for society. A university which fails in this respect has no reason for existence. (p. 97)

Using the developed framework we can now take our initial research question and operationalize it in each of the five identified dualisms. We then get five questions we really care about, and that all can help to balance between traditional and progressive education in various ways, provided that they can be answered constructively. They are:

How can entrepreneurship contribute with cognitive tools that...

- 1. ...simplify a complex, multidisciplinary and holistic constructivist learning environment?
- 2. ... preserve the concrete and individual aspects in a social learning environment?
- 3. ...inject more content and linearity into an iterative learning process?
- 4. ...facilitate detached reflection in an emotional and action-oriented learning environment?
- 5. ...absorb more theoretical knowledge into a practice-based experiential learning environment?

The main purpose of this paper is not to propose exhaustive answers to these questions, but rather to develop a framework where these questions can be put into perspective. We will now tentatively propose two cognitive tools with origin in the entrepreneurship domain that might have a potential to address these questions.

Proposed cognitive tool #1: Value creation

From the definition by Bruyat and Julien (2001) outlined previously we can regard the concept of creating value as a potential cognitive tool that can foster learning. The most obvious way that value creation fosters learning is by the way this specific definition of entrepreneurship states that the environment that is undergoing entrepreneurial change also changes the individual and causes learning. Alluding to John Dewey's famous notion of "Learning by Doing" we propose a similar pedagogic approach of "Learning by creating value", grounded in the field of entrepreneurship. This would then address question no 1 - "How can entrepreneurship contribute with cognitive tools that simplify a complex, multidisciplinary and holistic constructivist learning environments can be organized around. It would also address question no 2 - "How can entrepreneurship contribute with cognitive tools that preserve the concrete and individual aspects in a social learning environment?" – in that it allows for an individually oriented and very concrete outcome of a social learning environment.

The domain of entrepreneurship also contains various frameworks for value creation that can be used to give answers to question no 3 above – "How can entrepreneurship contribute with cognitive tools that inject more content and linearity into an iterative learning process?" – making the iterative and complex process slightly more manageable by an educational institution and thus perhaps quasi-linear. One example is the Business Model Generation approach proposed by Osterwalder (2004), which has reached global usage and acclaim in a very short time due to its simplification potential. Another similarly widespread example relevant to question no 3 is the "Customer Development Process" proposed by Blank (2005) as a means to control the early product development phase of starting a company.

If we assume that success is not a prerequisite for learning, we can assume that failure to create value will yield equal amount of learning, or even more learning. This would then provide some answer to question 4 - "How can entrepreneurship contribute with cognitive tools that facilitate detached reflection in an emotional and action-oriented learning environment?" – in that both success and failure will trigger reflection. Regarding question no 5 - "How can entrepreneurship contribute with cognitive tools that absorb more theoretical knowledge into a practice-based experiential learning environment?" – we propose a starting point of the value creation process to be some knowledge domain or theoretical concept coupled with the question "For whom can this knowledge be valuable / rewarding?", and from that point initiate a process of value creation. This approach could then provide a balance between theory and practice.

From this analysis we can conclude that value creation as a cognitive tool could be quite a constructive means to balance between traditional and progressive education. Some previous research supports this. Surlemont (2007) reports from a research project in Belgium where pupils participated in experiential learning projects where they created value for people outside their class, such as younger pupils, parents, friends, tourists, companies, etc. When initial teacher scepticism had been overcome, many were stunned with the levels of enthusiasm and commitment shown by the pupils. This was mainly due to increased ability to make sense of their own learning, increased self-confidence among learners and a sense of pride due to external exposure.

Proposed cognitive tool #2: Entrepreneurship as a method

We will now explore viewing entrepreneurship as a method as a cognitive tool to foster learning in relation to the five questions outlined above. Regarding entrepreneurship as a method supposes effectuation to be a dominant logic (Sarasvathy and Venkataraman, 2011). Effectuation could be regarded as a teachable concept containing some relatively easy-to-grasp concepts such as "expanding cycle of resources", "bird-in-the-hand principle" and a set of simple questions in the beginning of each iteration such as "Who am I?", "What do I know?", "Whom do I know?" and "What can I do?". We will not go into details of these concepts as this has already been done by others (Read et al., 2011, Sarasvathy and Dew, 2005). But we will use some of these principles for our analysis.

Addressing question no 1 - "How can entrepreneurship contribute with cognitive tools that simplify a complex, multidisciplinary and holistic constructivist learning environment?" – we can see that the work of Sarasvathy and colleagues over the last decade has provided a framework that has the potential to greatly simplify complex constructivist learning environments. The now available teaching material based on this framework can be a good opportunity for teachers wanting to take advantage of this framework in their teaching (Read et al., 2011). Regarding question no 2 - "How can entrepreneurship contribute with cognitive tools that preserve the concrete and individual aspects in a social learning environment?" – we can see that the four basic questions outlined above constituting the starting point of each cycle in an iterative effectual process foster a concrete connection to the individual since they are so immediately focusing on the self. This holds potential to balance the sometimes vague progressive approaches with some solid individually focused questions.

Sarasvathy (2001) states that an effectual process should focus on "the controllable aspects of an unpredictable future" rather than to "focus on the predictable aspects" (p. 251). Applied to educational institutions it could be interpreted as a call to let go of the usual ambition to predict every step in the educational process, and instead embrace unexpected surprises. Although this might not be a straight answer to question no 3 - "How can entrepreneurship contribute with cognitive tools that inject more content and linearity into an iterative learning process?" – it indicates an attitude that could prove helpful to teachers in designing constructivist learning environments.

The "expanding cycle of resources" outlined by Sarasvathy and Dew (2005) always starts each iteration with self-oriented questions. If this recipe is followed in designed learning environments it could be said to promote repeated self-reflection, and thus address question no 4 - "How can entrepreneurship contribute with cognitive tools that facilitate detached reflection in an emotional and action-oriented learning environment?" – promoting some kind of structured and detached evaluation of oneself. Question no 5 - "How can entrepreneurship contribute with cognitive tools that absorb more theoretical knowledge into a practice-based experiential learning environment?" – is also answered by one of these questions, i.e. the
"What do I know?" question. This specific question could be connected to curriculum content, balancing between theory and practice in a relatively elegant way.

Also the notion of entrepreneurship as a method seems to be a powerful cognitive tool possible to integrate into formal learning environments with a multitude of benefits related to the traditional versus progressive education dichotomy.

Implications and conclusions

This paper was but an initial exploration into ways to balance between traditional and progressive education by considering cognitive tools from the entrepreneurial domains of theory and practice. It seems that this attempt to bridge between education and entrepreneurship has yielded many interesting implications for both research and for practice. For researchers this opens up for new opportunities to consider entrepreneurship theory and practice as pedagogical cognitive tools in general education. For practitioners this can serve as inspiration for trying out some of the vast array of tools, models and concepts in the entrepreneurship domain.

The conclusion of this analysis and the resulting framework and five questions is that both value creation and entrepreneurship as a method can be considered as cognitive tools that have potential to balance the dualisms between traditional and progressive education. It also seems that further inquiry into the entrepreneurship domain can surface more cognitive tools of potential use in general education environments. It however seems appropriate to note that use of entrepreneurship tools outside the domain of entrepreneurship often requires the use of a wide definition of entrepreneurship, and thus could require substantial rewording and translation from specific business language to more generic "enterprising individuals" based language.

Some limitations of this study have also been raised. Generalizing across disciplines in the way we have done in this article constitutes significant risks since concepts and theories developed in one domain not necessarily can be translated into other domains without severe translational problems. Nevertheless, it was noted how substantially disparate domains use very similar vocabulary and reasoning around core concepts covered in this article.

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Appended paper 2

Venture Creation Programs: bridging entrepreneurship education and technology transfer

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Abstract

Purpose – The article explores how university-based entrepreneurship programs, incorporating real-life venture creation into educational design and delivery, can bridge the gap between entrepreneurship education and technology transfer within the university environment.

Design/Methodology/Approach – Based on a literature review and snowball sampling over a two-year period, 18 entrepreneurship education programs were identified as applying a venture creation approach. Ten of these programs were selected for case study, including direct interviews and participatory observation during a two-day workshop. Empirical findings were iteratively related to theory within entrepreneurship education and technology transfer.

Findings - The article identifies the bridging capabilities of venture creation programs across five core themes, illustrating the potential benefits of closer collaboration between entrepreneurship education and technology transfer in a university environment.

Research implications – A definition for 'venture creation program' is tested empirically. These programs are shown to be sophisticated laboratory environments, allowing for clinical research towards the understanding of entrepreneurship and technology transfer processes.

Practical implications – Findings identify practical benefits of combining entrepreneurship educators and technology transfer activities, such as increased value creation through not only new firms, but also an entrepreneurially equipped graduate population.. Venture creation programs allow for 'spin-through' of innovative ideas in the university environment, while simultaneously contributing to entrepreneurial learning.

Originality / **Value** – This article presents findings from the first multiple case study into entrepreneurship educations specifically designed to develop real-life venture as part of the core curriculum. Findings provide basis for investigating the value of integrating entrepreneurship education and technology transfer at the university.

Keywords: Entrepreneurship education, technology transfer, venture creation, university spin-outs

1. Introduction

Entrepreneurship is seen as a major engine for economic growth and job creation (Wong et al. 2005), with entrepreneurial competency development highly sought after by policy-makers and practitioners (Hofer et al. 2010; OECD 2011). And while debate continues whether entrepreneurs are born or made (Haase and Lautenschläger 2011; Henry et al. 2005a,b; Lautenschläger and Haase 2011), there is growing consensus that certain knowledge, skills and attitudes for entrepreneurial action is teachable (Gorman et al. 1997; Neck and Greene 2011; Pittaway and Cope 2007a; Rae et al. 2012). But while most entrepreneurship education focuses on learning about the phenomenon of entrepreneurship, few address learning for new venture creation (Mwasalwiba 2010; Pittaway and Edwards 2012), even though entrepreneurship education in higher education institutions continues to grow worldwide (Kuratko 2005). In parallel, university technology transfer practice has also experienced global growth following legislation passed in the U.S. in 1980¹ (Bozeman 2000; Goldfarb and Henrekson 2003; Mowery et al. 2001), and then copied around the world (O'Connor et al. 2010).

Exploiting university technology through venture creation (in addition to licensing or contractual agreements (Siegel et al. 2003)) is attributed primarily to the domain of university technology transfer (Di Gregorio and Shane 2003; Shane 2004; Shane 2002). However, university-based venture creation is increasingly recognized as an activity potentially facilitated through specialized entrepreneurship education (Barr et al. 2009; Rasmussen and Sørheim 2006; Siegel and Phan 2008). Technology transfer and venture creation-based entrepreneurship education are seen to share many goals, priorities and strengths (Meyer et al. 2011; Moroz et al. 2010); for example commercialization of new ideas or innovations or entrepreneurial competency development. Researchers point at potential synergies, such as using university inventions in class projects, using students as resources in technology evaluation, and increasing awareness of technology transfer opportunities among students (Boh et al. 2012; Greene and Rice 2011; Nelson et al. 2005). Boh et al. propose an emphasis on project-based classes in technology commercialization, allowing faculty and students to experiment together within a safe environment prior to launching ventures stemming from university inventions. Nonetheless, recent literature shows that research on the interaction/integration of technology transfer and entrepreneurship education is almost nonexistent (Nelson and Byers 2010; Ollila and Williams Middleton 2011; Siegel and Phan 2008), with a lack of literature regarding programs specifically combining entrepreneurship education and technology transfer activities. Heinonen and Hytti (2010) state that the main difficulty of integrating entrepreneurship education with technology transfer is the tension that exists between academic and pragmatic approaches within the university context.

The purpose of this article is to investigate the ways in which educational programs specializing in venture creation can contribute to bridging the gap between entrepreneurship education and technology transfer. From literature, we establish a definition for "venture creation program" (VCP). The definition is subsequently used to identify a population for

¹ U. S. University and Small Business Patent Procedures Act of 1980, also known as the Bayh-Dole Act.

empirical study. Entrepreneurship education and technology transfer literature is reviewed to determine a set of capabilities for bridging entrepreneurship education and technology transfer, from which we construct a theoretical framework of analysis. We outline methodologies for case study selection from the initial population, data collection, and data analysis. We present our findings from selected cases, followed by a discussion of the ways in which venture creation programs contribute to integration of entrepreneurship education and technology transfer activities.

2. Theory

One form of entrepreneurship education including authentic economic activity involves students temporarily buying and selling finished goods, such as giveaways or accessories, within a course setting. An example, Young Enterprise (Dwerryhouse 2001), enables adolescents to run a company for eight months followed by voluntary liquidation. More complex kinds of economic activity, including the intention to create a viable company, are mostly found in programs of longer duration and at higher educational levels. These programs can take significant time to develop, due to institutional, programmatic and pedagogical challenges (Thursby et al. 2009). Nonetheless, pedagogic foundations and program design for venture creation focused education have been proposed and applied (see for example Gibb 2011; Gibb 1993; Ollila and Williams Middleton 2011). We use one of these, the venture creation approach, as a means to establish a definition for identifying entrepreneurship education programs contributing to new venture creation.

2.1 The venture creation approach

Ollila and Williams Middleton (2011) state the primary focus of a venture creation approach as "the development of new ventures from university research" (p.173) through an educational platform. Learning is facilitated through an integrated environment consisting of both education and incubation, resulting in the development of both entrepreneurs and ventures. Students 'test the waters' by attempting to create real-life ventures in collaboration with complementary stakeholders such as academics, investors, and practitioners. Mistakes are encouraged and learning outcomes emerge from the real experiences in both problem- and solutions-oriented ways, facilitated in part through reflection-in-action (Schön 1983). The creation of new ventures is a consistent outcome of the venture creation approach; for example, the European Commission (2012) summarized the results from a program applying this approach as follows:

"The output so far has consisted of 47 technology ventures with a survival rate of 80%, and around 300 educated entrepreneurs. These ventures had a total turnover of ϵ 30 million and around 270 employees in 2010. Common for most of the ventures from CSE [Chalmers School of Entrepreneurship] is that their initial ideas would have been too early or too vague to be accepted by traditional incubators. This means that the CSE model represents a novel means to create value that would never have been created otherwise." (p. 31)

The approach is also recognized as delivering an experiential and experimental learning environment, enabling transformation of students into entrepreneurs (Berggren 2011; Williams Middleton 2010). Thus, the approach acts as a basis for a "venture creation

program" (VCP) definition: entrepreneurship education programs which utilize the on-going creation of a real-life venture as the primary learning vessel (thus involving venture creation as part of the formal curriculum), including intention to incorporate.

2.2 Literature on "venture creation programs"

There is limited research addressing action-based entrepreneurship education, and in particular, learning through venture creation. As faculty of a VCP, we are familiar with literature that has addressed our own program (Berggren 2011; Hofer et al. 2010; Lindholm Dahlstrand and Berggren 2010; Lundqvist and Williams-Middleton 2008; Ollila and Williams Middleton 2011; Rasmussen and Sørheim 2006). To 'test' the VCP definition, we reviewed literature addressing entrepreneurship education programs applying some kind of venture creation approach. Most of the literature found describes single case studies discussing programs in which students create real-life ventures (Barr et al. 2009; Boocock et al. 2009; Janssen et al. 2007; Laukkanen 2000; Meyer et al. 2011; Thursby et al. 2009). We also identified a multiple case study (Kingon et al. 2001) comparing U.S. based programs developing high-technology start-ups.

The program descriptions in the literature were seen to align with the proposed VCP definition. Reviewing the literature also highlighted potential commonalities of VCPs: experiential learning, interdisciplinarity, process-based curriculum, an external network of resources, and contribution to regional economic development. These five common themes are used towards a constructed framework of analysis, discussed further in the method section.

2.3 Venture creation in a university setting

Literature on venture creation at the university falls under multiple streams, including university entrepreneurship (for example Rothaermel et al. 2007), academic entrepreneurship (for example Shane 2004), incubation (for example Carayannis and von Zedtwitz 2005), and university spin-offs (for example Pirnay and Surlemont 2003). It is not our intention to substantially review these streams, but to highlight key principles for university venture creation, and to recognize it as one form of university technology transfer. We differentiate venture creation at the university from most entrepreneurship education, as such education typically focuses on knowledge about the phenomenon of entrepreneurship (Kirby 2007; Mwasalwiba 2010, and others previously mentioned), and not actual engagement in an entrepreneurial process.

In Rothaermel et al.'s substantial review (2007), creation of new firms from university research is primarily conducted through technology transfer offices (TTOs), incubators and science parks. However, TTO operations typically prioritize licensing and material transfer activities over creation of new firms (Siegel et al. 2003). Louis et al. (1989) found that new venture creation was the least common form of entrepreneurial activity carried out by lifescience academics at universities. Deprioritization was based on the perceived controversy in using university resources for commercial goals.

Literature on university spin-offs specifically addresses new firm creation at the university. Pirnay et al. define university spin-offs as "new firms created to exploit commercially some knowledge, technology or research results developed within a university" (2003, p. 356). Van Burg et al. (2008) propose a framework for creating university spin-offs, derived from a theory-based meta-analysis of two recent literature reviews and a book on university spin-offs (Djokovic and Souitaris 2008; O'Shea et al. 2004; Shane 2004), and a practice-based grounded theory methodology involving 25 interviews in Netherlands. The van Burg et al. (2008, p. 114) framework is presented as five principles:

"(1) create university-wide awareness of entrepreneurship opportunities, stimulate the development of entrepreneurial ideas, and subsequently screen entrepreneurs and ideas by programs targeted at students and academic staff;

(2) support start-up teams in composing and learning the right mix of venturing skills and knowledge by providing access to advice, coaching, and training;

(3) help starters in obtaining access to resources and developing their social capital by creating a collaborative network organization of investors, managers, and advisors;

(4) set clear and supportive rules and procedures that regulate the university spin-off process, enhance fair treatment of involved parties, and separate spin-off processes from academic research and teaching;

(5) shape a university culture that reinforces academic entrepreneurship by creating norms and exemplars that motivate entrepreneurial behavior."

Pirnay et al. (2003) distinguish between university spin-offs founded by researchers and those founded by students. In this article's study, we explore university spin-offs based upon ideas initiated by both researchers and students, but developed through a process where students are the lead driving force. While the van Burg et al. (2008) principles are developed in regards to university spin-offs, we posit that they constitute a useful means for analyzing venture creation in a university setting, including our focus on entrepreneurship education programs performing venture creation. Thus, we utilize these principles as the basis for constructing the first part of our own framework of analysis, discussed further in the method section.

2.4 Potential bridging capabilities of VCPs

Three of the cases from literature refer to the potential of university venture creation utilizing education (thus by our definition VCPs) to create economic value by bridging the "valley of death" (Barr et al. 2009; Boocock et al. 2009; Meyer et al. 2011) – the financial gap innovators often face when bringing research to the market (Branscomb and Auerswald 2003). Lack of available/applicable financing is often termed a "market failure", signalling need for government-funded institutional support (ibid, p. 11). Meyer et al. (2011) propose that the "valley of death" represents three separate gaps: technology discovery, commercialization, and venture launch. They argue that each gap could potentially be addressed through the experiential learning and process-based design we associate to VCPs. Previously studied ventures created through such programs have delivered mixed economic outcome, with only some reporting high levels of employment and value generation (Barr et

al. 2009; Lundqvist and Williams-Middleton 2008), while others have indicated modest or disappointing economic performance (Janssen and Bacq 2010; Meyer et al. 2011).

Another potential bridging capability of VCPs is interdisciplinarity (Barr et al. 2009; Boocock et al. 2009; Janssen et al. 2007; Meyer et al. 2011; Thursby et al. 2009). Interdisciplinarity in regard to a VCP framework may include student team composition, diversity of problems to solve, and faculty portfolio. Interdisciplinarity can connect disciplines, reaching across organizational and cultural boundaries within the university, to connect students and faculty from different domains. However, interdisciplinarity also presents institutional challenges, including logistics regarding cross-campus collaboration, 'buy-in' from faculty and administrative staff, and domain-specific conflicts within thesis assessment (Janssen and Bacq 2010; Janssen et al. 2007; Thursby et al. 2009).

Entrepreneurship education utilizing venture creation can be seen to integrate university commercialization activities when collaborating with technology transfer partners (Barr et al. 2009; Meyer et al. 2011; Rasmussen and Sørheim 2006; Thursby et al. 2009). Collaboration facilitates entrepreneurial competency development through interaction with key stakeholders (Williams Middleton 2010; Williams Middleton 2013). However, collaboration between education and commercialization activities also presents various negotiation challenges regarding ownership (Meyer et al. 2011) and rights to intellectual property (Barr et al. 2009).

3. Method and data collection

Due to the perceived lack of systematic exploration into this area of research, a qualitative and explorative multiple case-study approach (Yin 2008) is used, aligning with methodological recommendations (Edmondson et al. 2007).

Five design principles for venture creation at the university (van Burg et al, 2008)	Ten themes of a VCP	Ten themes in short	References (in addition to van Burg et al, 2008)	Five resulting design principles for VCPs
Create university-wide awareness through programs targeted at students and academic staff	Marketing to and selection of students	Marketing / screening		Targeting and selecting the students
Create and support start-up teams by providing skills matching,	Establishing start-up teams in a creative environment	Teams		Creating the start-up teams
training and coaching	Establishing fair and motivating rules	Rules / motivation	Cope and Watts, 2000	
Create a network of investors,	Securing collaborative network	Network		Collaborating with
managers and advisors	Linking to external outreach activities	Outreach	Mwasalwiba, 2010	external actors
Set clear and supportive rules and procedures that regulate the start-	Maintaining good academic entrepreneurship environment	Faculty	Gibb, 2005	Designing the learning environment
up process	Supplying relevant theory content with the right mix	Content	Mwasalwiba, 2010	
	Delivering a well balanced mix of pedagogical methods used	Pedagogy	Mwasalwiba, 2010	
	Actual business start-up process (Core process)	Start-up process	Gibb, 1998	
Shape a culture that motivates	Influencing students' attitudes	Attitudes	Barr et al, 2009;	Developing entrepre-
entrepreneurial behavior	towards entrepreneurship		Gibb 2002	neurial attitudes

Table 1. Theoretical framework for data collection

We developed a theoretical framework consisting of ten main themes, building from van Burg et al.'s five design principles for university spin-outs (2008), a select case study (Barr et al. 2009), and general literature within entrepreneurship education (Cope and Watts 2000; Gibb 1998, 2002, 2005; Mwasalwiba 2010). The ten themes were grouped resulting in an adapted version of five design principles, see Table 1. This framework was used when designing a semi-structured interview template, and when comparing the empirical VCPs. There are potential limitations to using such a framework, since the creation of a new venture is contextual and influenced by institutional and cultural factors. Nonetheless, there was a need for structure due to the large amounts of data resulting from a qualitative approach.

3.1 Data collection

General knowledge of the field was used to form an initial sensitizing concept (Flick 2006) for the VCP definition, and then tested relative to example cases from existing literature. Following definition establishment, we identified potential VCPs from the regions of Europe, North America and Asia-Pacific using previously available research, internet resources and snowball sampling. This resulted in an initial population. A website² was also created as a receiving point for programs self-identifying as VCPs. The initial population was analyzed through email/telephone contact in order to determine a refined VCP population. After two years of investigation, 18 VCPs have been identified.

For the purpose of this article, key individuals at ten programs were selected for interview, based on availability, utilizing the designed interview template. A pilot interview was held with a trusted individual at one of the programs, from which adjustments were made prior to data collection. The three members of the research team³ conducted interviews independently. Interviews were recorded and transcribed and complemented by written interview notes. Documentation and public data found online or provided by the interviewee were used to supplement the interview data. Follow-up interviews were conducted as necessary.

A two-day focus-group of program directors/key colleagues was held with 14 of the identified 18 programs in June 2012 (in Gothenburg, Sweden), providing additional in-depth data. A folder containing one-page structured program descriptions (which were supplied by the participating directors) was compiled prior to the meeting. Presentations were video recorded and participants produced written material during the meeting based on key themes identified through the initial interviews, including: program objectives, background, key partners, achievements, challenges and funding. These texts added to the available data on the ten VCPs interviewed. Written participant feedback from the meeting confirmed "venture creation programs" as a productive and surprisingly unusual common denominator.

² www.vcplist.com

³ The two authors and an additional member from the same research division at Chalmers.

3.2 Data Analysis

Basic and themed information about the VCPs was compiled into tables (see Table 2 and 3). Data from the ten VCPs was compared in order to identify common characteristics, methods and practice. Each of the interviewers then focused on a specific theme, listening to and reading the interview data, in order to reduce individual bias or select interpretation of data. The refined data was compiled independently by the authors into a matrix (Table 4), according to the five design principles generated from literature (Table 1) on one axis, and five proposed bridging capabilities on the other. The matrix contents developed by each author were then discussed, combined into one, and analyzed jointly to clarify findings drawn from the interviews and identify potential patterns across the ten VCPs.

4. Findings

The VCPs are all masters-level programs or higher, except for one bachelor-level program, and range from one to two years in length. The student cohort size ranges from 12 to 60. Six of the programs were founded between 1995 and 2001, with the remaining four founded 2006 or later. Students have different educational backgrounds. Almost all of the programs collaborate, to a greater or lesser extent, with a technology transfer (or equivalent) organization. All of the programs have successfully facilitated creation of new firms. A summary of basic information about the selected VCPs is presented in Table 2.

When looking more specifically at the components of the various VCPs in regards to the ten themes presented in Table 1, some differences appear. Some of the programs are marketed externally, while others are only open to students already enrolled at the university/college. Six of the ten VCPs have students explicitly selected from different disciplines (ex. business, engineering, medicine). Seven VCPs use a team-based format, and the remaining three programs allow for team- as well as individual-based ventures. All team-based VCPs utilize a mix of students from multiple disciplines, with team sizes ranging from two to eight. At some of the VCPs students form the teams independently, while other programs utilize designed team formation managed by the faculty. Designed team formation is more common for VCPs providing university technologies or external ideas as the basis for the venture. Programs allowing students to develop their own ideas are the only programs with individual-based venture formats.

Motivation to engage in venture creation is often supported through financial and ownershipbased incentives. Access to networks of mentors brings in reflections from 'real world' experience. In some cases, contributing practitioners are university or program alumni. Core faculty size ranges from one and a-half to 13 full-time individuals, with four to six being the most common amount of faculty. Most programs include a mix of academics and 'pracademics'⁴. While anchored in an action-based experiential approach, core pedagogy also includes lectures and literature. The start-up processes at most VCPs include phases of initial idea evaluation and verification, often requiring presentation tollgates, and sometimes connected to financial investments during or after the program. Detailed VCP data is presented in Table 3.

⁴ practitioners delivering lectures in the academic environment

VCP	Location	University Size – total students	Type of institution	Start year	Degree	Annual Student Cohort (total alumni)	Program Length	Tech transfer partner	Activity of some ventures started at program
А	USA	3300	Private College	2000	MBA	15 (200)	1 year	Alumni Fund	Public space recyclingOnline and mobile recipes
В	Sweden	11500	Public University of Technology	1997	MSc	25 (300)	2 years	Associated Incubator	Fleet management systemsAviation brokerageTidal energy solutions
С	USA	30000	State University (Land Grant)	2007	MSc / MBA	25 (100)	1,5 years	Associated Accelerator	Women's health productsSolar lightning technologyIrrigation pumps
D	Sweden	47000	Public University	2006	MSc	40 (90)	1 year	Associated Innovation Office	 Accomodation solutions Web based charity Game development engine
Е	USA	34000	State University (Land Grant)	1995	MBA	60 (450)	2 years	TTOs at home and neighboring universities	Textile dyeing technologyPersonalized diagnosticsNanofiber production
F	Belgium	21000	Public University	1997	MSc / MA	35 (350)	2 years	Regional TTO and Science Park	Biogas plant constructionChain of leisure storesDigital storage
G	England	1000	Private University	2006	BSc	12 (26)	2 years	N/A	 Sustainability business Sky Diving Supporting New Entrepreneurs
Н	USA	24000	Public University	2001	MBA / JD / PhD	20 (400)	1 year	TTO at home and Innovation laboratories	Renewable energy sourcesGenomic analysis technologyCustom sunglasses
J	USA	51000	Public University	1996	MSc	60 (800)	1 year	TTOs at home and other universities	Eye diseases treatmentAesthetic laser technology
К	Norway	9000	Public University	2008	MSc / MBA	20 (10)	2 years	Regional TTO	Ground movement monitoringDrug uptake technology

Table 2. Basic information of selected VCPs.

Table 3. Specific components of selected VCPs

VCP	Idea Basis ^a	Team structure	Venture structure	Venture process in education	Network
А	Student	individual (majority) or 2-3 team; student formed	Mentorship	Two phases: opportunity development and delivery; go/no-go incorporation at post education	Faculty, incubator, (Entrepreneurial) Alumni Financiers
В	Provided	2-3 team (interdisciplinary); faculty formed (w/ input)	Student ownership stake (3%); mentorship; funding	Multi-phase: evaluation to incorporation with 4 tollgates; final go/no-go incorporation post education.	Research depts., faculty, incubator, alumni, financiers, regional service providers, regional innovation system
С	¹ / ₂ student ¹ / ₂ provided	3 team (interdisciplinary); faculty formed (w/ input)	Student ownership stake (idea origin dependent)	Multi-phase including implication in the field; final go/no-go incorporation post education	Research depts., faculty, incubator, alumni, financiers, regional service providers, regional innovation system
D	Student or provided (optional)	2-3 team or individual; student formed	Student ownership stake (idea origin dependent); funding (discretionary)	4 phases of development; educational tollgates (linked to courses)	Incubator, holding company, mentors, private donor
Е	Provided	5-8 team (interdisciplinary); student formed	Student ownership stake (depending upon student performance)	Multi-phase: ideation, assessment & commercialization; tollgates; final go/no-go incorporation post education	Faculty, financiers, regional entrepreneurial community
F	Student or provided (optional)	2-3 team (interdisciplinary); student formed	Student ownership stake (idea origin dependent); funding (discretionary)	Non-specific – mainly competency development	Research depts., faculty, incubator, TTO, holding company, student club
G	Student	50/50 individual and team; student formed	Student ownership stake; funding (discretionary)	Four-phase process from start to launch to operation and finally transition.	Private donor; regional and national service providers and innovation system; 'incubator'
Н	Provided	4 team (interdisciplinary); faculty formed	Student ownership stake (idea origin dependent); funding (discretionary)	Multi-phase: ideation, assessment & commercialization; tollgates; final go/no-go incorporation post education	Univ. research depts., financiers
J	Provided or student	4-6 team; faculty formed (w/ input)	Student ownership stake (depending upon idea origin)	Multi-phase: technology validation, business plan, operational plan, & venture launch. Intrapreneurship projects encouraged	Faculty, TTO, financiers, "corporate America"
K	Provided	2-3 team (interdisciplinary); faculty formed (w/ input)	Student ownership stake (2%); funding	Multi-phase: evaluation to incorporation with 4 tollgates; final go/no-go incorporation post education.	Faculty, TTO, holding company

Findings from the ten VCPs provided multiple examples of the five proposed bridging capabilities. In the following sections 4.1 to 4.5, quotes from the VCP interviews are used to illustrate bridging capabilities relative to the five resulting design principles for VCPs in Table 1.

4.1 Targeting and selecting the students

Interviews revealed that VCPs market their programs broadly. VCP F and H communicate the ambition to attract action-oriented students from multiple disciplines, noting the value of team interdisciplinarity on venture creation activity.

"students from almost all schools at the comprehensive [university] are brought together in cross-disciplinary teams to create businesses." (Quote 1, VCP F)

"We have added other universities [as partners]...they have an engineering school which we do not have. ... [Teams] seemed to always fare better because they had this interdisciplinary nature to them" (Quote 2, VCP H)

Many VCPs try to align student composition with the needs stipulated by the venture creation process and partnering organizations. The following quotes from VCP K and VCP D illustrate that the associated TTO willingly collaborates with both student and project recruitment:

"Because our students are almost potential recruits to start these businesses, it's important to us that [our TTO] is also included in the [student] selection group. [This group consists of] students from the previous class, the teachers and [TTO staff]." (Quote 3, VCP K)

"[the TTO] brings up a number of projects that they deem appropriate. They're pretty well versed in the program because they have been involved the whole time. They know what type[s] of projects are possible, because they know the technical level of our students" (Quote 4, VCP D)

4.2 Creating the start-up teams

Once students and ideas are sourced into the program, multiple match-making processes take place. Team formation activities may include careful composition based on required roles, as evidenced by VCP J, or pairing idea partners with student teams as explained by VCP B.

"We put them in teams based on a number of dimensions, but [a personality test] is probably the most important one. The hypothesis is that if you have individuals from each of the four quadrants, you have a more effective team. The four quadrants would be planners, communicators, doers, policy people." (Quote 5, VCP J) "Teams of two or three students are matched with a scientist or innovator to take forward a business idea into a business." (Quote 6, VCP B)

Team formation also involves fixed or negotiated partnership distribution. VCP B utilizes an established equity distribution, with a 30% share open for negotiation at a later stage. At VCP H, the partnership negotiation is more in regards to who becomes the core team of any particular venture from within the student cohort:

"The equity is distributed 20% to [the university], the rest goes to approximately 45% idea provider, students in total 10% by default, 30% left to be decided on at a later stage, often given to the students if proving themselves." (Quote 7, VCP B)

"They can fire team members that they don't get along with, and they can hire some new ones, but it's up to them" (Quote 8, VCP H)

4.3 Collaborating with external actors

An important part of the students' action-based activities at the VCPs is based on external collaboration. A variety of external actors, primarily motivated by creating value, are involved.

"It isn't just a classroom curriculum. Getting the student interacting with the environment, with customers, with trade-shows, with a mentor who's been there and done that ... We also give them exposure to potential investors" (Quote 9, VCP A)

Presentation opportunities in front of external actors, such as the 'pitching' conducted at VCP G, are commonplace across the VCPs interviewed.

"Within 4 months of starting the programme, students must prepare and 'pitch' their business plan to [a] VC panel." (Quote10, VCP G)

VCPs are also shown to be highly integrated within the regional entrepreneurial ecosystem, both within and associated to the university system. Incubators, TTOs are important partners, as evidenced in Table 3, and stated again by VCP F, as well as student organizations. VCP H also explains the importance of embedded partners within academic disciplines.

"The most important partners are the different schools ... technology transfer office ... incubators, the student entrepreneurship club" (Quote 11, VCP F)

"you need a champion in each of these [university] departments willing to lead their particular area to be good contributors to the whole." (Quote 12, VCP H)

4.4 Designing the learning environment

Most of the VCPs studied have designed their learning environment around a venture creation process rather than according to content. Entrepreneurial practice is often tightly coupled with theory and reflection, but fundamentally based upon the real-world activities connected to the iterative process of creating a viable business, as explained by both VCP D and B:

"The programme is focused on letting the student learn from their own actions by reflection and by relating action and practice to theory." (Quote 13, VCP D)

"It is an iterative process with increasing degree of engagement and personal ownership in the process. ... it is the doing around the business plan that is important." (Quote 14, VCP B)

This action-based setting is viewed as attractive by technology transfer staff, since the tasks that the students do are the same tasks that they themselves would have needed to do otherwise:

"a student must satisfy multiple parties. The inventor can relax. Now and then [the inventor] is not so interested in having the students, but when [the inventor] sees how much work [the students] do, ... the TTO is so interested in this, because the TTO has problems in that they are [too] few people." (Quote 15, VCP K)

4.5 Developing entrepreneurial attitudes

Many interviewees comment upon strong personal development, specifically entrepreneurial attitude, intention and behaviour, both during and after the program. They relate the personal developments in students to the experiential and interdisciplinary setting of the VCPs. For example VCP G notes the change in students' ability to be self-promoting. VCP A associates personal change to the dynamic fluctuation experienced through the program, which reinforces the entrepreneurial experience:

"Enormous personal development... they learned and they changed a great deal ... they move from being very much teenagers to being people who are able to go out and do things and sell themselves" (Quote 16, VCP G)

"they're exposed to the highs and the lows, and you often see them get very discouraged, to give up some of them, you see some of them get some very early indications of success and they get very excited, so yeah it is kind of that usual roller-coaster that you would expect for any entrepreneur" (Quote 17, VCP A)

And finally, VCP H described development occurring through a "tipping point" moment:

"you [the student] go into the fall, you write this business plan, and it's still a school project. But now you go into the winter and spring, and you're starting to

think, holy smokes, I'm gonna graduate in four months and I've been studying this business idea for X months and I'm really getting kind of excited about it, and you know the question is: is this something I'm really gonna do? ... [for some people] they will tip over from being a school project to being real. That is a very exciting moment for us as educators, because all of a sudden, they own it more than you do. All of a sudden, the students own it. They own the problem. They own the business. They own the whole concept of going forward in this thing. And they take off with it. And they start working harder than they've ever worked before on anything in their life. It's amazing." (Quote 18, VCP H)

In the discussion, the quotes from sections 4.1 to 4.5 are used to illustrate the ways in which VCPs can be seen to bridge between entrepreneurship education and technology transfer activities in a university environment with regard to venture creation.

5. Discussion

This article aims to investigate how educational programs specializing in venture creation can contribute to bridging the gap between entrepreneurship education and technology transfer. Some VCPs communicated results of direct combination between their education and venture-creation-based technology transfer at their institution, as exemplified by VCP E: "over the last ten years our teams have raised 250 MUSD in equity funding ... they created 250 jobs. Of all the new business start-ups using [our university's] technology, [our] program accounted for 55% of them." To look further at the potential contributions of VCPs, we analyzed the empirical data from ten programs relative to the five design principles from Table 1 and the bridging capabilities derived from the literature in section 2. Table 4 summarizes the ways we found VCPs to demonstrate bridging capabilities relative to design principles, marrying entrepreneurship education and technology transfer objectives in a university setting.

5.1 Experiential learning

Engaging entrepreneurially driven students in the venture creation process is a key contribution that VCPs can provide to technology transfer. In return, the entrepreneurial education receives access (through the TTOs and incubators) to projects and human capital resources that are 'real' and can result in creation of an incorporated venture. The creation of venture teams, including not only students as the driving force, but also the other key players to provide insight, feedback or even resources (quotes 6, 7, 9, and 11), facilitates learning through engagement in entrepreneurship. The negative experiences of the entrepreneurial roller-coaster may also trigger transformative learning, which can lead to "profound changes in self" (Mezirow 1991, p. 177).

Bridging entrepreneurship education and technology transfer in the way VCPs have been shown to do can facilitate more in-depth study of the treatment effects of entrepreneurial education on students (see for example Thursby et al. 2009). The VCPs studied present multiple examples of student teams achieving the commitment and dedication needed for starting a real-life venture, based on the experiential and process-based design of the education (quotes 16-18). Through contractual and emotional ownership of a real-life venture, students reach a 'tipping point', treating the venture as 'theirs'. Literature outlines the
 Table 4. Bridging capabilities of VCPs stemming from design principles

	Experiential learning	Interdisciplinarity	Process-based design	Network resources	Regional economic development
Targeting and selecting the students	Attracting action-oriented students from the entire university in order to learn by doing	Students from different faculties recruited bringing diversity into the process	Comprehensive screening, searching for the "right" mix of people for the job Implicit screening continues during program	Selection of students is done in collaboration with the network, such as alumni and TTO personnel	Attracting students that otherwise might not have self-selected into an entrepreneurial (or entrepreneurially-oriented) career
Creating the start-up teams	Teams, tasks and dedicated office space offer a degree of closeness and trust contributing to learning and productivityRoles in teams are assigned based on discipline knowledge, taking advantage of interdisciplinarity		Multiple match-making processes involving students and idea providers, which are sometimes faculty led, and often negotiated	Ideas sourced from the surrounding network – TTOs, alumni, industry, innovators, faculty, etc. Equity and royalty negotiations are common	Dedicated (incubator-like) facilities provided as formal part of education Funding often provided or available during education period
Collaborating with external actors	Student learning through interaction with actors that are motivated by creating value	Programs utilize a wide variety of key partners such as other faculties at the university, specialty advisors and business practitioners	Educational process includes 'pitching' opportunities, business plan competitions, trade fairs and/or network events	External actors provide new pathways to resources normally not available through traditional education	Projects are active in the regional entrepreneurial ecosystem and its support structures
Designing the learning environment	Real venture creation is tightly coupled with academic theory and reflection through an iterative format	A mix of senior academics and pracademics helping to bridge the gap between university and industry	A prevalence of process- oriented descriptions rather than content oriented descriptions, address not only what to do, but how as well	Students conduct (are responsible for) much of the networking and outreach that is normally done by organizations such as the TTO	Explicit focus on creating value for external stakeholders as part of the formal learning environment
Developing entrepreneurial attitudes	Students experience the entrepreneurial roller- coaster, contributing to entrepreneurial attitude and skill development	Team diversity contributing to the level of holistic learning and the quality of the venture created	The iterative nature of managing a real-life venture creation process contributing to entrepreneurial self- efficacy	Expanding the venture's resource base though networking leads to effectual and bricolage skills	Real-life entrepreneurial value-creating behavior and action (beyond intentionality)

potential benefits of ownership perception, such as increased creativity (Amabile et al. 1996), emotional involvement and commitment (Gibb 1987), motivation (Savery and Duffy 1996), and responsibility (Cotton 1991).

5.2 Interdisciplinarity

Attracting and forming small interdisciplinary student teams matched with research-based intellectual assets (often from university research) and their associated providers is one of the most common bridging capabilities across the VCP cases, as evidenced in Table 2, where TTOs are listed as key partners. Students at for example VCP F stem from business, law, engineering, physiotherapy, psychology, sciences, agronomy and liberal arts. A multi-discipline recruitment base increases diversity in the venture creation-based technology transfer processes at universities where VCPs collaborate with their TTOs, incubators, etc. According to Meyer et al. (2011), diversity is necessary for effectively determining the commercial potential of university research, and interdisciplinary teams are said to often do a better job than professional business development consultants, in uncovering unforeseen or promising applications for the technologies assessed.

According to Rasmussen and Sørheim (Rasmussen and Sørheim 2006), several desirable goals are achieved through a match-making approach, including successful commercialization of research conducted by scholars reluctant to become entrepreneurs, development of ideas that might otherwise have been neglected, and better access to ideas for students that want to become entrepreneurs. The screening processes utilized by VCPs may better facilitate match-making between entrepreneurial actors, innovative ideas and mentors/advisors. For example, VCP K's student admissions process involves not only faculty, but also TTO staff and alumni, to include real-world perspectives upon the forthcoming venture process (quote 3). Many of the VCPs have highly designed match-making processes that include equity distribution and partner negotiation (quotes 5-8, and venture structure in Table 3). VCPs can be seen to constitute an educational platform that facilitates a diverse competency basis for technology assessment, through a diverse team structure (Table 3), as students work with creating ventures based on or in collaboration with university research (as illustrated through Table 3 idea basis and quotes 4 and 11).

5.3 Process-based design

VCPs are by definition action- and experience-oriented, as they use the process of creating a real-life venture as a primary learning vessel. Less obvious, but emphasized by many VCP directors, is the iterative nature of the process, common to current developments in entrepreneurship research on effectuation (Sarasvathy 2001) and technology transfer research on university spin-outs (Vohora et al. 2004). In technology transfer literature, learning from iteration is shown as able compensation for lack of commercial experience (Druilhe and Garnsey 2004). The challenge is finding industrial partners tolerant of time and resource intensive iterations (Wright et al. 2004). We argue that VCPs provide an alternative partner to TTOs, capable of facilitating the necessary resources for venture spin-out, including access to surrogate entrepreneurs (Franklin et al. 2001; Lundqvist in press; Radosevich 1995) in a designed learning process tailored to the needs of the new ventures.

The experiential and process-based design emphasized by many of the respondents may explain why a venture creation approach (Ollila and Williams Middleton 2011) is potentially at odds with the more traditional academic values emphasizing theory and content (Ardalan 2008). We propose that the learning environments of VCPs can empower research within both entrepreneurship and technology transfer. Viewing entrepreneurship as a learning process (Cope 2005; Minniti and Bygrave 2001; Rae 2004), we claim that VCPs allow for focused studies on nascent entrepreneurial stages of creating research-based ventures, and could be regarded as clinical laboratory environments. The term "clinical" (Schein 1993), builds on the work of Lewin (1947) stating that only by changing a human system it can be understood.

5.4 Network resources

VCPs actively collaborate with key partners such as technology transfer offices and incubators, arguably building upon at least some shared values and goals. From an entrepreneurship education standpoint, students gain practical experience in future entrepreneurial activity (quote 18), exemplified through incorporated ventures stemming from the programs (Table 2). From a technology transfer or incubator standpoint, students can fulfil tasks valuable to their organization such as idea evaluation, IP analysis or market verification (Table 3, quote 15), or even acting as surrogate entrepreneurs (as mentioned previously). The ability for students to fill this space has been recognized in previous research (Barr et al. 2009; Lundqvist in press). We posit that VCPs provide an opportunity for TTOs to extend their resource base with entrepreneurial and committed students capable of creating value.

The VCPs studied exemplify student collaboration with external actors (Table 3, quotes 9 and 10). Collaborative activities include business plan competitions, pitching events, trade fairs and key stakeholders procurement, and are conducted as a formal part of the curriculum, using a venture creation approach (Ollila and Williams Middleton 2011). Such activities also resemble situated learning in communities of practice (Lave and Wenger 1991; Wenger 1998), where social processes increase emotional exposure, fostering reflection, personal development, and entrepreneurial skills development (Cope 2003; Pittaway and Cope 2007b).

5.5 Regional economic development

Entrepreneurship education has been shown to be capable of facilitating development of entrepreneurial attitude and intention (Lüthje and Franke 2003; Peterman and Kennedy 2003; Souitaris et al. 2007), when grounded in social learning theory and self-efficacy (Bandura 1997). Attitude developed is assumed to lead to entrepreneurial behaviour, building primarily on the theory of planned behaviour (Ajzen 1991). But, research conducted in entrepreneurship education lacks empirical evidence illustrating direct transition from intention to behaviour (Williams Middleton 2010), argued as perhaps due to the often substantial time lag between educational treatment and entrepreneurial behaviour (Fayolle 2005).

In our study, the challenge of establishing a link between attitude, intention and behaviour is a secondary issue, as the VCPs present evidence of actual entrepreneurial behaviour both during and after the programs. Entrepreneurial behaviour can be illustrated through direct or indirect

contribution to regional economic development; direct contribution evidenced through the actual creation of new ventures (Table 2), and indirect contribution through annual cohorts of students actually engaging in venture creation (Table 2), or individual efficacy in the role of 'entrepreneur' (quote 16 and 18). Through partnering with TTOs and incubators, VCPs also simultaneously deliver commercialization of university research, or, in the cases of externally-based ideas (student, corporation or independent), through utilization of university competencies. We argue that VCPs are capable of shaping a more entrepreneurial university culture by developing entrepreneurial behaviour among involved students, researchers and other stakeholders, relating to the fifth design principle of van Burg et al. (2008).

6. Implications and conclusions

Our study addresses ways in which VCPs bridge the gap between entrepreneurship education and technology transfer. Both areas may benefit from closer collaboration, confirming previous claims (Greene and Rice 2011; Moroz et al. 2010; Nelson and Byers 2010). We illustrate that VCPs contribute to technology transfer processes by: increasing the number of engaged stakeholders which expands the competency base, increasing effective assessment of disclosed inventions, decreasing neglect of latent opportunities, and providing match-making between innovators and entrepreneurial capacity which includes access to entrepreneurial talent. While VCPs report significant variance in the frequency and economical significance of ventures created, they present potential for substantial value creation through not only economic value generated from new firms, but value created through increased entrepreneurial capacity (student graduates). Further research is required to understand if venture creation variation is due to contextual factors, or if output can be increased through exchange of good practices.

VCPs provide new access to clinical research opportunities, increasing our knowledge about nascent stages of entrepreneurship and technology transfer, and allowing for observation of entrepreneurial behaviour, as it is taking place, instead of in hindsight. Students learn from real-life failure in a designed environment, resulting in potential treatment effects from entrepreneurship education. In such an environment, failure experienced in a venture can be a positive learning outcome for the student and provide insight in terms of invention assessment (Meyer et al. 2011).

The unique environments of VCPs stress the importance of balancing between multiple dualisms. Practice needs to be balanced with theory. Action needs to be balanced with reflection. Learning goals need to be balanced with more business-oriented value creation goals. Research-oriented faculty need to be balanced with pracademics. Much of the perceived incompatibility of a venture creation approach in university settings could potentially be associated to these dualisms. While VCPs could be seen as too practice-, action- and business-oriented (Janssen and Bacq 2010; Meyer et al. 2011), they may present a compromised balance between the multiple dualisms. The problems of dualisms in learning and education have been addressed by Hager (Hager 2005), and we posit that viewing VCPs from this rather philosophical point of view could help increase our understanding not only of

what it might take to bridge between entrepreneurship education and technology transfer, but also between education and real-world learning.

For policy makers, VCPs constitute an opportunity to alleviate the "valley of death" in early stages of university commercialization, and at the same time increase the entrepreneurial capacity in a region. There are also opportunities for industry-based commercialization to benefit from complementary university knowledge by bringing corporate ideas into the university setting. This 'university spin-through' provides societal benefit as well by taking potential innovations off the shelf in the corporate setting.

Finally, some important challenges are identified. TTOs remain reluctant to consign valuable IP to inexperienced students. The interdisciplinarity of a VCP learning environment poses substantial issues in an academic environment. Dualisms will continue to spur discussion and disagreement around VCPs. The low level of predictability in the learning process and the resource intensive VCP environment demands entrepreneurial and practice-oriented faculty, currently in short supply. Finally, further study is needed to understand the emotional impact upon students experiencing the entrepreneurial roller-coaster, in order to address moral and ethical considerations.

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Appended paper 3

Links between Emotions and Learning Outcomes in Entrepreneurial Education

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Abstract

This paper investigates links between strong emotions and entrepreneurial learning outcomes in an action-based entrepreneurship education program. Students' own experiences were assessed during their participation in a master level university program where they were expected to start a real venture as formal part of curriculum. An explicit focus on emotions in action-based entrepreneurship education is unusual in previous research, but can trigger new insights on antecedents to entrepreneurial learning outcomes. It also represents a novel approach to assessing learning outcomes of entrepreneurial education.

Methodology. A longitudinal design was applied following three students during nine intensive months. Students were equipped with a mobile app-based survey engine in their smartphones, and were asked to momentarily register emotions and critical learning events related to their educational experience. These app-based measurements were followed up quarterly with semi-structured interviews to uncover links between strong emotions and resulting entrepreneurial learning outcomes. Links were identified by using software analysis package NVIVO and theoretical as well as open coding of data.

Findings. Findings indicate a large number of links between strong emotions and entrepreneurial learning outcomes. Some links seem stronger than others. Three sources of emotions that seem to be particularly linked to entrepreneurial learning outcomes are interaction with outside world, uncertainty and ambiguity in learning environment and team-work experience. These sources of emotion seem to be linked to formation of entrepreneurial identity, increased self-efficacy, increased uncertainty and ambiguity tolerance and increased self-insight. Strong emotions induced by action-based entrepreneurial education seem to primarily impact attitudinal learning outcomes.

Implications. These findings represent a novel approach to assessing learning outcomes within entrepreneurial education. They also represent early empirical evidence for three seemingly effective design principles of entrepreneurial education. Educators aiming to develop entrepreneurial competencies should try to design a learning environment ripe of uncertainty and ambiguity where students frequently are able and encouraged to interact with the outside world in a working environment characterized by a team-based approach. This study also represents an attempt to open the "black box" of entrepreneurial learning, since it has been possible to uncover some of the mechanisms behind the links observed between emotions and learning.

Limitations. Important limitations of this study include a small number of interviewees, unknown transferability of results to other contexts and learning environments, risk for individual bias in the data coding procedure and a lack of established theoretical frameworks for strong emotions and learning outcomes within the domain of entrepreneurship education.

Introduction

Action-based approaches are by many scholars perceived central to entrepreneurial education in order to develop entrepreneurial competencies (Pittaway and Cope, 2007, Pittaway and Thorpe, 2012, Mwasalwiba, 2010). A project-based, hands-on and context-based approach is recommended, as it captures the social, emotional and experiential nature of entrepreneurial learning (Pittaway and Cope, 2007). Educators should try to build in opportunities for students to learn from emotional and risk-laden events and processes by letting them resolve uncertain, complex and ambiguous situations, preferably in authentic settings (ibid).

The role of emotions in educational settings is a growing but immature field of research. Both positive and negative emotions seem to play important roles. Positive emotions are necessary for experiencing "flow" (Csikszentmihalyi, 1991), and negative emotions help focusing attention (Derryberry and Tucker, 1994). Damasio is one of the pioneers in connections between reasoning, decision-making and emotions, and has stressed the importance of emotions in education (Immordino-Yang and Damasio, 2011). But it was not until in the late 1990s that emotions gained importance in educational research (Sutton and Wheatley, 2003).

According to Man (2007), "understanding entrepreneurial learning is essential for the design of enterprise education and entrepreneurship training programmes." (p.190). Markowska (2011) has described entrepreneurial learning as the process by which entrepreneurs acquire entrepreneurial competencies. Combining the two ambiguous terms *entrepreneurial* and *competencies*, we however get a concept that varies substantially in its meaning and interpretation. Still, scholars have found value in using the concept of entrepreneurial competencies (Man et al., 2002, Bird, 1995, Rasmussen et al., 2011). Man et al. (2002) see it as a higher-level characteristic that reflects the "total ability of the entrepreneur to perform a job role successfully" (p.124). According to Bird (1995) measuring entrepreneurial competencies is problematic, requiring multiple methods and approaches that to a varying degree are subjective. She lists 17 potential methods for assessing entrepreneurial competencies, such as diaries, observation, archival data, critical event interviewing, role set ratings, cases, think aloud protocols and job shadowing.

The search for evidence for developed competencies in education has led many scholars to advocate and apply research methods taken from natural science, such as the randomized experiment. It has been a recurring theme for some decades now, fuelled by research funding policy in United States and elsewhere (Slavin, 2002). This kind of evidence based approach has however been heavily criticized by scholars in education (Biesta, 2007, Olson, 2004). Olson (2004) claims that "the more simple cause-effect relations so important to the physical and biological sciences are largely inappropriate to the human sciences, which trade on the beliefs, hopes, and reasons of intentional beings." (p. 25).

This article represents a different approach to outcome assessment by exploring what entrepreneurial competency development can be tied to emotionally laden experiences caused by an action-based entrepreneurial education program. If developed entrepreneurial competencies can be robustly tied to specific emotional events occuring at an educational intervention, it represents a different approach to the assessment challenges inherent in entrepreneurial education (Fayolle, 2005, Fayolle et al., 2006). The paper thus asks the question: How are emotionally laden experiences and entrepreneurial learning outcomes linked in an action-based entrepreneurial education program?

This article proceeds as follows. Relevant literature within action and experiential learning, emotions in entrepreneurial education and assessment of entrepreneurial competencies is explored. Then the study design and underlying methodological assumptions are described, followed by the resulting data. This is then discussed and analyzed, followed by implications for practitioners and scholars.

Review of literature

This study draws extensively on work by entrepreneurship scholar Jason Cope, who has developed a comprehensive framework for entrepreneurial learning (Pittaway and Thorpe, 2012). Cope pioneered research on discontinuous and emotional learning "events" in the field of entrepreneurial learning, and states (2003) that they have "a prominent role to play in how entrepreneurs learn" (ibid, p.436). Cope (2005) states however that "the entrepreneurship discipline does not currently possess sufficient conceptual frameworks to explain how entrepreneurs learn" (ibid, p.373). According to Cope, we need to go outside the entrepreneurship domain to find learning theories that can help us explain the emotionally intense process that entrepreneurial activities constitute.

According to Gondim and Mutti (2011), Jarvis theory of human learning (2006) fully acknowledges the importance of emotion in the learning process. This is unusual in today's society where a rationalist bias is ever so present, emphasizing rationality, objectivity and cognition, and downplaying emotion and experience (Yorks and Kasl, 2002, Postle, 1993, Lutz and White, 1986).

A foundational statement in Jarvis (2006) theory of human learning is that "it is the whole person who learns" (ibid, p. 31, 32, 50, 116, 151, 181 and 186). This reflects a view of the learner as comprising both body (genetic, physical and biological) and mind (knowledge, skills, attitudes, values, emotions, meaning, beliefs and senses). Another key concept in Jarvis theory of learning is "disjuncture", which is a situation where a person's harmony is disturbed by something or someone in the environment, triggering thoughts, emotions and actions. This concept is similar to Cope's notion of discontinuous and emotional learning events (Cope, 2003). According to Jarvis, the trigger can be another person, a phenomenon (thing/event), a future phenomenon or self. This situation forces the person to raise questions such as "What do I do now?", "What does that mean?" etc., and subsequently initiate a learning process. Based on this, Jarvis outlines ten different types of learning (2010), where only one of them, action learning, fully takes thoughts, actions and emotions into account.

Action learning

According to a review of action learning conducted by Marsick and O'Neil (1999), the main theoretical base of action learning comes from David Kolb (1984) and Reg Revans (1971), representing the experiential school and scientific school respectively. Kolb's proposed experiential learning cycle has been widely used in entrepreneurial education theory and practice, and consists of four phases – concrete experience, reflective observation, abstract conceptualization and active experimentation (Kolb, 1984).

But experiential learning did not start with Kolb's seminal work. Hoover and Whitehead (1975) had earlier defined experiential learning as follows: "Experiential learning exists when a personally responsible participant(s) cognitively, affectively, and behaviorally processes knowledge, skills, and/or attitudes in a learning situation characterized by a high level of active involvement." (p.25). This definition is illustrative of aspects important in this study in that it leans on activities involving all three

faculties of mind, i.e. thoughts, actions and emotions (Hilgard, 1980), and also is similar to the "whole person" approach.

Revans did not consider the Kolbian cycle to be an appropriate theory base for action learning (Marsick and O'Neil, 1999). Instead Revans proposed three problem solving phases – Alpha, or situation analysis; Beta, or implementation of a solution; and Gamma, or the manager's mindset and its development (Marsick and O'Neil, 1999, Dilworth, 1998). Revans was reluctant to define action learning due to the risk of opening up to shallow thinking, and stated that "the day it is accurately described in words will be the day to stop having anything to do with it" (p. 49). In addition to Revans some other scholars also critique Kolb's experiential learning theory (Jarvis, 2006, Holman et al., 1997), stating that it cannot be empirically validated and that it omits considering emotional aspects of learning. This shows the importance of being able to empirically validate learning theory, which is the aim of this study.

Emotions in entrepreneurial education

The importance of studying emotions in connection with education has been highlighted in the fields of entrepreneurship (Kyrö, 2008, Gibb, 2002, Rae, 2005, Shepherd, 2004), education (Hargreaves, 1998, Hattie and Timperley, 2007, Zembylas, 2005, Dirkx, 2001), psychology (Schutz and Pekrun, 2007, Eynde et al., 2007) and neuroscience (Immordino-Yang and Damasio, 2011, OECD, 2007). Dirkx states (2001) that explicit attention paid to affective dimensions of learning can contribute to a more positive educational experience. Postle (1993) has identified emotion as the foundation on which all learning leans. Hargreaves states (2005) that schools are full of emotions, and that good teaching is all about emotionally connecting with the students, their feelings, their interests and their excitement. Teaching without emotion thus risks getting lost in boredom and stagnation, and educational reform not taking emotions into account can severely damage what teachers do well.

Within the entrepreneurship domain, Gibb (2002) leans on Kyrö (2000) when stating that emotion based perspectives "can lead to major reconsideration of approaches to research as well as teaching" (p.256). Kyrö (2005) in her turn leans on pragmatist John Dewey when stating that "the affective construct actually rare in entrepreneurship research, should take a more explicit place in learning and teaching practices." (p. 46). Pittaway and Cope (2007) point out that "emotional exposure … created principally via group dynamics … plays a major role in creating an environment within which effective student learning can take place." (p. 222-223). Gondim and Mutti (2011) show that teaching activities similar to real situations generate greater emotional impact. Souitaris et al (2007) conclude that the only factor affecting entrepreneurial attitudes and intentions is inspiration, and draw the conclusion that an educational intervention's capacity to make the students "fall in love" with an entrepreneurial career is vital if the goal is to increase entrepreneurial behaviour.

A recent literature review on emotions in entrepreneurial education (Lackéus, 2012) has highlighted a model putting more equal emphasis on the three faculties of human mind, i.e. thoughts, actions and emotions. This model has been called the tripartite division of mind (Hilgard, 1980). The review concluded that a main reason for the low utilization of recent decades' scholarly advancements in learning theory in the field of entrepreneurial education is a prevailing cognitive bias in society, both among researchers, educators, policymakers and others. Many of the articles studied in the literature review used the tripartite division of mind to put more emphasis on non-cognitive domains. Some labelled it as cognition, conation and affection, while others discussed it as thoughts, actions and

emotions. Yet others referred to knowledge, skills and attitudes which also could be attributed to the tripartite division of mind.

Entrepreneurial competencies

Sanchez (2011) defines competencies as "a cluster of related knowledge, traits, attitudes and skills that affect a major part of one's job; that correlate with performance on the job; that can be measured against well-accepted standards; and that can be improved via training and development" (p.241). Bird (1995) has explored various "laundry lists" of entrepreneurial competencies mainly derived from management theories, and proposes a model of entrepreneurial competency development starting with antecedents to competency such as family background, education, industry experience and work experience.

An aspect of a competencies approach of particular interest here is its emphasis on measurability. Some definitions of competencies include measurability, others do not (Moore et al., 2002). Measuring competencies is problematic, requiring multiple methods and approaches that to a varying degree are subjective. Bird (1995) lists 17 potential methods for assessing entrepreneurial competencies, such as diaries, observation, archival data, critical event interviewing, role set ratings, cases, think aloud protocols and job shadowing.

In the domain of entrepreneurial education an often advocated approach to assess the degree of competencies developed in an entrepreneurship course or program is the use of pseudo-randomized experiments with pre- and post measurements on treatment and control groups (Martin et al., 2012). The measurement instruments are often survey-based and try to capture the prevalence of entrepreneurial knowledge, skills, attitudes and intentions before and after an educational treatment. A problem with such quantitative approaches to measuring entrepreneurial competence development is their inability to open the "black box" of entrepreneurial learning, i.e. how and why entrepreneurial competence is developed rather than only determining if entrepreneurial competence has been developed or not. It is worth noting here that this study represents a novel attempt to open the entrepreneurial learning "black box" (for other attempts, see Markowska, 2011, Krueger, 2005).

Fisher et al. (2008) have proposed a framework for assessing entrepreneurial learning outcomes that leans theoretically on the tripartite division of mind, as outlined by Kraiger et al. (1993) in their article applying cognitive, skill-based and affective theories of learning outcomes to training evaluation. This framework has been adapted and elaborated for the purpose of this study.

Methodology

This study applied a longitudinal design following three students during nine intensive months starting in September 2012 and ending in May 2013. These students were all following an action-based entrepreneurial education program at Chalmers University of Technology. This program is known for its active and hands-on approach, requiring student teams to start a real-life venture based on a technology supplied by external inventors at or outside the university. This specific program as well as the "venture creation approach" used at this program have been extensively described in previous research (Ollila and Williams-Middleton, 2011, Lackéus and Williams-Middleton, 2011, Hofer et al., 2010, Rasmussen and Sørheim, 2006, Lindholm Dahlstrand and Berggren, 2010). All students in this study worked with intellectual property developed by university researchers or individual inventors outside university, aiming to commercialize it through starting a venture. All three students belonged to a group of three students respectively, where only one of the group members was part of this study. All three student teams collaborated extensively with the inventors supplying the idea for the prospective venture. The educationally connected part of the attempt to develop a venture around the initial idea and related intellectual property was initiated in September 2012 and finished in May 2013. After that the students and inventors were free to continue on their own.

A mixed-methods approach was applied, using both quantitative and qualitative research methods. A quantitative approach was used to capture emotions as they occured through a mobile survey and a qualitative approach was used to reveal underlying mechanisms through semi-structured interviews, primarily searching for connections between strong emotions and learning outcomes.

Quantitative approach: mobile survey engine

According to Pekrun et al. (2011), measuring emotions quantitatively in educational settings is difficult due to lack of measurement instruments. One area where research on emotions has been quite indepth is consumer research. The emotions that products and advertisements trigger have been studied indepth by many scholars. An interesting non-verbal approach to measuring emotions can be found in this domain (Morris et al., 2002), where using a questionnaire consisting of images instead of words has been developed as a means to overcome challenges in cognitive translation of emotions among respondents. Morris and colleagues call it the self-assessment mannikin (SAM), see Figure 1.



Looking at verbal approaches to measuring emotions, this is an area of controversy. The extremes could be illustrated with the many different ways used to measure emotions, from the circumplex model of affect involving only two independent constructs, valence (pleasantness) and activation (Russell, 1980, Posner et al., 2005), to up to 12 different constructs, all stated to be independent from eachother. The use of factor analysis is common in constructing these measurement instruments (Russell, 1980).

Even though factor analysis in this domain is extensive and convincing to many, scholars have disagreed for long whether or not there exists a set of basic emotions from which all other emotions are
constructed or derived. Ortony and Turner (1990) state that such a statement would be as unreasonable as stating that there is a basic kind of person or language, and that it is "an unsubstantiated and probably unsubstantiatable dogma—an air, earth, fire, and water theory of emotion" (p.329). But even these critics agree that it is reasonable to classify emotions in certain ways as a research strategy.

The approach opted for in this study is a mixture between the self-assessment mannikin and the circumplex model of affect. Students were equipped with a mobile app in their smartphones connected to a mobile survey engine, and were asked to momentarily register every strong positive and negative emotion they experienced related to their educational experience, and rate it according to the circumplex model of affect, i.e. to rate valence and activation for each event deemed worthy of registering. They were asked to quantitatively rate the following two questions from 1-7 in a likert scale manner each time they made a report; Q1: "How do you feel? (1=very sad/upset versus 7=very happy/contented)", and Q2: "How intensely do you feel this? (1=not at all versus 7=very intensively)", see figure 2. The self-assessment mannikin pictures were used when introducing the measurement instrument to the students in order for them to be able to use the instrument in a coherent way. The students were also encouraged to write a sentence or two on why they felt like they did in each app report produced.



Figure 2. The circumplex model of affect and its relation to the two questions posed.

The mobile app also contained a possibility to report critical learning events, since this kind of events constitutes an important source of both emotions and learning according to Cope's entrepreneurial learning framework described previously in this article. The app probed for six different kinds of critical learning events: (1) changed personal norms, values or attitudes (Cope, 2003); (2) changed basic assumptions (Cope, 2003); (3) changes in important taken-for-granted matters (Cope, 2003); (4) changes in self-image or self-awareness (Cope and Watts, 2000, Woods, 1993); (5) changes in self-esteem or self-efficacy (Fisher et al., 2008); and (6) major revelations about oneself or significant others (Cope, 2003, Woods, 1993). These critical learning event reports were also coupled with an opportunity for the students to write a sentence or two about the reason for the critical learning event occuring.

Qualitative approach: Semi-structured interviews

The app-based measurements were followed up with three quarterly individual interviews aiming to uncover links between strong emotions and resulting entrepreneurial learning outcomes. A semistructured approach was applied, using an interview template with themes covering learning and themes covering emotions. Themes in the learning part were: (1) sources of learning; (2) learning events; (3) learning outcomes; and (4) similarities and differences compared to previous educational experiences. Themes in the emotion part were (1) emotions experienced; (2) sources of motivation; (3) important decisions taken; (4) behaviour important to learning; and (5) connections between learning and emotions. In addition to the semi-structured parts, each interview also included a discussion around app reports deemed to be particularly interesting from a research perspective, aiming to guide the discussion to interesting events having occurred between interviews. All interviews were recorded and transcribed verbatim.

Data analysis: Coding procedure

All data collected in the study was coded in the qualitative data analysis software package NVIVO, using two coding frameworks – one framework for sources of emotions and one framework for entrepreneurial learning outcomes. Each framework consisted of 9 and 15 sub-themes respectively. The coding framework for sources of emotions was based on a working paper by Arpiainen et al. (2013) outlining main sources of strong emotions in two entrepreneurship education programs in Finland and Namibia and one entrepreneurship education course in Estonia, see table 1. This framework was developed through thematic analysis, iteratively going back and forth between longitudinal student interview data and interpretation of sources of strong emotions in the three different educational environments. The coding framework for entrepreneurial learning outcomes was based on a framework developed by Fisher et al. (2008), and was further developed by drawing on work by other scholars, see table 2.

Main themes	Sub themes used for coding in NVIVO	
New kind of learning environment	Uncertainty and confusion	
	Theory versus practice	
	Support from outside of the learning environment	
Collaborative learning	Team-work experience	
	Time pressure	
	Individual differences between the students	
Challenging tasks	Overcoming knowledge and skills gaps	
	Interacting with outside world	
	Leadership and managing people	

Table 1. Sources of stro	ng emotions in entre	preneurship education	n (Arpiainen	et al., 2013)

Main theme	Sub themes used for coding in NVIVO	Source
Knowledge	Mental models	Kraiger et al. (1993)
	Declarative knowledge	Kraiger et al. (1993)
	Self-insight	Kraiger et al. (1993)
Skills	Marketing skills	Fisher et al. (2008)
	Opportunity skills	Fisher et al. (2008)
	Resource skills	Fisher et al. (2008)
	Interpersonal skills	Fisher et al. (2008)
	Learning skills	Fisher et al. (2008)
	Strategic skills	Fisher et al. (2008)
Attitudes	Entrepreneurial passion ("I want")	Fisher et al. (2008)
	Self-efficacy ("I can")	Fisher et al. (2008)
	Entrepreneurial identity (I am / I value")	(Krueger, 2005, Krueger, 2007)
	Proactiveness ("I do")	(Sánchez, 2011, Murnieks, 2007)
	Uncertainty / ambiguity tolerance ("I dare")	(Sánchez, 2011, Murnieks, 2007)
	Innovativeness ("I create")	(Krueger, 2005, Murnieks, 2007)
	Perseverance ("I overcome")	(Markman et al., 2005, Cotton, 1991)

Table 2. Entrepreneurial learning outcomes framework.

During the coding process more codes were added when the coding frameworks did not capture important dimensions in the data. This kind of coding is called "open coding", and is a method suitable for developing theory or creating new theory (Corbin and Strauss, 1990). After the interviews were coded, a coding matrix was produced using functionality for this in the NVIVO software package. This matrix was used to identify salient connections between emotions and learning outcomes in the data.

Findings

Quantitative data – mobile app based survey engine

The mobile survey engine resulted in a total of 55 reports; 16 critical learning events, 13 negative emotions, 3 neutral emotions and 23 positive emotions (see Table 3). The mobile survey reports were predominantly done by the participating students in the two first months of the study, indicating that a certain reporting fatigue occurred for all three participants. One hypothesized way to counter this was to send out reminders by e-mail to the participants, but attempts to do this during spring 2013 were not effective. Some kind of incentive might be worth trying in future studies.

Two of the students reported both positive and negative emotions, and one of the students reported predominantly positive emotions. The level of difference in reported activation levels was rather small, indicating that this measure might perhaps be left out in future studies for simplification reasons since it does not add significantly to the study.

Student (anonymized)	ldea origin	# of app reports	# of emotions reported	# of CLEs reported
Anthony	Individual inventor	7	4	3
Barbara	University research	16	12	4
Carol	University research	32	23	9
Total		55	39	16

Table 3. Number of app reports done by each student in the study.

The reporting of critical learning events was perceived as difficult to understand by some participants, particularly the part where the kind of CLE was to be specified. In future studies this classification could be simplified or left out, instead captured through the text and subsequent interviews. The use of the mobile phone's keyboard to input text posed no significant problems for the users. All reports were accompanied with a text consisting of between ten and 100 words, which could later be used during the interviews to increase the quality of the discussion. Some examples of text supplied in emotion reports illustrating education related emotional moments are given:

"Similarly to before, I learn of my own interests and what I don't like. Accepting this as ok personally even though it causes some difficulty in group." (Anthony)

"Excited!!! We handed in our business model and we hired a guy to develop our prototype and we are applying for money to go to this awesome fair" (Barbara)

"Tough personal insight made me say I am sorry to my team. Felt great afterwards since they responded very well." (Carol)

Similarly, the reporting of critical learning events contained text illustrating what was going on at that particular time:

"[Changed personal norms / self-awareness:] Interest in tech fields vs interest in business. Perceived bullshit in business world. Own academic learning. Self -ability higher than thought. Importance of doing what feels right in one's core." (Anthony)

"[Major revelation about a person important to you:] Under pressure people's priorities clearly comes out. Time pressure, and its time to deliver" (Barbara)

"[Changed personal attitude:] My thought of how the success of this project year will be defined was completely revised." (Carol)

A full overview of Barbara's reportings is given in Figure 3. It illustrates how the app reports can inform the interviewer, giving a multitude of possible cues for good questions during the interview to quicker lead the discussion on to aspects of interest to the study, and thereby increase the usefulness of the interview data for the study. Figure 3 also illustrates the reporting fatigue, but it is still worth pointing out that those reports that were nevertheless done later in the study were very relevant and could be used to increase the quality of interview 2 and 3. It also shows that interacting with the outside world is a common source of positive emotions, and that confusion and ambiguity is a common source of negative emotions. Further, team-work experience can be a source of both positive and negative emotions.



Qualitative data - interviews and coding of interviews

Six interviews have been transcribed verbatim and analyzed in software package NVIVO. Since this is a working paper where some work remains to be done, three interviews remain to be analyzed. But already from the six analyzed interviews some patterns can be seen. The total number of occurences for emotion codes, learning outcome codes and other codes is displayed in Table 4.

The most common sources of emotions in the transcribed interviews are interaction with the outside world, team-work experience and uncertainty and confusion in the learning environment. In addition some sources of emotions not being part of the theoretical coding framework were identified, where the most common ones were presenting in front of others, getting feedback on own performance and reaching a "tipping point". The tipping point is defined in a preceding study on venture creation programs as the moment when students go from treating the project as a school project to assuming emotional ownership and treating the project as "their own" (Lackéus and Williams Middleton, 2013).

The most common entrepreneurial learning outcomes in the transcribed interviews are entrepreneurial self-efficacy, self-insight and entrepreneurial identity. The theoretical coding framework for this theme seems to be covering a higher proportion of the situations discussed by the interviewees, because only three open codes were introduced; autonomy, self-esteem and other.

Codes			Total
Main theme Kind of codes Sub theme (theoretical codes)		number of	
	Kind of codes		occurences
Sources of	Theoretical	Interaction with outside world	29
emotions	emotions codes Team-work experience		
		Uncertainty and confusion in learning environment	24
		Theory versus practice	15
		Individual difference	10
		Overcoming competency gaps	9
		Leadership and managing people	6
		Support from outside of learning environment	5
		Time pressure	5
	Open codes	Presenting in front of others	12
		Getting feedback on own performance	8
		Reaching tipping point	8
		Other	6
		Relevancy	6
		Motivation	5
		Need for sacrifice	5
		Discrimination issues	2
Entrepreneurial	Theoretical	Self-efficacy	30
learning	codes	Self-insight	20
outcomes		Entrepreneurial identity	20
		Uncertainty, ambiguity tolerance	16
		Marketing skills	12
		Entrepreneurial passion	12
		Perseverance	12
		Interpersonal skills	11
		Mental models	8
		Resource skills	8
		Declarative knowledge	3
		Opportunity skills	3
		Proactiveness	3
		Strategic skills	2
		Learning skills	1
		Innovativeness	-
	Open codes	Autonomy	6
		Self-esteem	4
		Other	2
Other themes	Open codes	Building castles in the air and imagination aspects	11
		Learning environment	10
		Roller-coaster discussions	6
		Make a difference in the world	3
		Being exposed, nowhere to hide	2
		Starting a business as a consequence of the program	2
		Difficult to find employer to work for	2
		Methodology	1
		Graduation hesitation – continue project or take job	1

Table 4. Number of occurences for theoretica	I and open codes in transcribed interview data
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In addition to emotion and learning outcome codes, nine open codes were added in the coding process, deemed to be of particular interest in this study. All three interviewees discussed aspects of building "air castles" (Swedish term), or as the expression is in English; "Building a castle in the sky / air". These quotes are illustrative:

"we started kind of three months ago but now we suddenly, now we have 9 people working for us and like okay where did they come from? What happened there? And we sat and ordered soldering and electronics components and built stuff as well - really succeeding like this, managing to take this from just an idea - this air castle and make it concrete - it's very cool. Wow, this was possible to get down to something. And also the feeling of making others think it is so interesting that they want to spend lots of time on it is very cool I think." (Carol)

"There has to be a seed somewhere in order to grow a flower. Starting a venture is like convincing everyone that there is a flower even though you know that there is only a seed at this point. It is the entrepreneur's job to nurture the seed, replace the soil and water it until it becomes a flower in the end as promised in the beginning. Everyone else needs to see a flower while I see a seed." (Barbara)

According to the interview data, this capability to create and transmit an initial vague idea and turn it into reality was improved as an effect of the program. This capability was related by interviewees to increased marketing skills, increased resource acquisition skills and increased capability to manage uncertainty and ambiguity. It was also clear that the act of building an "air castle" was not something that everybody perceived as desirable or positive.

Also, all of the interviewees talked of the education as representing an emotional roller-coaster:

"the whole trip was really like this - first we went up. ... Coming in at the [potential customer], talking to all the people, coming out quite lyrical and then we go to the patent office and are told that we must have a patent, and it was only down again so that this will not go anyway then... But I think that [the feeling that] we can take over the world if we want to – you don't get it if it hasn't felt pretty damn hard before, I don't think so ... Somehow you learn how terribly funny it is - it may still be worth all these pesky, pesky hours, and also getting to share it with someone." (Carol)

"there is a lot going on for us right now, and the last 3 weeks have been really crazy and the last week now from Monday to Friday has been a roller coaster emotionally for me, ... there was kind of a crisis in my head and there was crisis in my stomach" (Barbara)

This indicates that an emotional roller-coaster can result in entrepreneurial self-efficacy as well as entrepreneurial passion and identity. But it is not without risk for negative experiences:

"It wasn't a roller-coaster, it was free falling from an airplane without a parachute ... I don't see the point in doing this as education instead of just doing entrepreneurship outside of education." (Anthony)

Links between strong emotions and entrepreneurial learning outcomes

After coding all interviews it was possible in the NVIVO software to construct an interaction matrix, capturing all instances of text where sources of emotions and entrepreneurial learning outcomes were discussed simultaneously. This analysis resulted in 80 such strings of text. The most common links are displayed in Table 5.

Coding based linkages in interviews		Number of	Number of	Number of	Number of
Source of emotions	Entrepreneurial learning outcome	occurences in total	occurences Anthony	occurences Barbara	occurences Carol
Interacting with outside world	Self-efficacy	13	-	5	8
Uncertainty and confusion in learning environment	Uncertainty, ambiguity tolerance	10	4	2	4
Team-work experience	Self-insight	9	5	3	1
Interacting with outside world	Marketing skills	8	-	4	4
Overcoming competency gaps	Self-efficacy	7	2	-	5
Interacting with outside world	Uncertainty, ambiguity tolerance	7	-	3	4
Team-work experience	Entrepreneurial identity	7	2	4	1
Uncertainty and confusion in learning environment	Entrepreneurial identity	6	2	1	3
Interacting with outside world	Self-insight	6	-	4	2
Interacting with outside world	Entrepreneurial identity	5	-	3	2
Team-work experience	Self-efficacy	5	1	2	2
Theory versus practice	Self-insight	5	3	2	-
Team-work experience	Interpersonal skills	5	-	-	5
Getting feedback on own performance	Self-efficacy	5	-	3	2
Uncertainty and confusion in learning environment	Self-efficacy	5	2	-	3
Individual differences	Self-insight	5	4	-	1
Interacting with outside world	Entrepreneurial passion	4	-	1	3
Team-work experience	Entrepreneurial passion	4	-	2	2
Uncertainty and confusion in learning environment	Perseverance	4	-	2	2
Leadership and managing people	Interpersonal skills	4	-	-	4

Table 5. Links between sources of emotions and entrepreneurial learning outcomes.

The results of this table cannot be adequately interpreted without being aware of two quite different kinds of experience of the education for the three participants in the study. The data shows that Anthony did not engage in any substantial interation with the outside world that caused strong emotions (see table 5), while Barbara and Carol engaged to a very large extent in interaction with the outside world. Interviews with Anthony indicate that the reason for this is related to group dynamics. The group Anthony was part of did not function well for the entire fall of 2012, but was instead split up in December following a decision by the faculty. The groups Barbara and Carol were part of reached deep levels of collaboration and productivity, giving a distinctly different experience of the program. Still, Anthony reported some quite interesting learning outcomes related to entrepreneurship, such as increased uncertainty / ambiguity tolerance, increased self-insight, increased entrepreneurial self-efficacy and the formation of a distinctly personal entrepreneurial identity. In fact, after the program was finished, Anthony started up his own company together with some friends, which according to Anthony was a direct effect of his taking part in the education studied here. In this company Anthony was determined to practice his more "substance" or "technology" based view of entrepreneurship formed during the program and rooted in his background in electrical engineering:

"I'd like to ... [practice] something you could call informed entrepreneurship, ... when you actually know what you're doing, ... something where I feel I am on top of everything needed in order to initiate a start-up. ... [Take] for example a math book where you have a proof and every step must be justified, it is for me [a] completely opposite approach and ... I can imagine that there are others who also think so. I think that when you apply social constructivism on technology development, ... it summarizes what I think is wrong [in this education's approach to entrepreneurship]" (Anthony)

The most common link between emotions and learning in this study is interaction with outside world being related to build-up of entrepreneurial self-efficacy:

"I guess it is the blend between the people you meet and the success stories you hear and things you do in the project as well as when you get confirmation that – hell, we could probably do this. (Barbara)

"it had certainly not been the same if it were not for real. Then it would have been like any other school project that you have done, you might say. Yes, I would say it's a feeling that you - that you can - that you - yes, and that people trust you, that our idea partners can come to us with this idea and trust that we can do something good out of it – that they give you their trust and that - I do not know why it is so immensely motivating that it's real, but it really is." (Carol)

In addition to this link the interview data also contains quotes indicating that interaction with outside world also can lead to build-up of marketing skills, increased uncertainty / ambiguity tolerance, increased self-insight and build-up of entrepreneurial identity and passion.

The second most common link between emotions and learning in this study is uncertainty and ambiguity in the learning environment leading to increased uncertainty and ambiguity tolerance:

"during that time in the fall [i.e. in the preparatory year, one year before this study started], I thought that yes, yes it was really a good simulation but in real life it can not be as uncertain as that. And I've noticed that [in reality] it is even as uncertain as it was there. ... It was an interesting reflection. ... it's almost a little ridiculously uncertain. ... If I had been trying to sell my stuff to someone who has no knowledge about [this] topic, I would just have needed to make up a bunch of bullshit and they would have swallowed that ... but that is nothing I can stand for ... I can imagine that in some areas it can work out very well that way. ..." (Anthony)

"you get a task, and one would think like this: Oh God, we do not even know what it is, no one understands what we are doing, and [still] at the end you have something to submit. ... It has built a little peace of mind that okay, it might be as stressful or as messy as anything, but it always turns out with something. I think it has been very much [a source of learning to me]." (Carol)

Also in this case uncertainty and ambiguity in the learning environment seems to lead to other learning outcomes, such as build-up of entrepreneurial identity, increased self-efficacy and increased perseverance.

The third most common link in the data is between team-work experience and increased self-insight:

"I would say that the greatest source of learning then has ... been largely myself and the situation the group has been in, ... more self-awareness, perhaps, I feel I know myself better." (Anthony)

"[Right] now [the major source of learning] is probably more the interaction between the three of us - that we have come quite far in ... how well we know each other. So we have discussions on group climate and group norms, they are on a very deep level. ... Those small things that can still create a bit like crisis and so then when you understand the different ways to deal with it so it will be like this - yes - we'll try to meet there." (Carol)

Also team-work experience has been shown to lead to learning outcomes such as entrepreneurial identity, increased self-efficacy, increased interpersonal skills and increased entrepreneurial passion.

Discussion

This study has uncovered a large number of links between strong emotions and entrepreneurial learning outcomes, see Figure 4. The evidence for some links is stronger than for others. Three sources of emotions that seem to be particularly linked to entrepreneurial learning outcomes are interaction with outside world, uncertainty and ambiguity in learning environment and team-work experience. These sources of emotion seem to be linked to formation of entrepreneurial identity, increased self-efficacy, increased uncertainty and ambiguity tolerance and increased self-insight. A conclusion that can be drawn from this is that strong emotions induced by action-based entrepreneurial education seem to primarily impact attitudinal learning outcomes, rather than skill-based and knowledge based learning outcomes.



Entrepreneurial learning outcomes

Figure 4. Links between sources of emotions and entrepreneurial learning outcomes uncovered / confirmed in this study.

Action-based entrepreneurship education and whole-person learning / competency

Adopting a whole-person view of learning and competency, as advocated by Jarvis (2006) and Man et al. (2002) respectively, has led this study to focus particularly on the emotional aspects of an action-based entrepreneurship education program. This approach has been capable to empirically confirm some aspects of Cope's framework for entrepreneurial learning stating that emotional learning events are central to how people become entrepreneurial (Pittaway and Thorpe, 2012). This study can also empirically confirm that disjunctural situations where a person's harmony is disturbed, the importance of which is emphasized by Jarvis (2006), can initiate profoundly personal and deep learning processes changing a person on attitudinal level, i.e. spurring new insights on issues such as "Who am I?", "What can I do?" and "What do I dare?".

Although it is outside of the scope of this article to extensively describe how the links between strong emotions and entrepreneurial learning outcomes play out in detail and why it is so, some basic mechanisms can be noted. Interaction with the outside world in the educational setting studied here at times seems to trigger very high levels of happiness and motivation among students, which in turn leads to a number of effects. They increase their level of energy put into the tasks and challenges constituting the action-based learning environment. They increase the willingness to overcome obstacles and tolerate uncertainty and ambiguity, leading to increased perseverance. It seems that when students get to present their work for people outside the educational environment, and when these external people give their honest feedback in a committed and interested way, the students feel highly acknowledged and appreciated. This feeling of being valued and valuable leads to increased self-efficacy and selfconfidence. The students seem to develop an aptitude for these situations, which over time in turn leads to increased entrepreneurial passion ("I want more of this") and even a more entrepreneurial identity ("this is who I am"). This in turn correlates in time with the "tipping point" when students asssume emotional ownership of their projects, treating them as "theirs", especially if the positive feedback external people give them can be attributed to the students' unique contribution to the project, and if the external people devote time to the projects for other reasons than giving back to university, i.e. if they are motivated by the actual or perceived value created in the project.

This uncovering of basic mechanisms explaining links between emotions and learning only represent a first glimpse into the "black box" of entrepreneurial learning at this specific learning environment, and might well be contextual and not transferable to other environments. But they are still encouraging, and merit further research.

Implications for design of entrepreneurial education

Some of the methods for assessing entrepreneurial competency development advocated by Bird (1995) have been used in this study, such as "self-reflective diaries", "retrospective construction of events and behavior", "critical event interviewing" and "oral histories" (p. 61). This study can confirm this as a productive way to link educational intervention to entrepreneurial learning outcomes, provided that one agrees that the strong emotions reported in this study are indeed caused by educational design. Although a venture creation approach in education (Ollila and Williams-Middleton, 2011) is a very unusual educational design even on a global level (Lackéus and Williams Middleton, 2013), the underpinning principles of promoting interaction with the outside world, constructing a learning environment characterized by uncertainty and ambiguity and building on a strong team-work logic all

seem to be design principles worthy of emulating in other kinds of learning environments if the aim is to develop entrepreneurial competencies. Building a learning environment on these principles seems to be able to result in formation of entrepreneurial identities, increased self-efficacy, increased uncertainty and ambiguity tolerance and increased self-insight.

Implications for further research

This study set out to explore an alternative route to assessing entrepreneurial competency development, instead of the traditional pseudo-randomized experiments with pre- and post measurements on treatment and control groups using surveys based on psychological constructs (Martin et al., 2012). Although only based on three students, some rather strong patterns have been observable, opening up the "black box" of entrepreneurial learning. This is promising, and merits further research with similar methodological approaches. This study also confirms previous claims that venture creation programs constitute "clinical" laboratory environments allowing for focused studies on nascent entrepreneurial stages of venture creation (Lackéus and Williams Middleton, 2013). The utility of such research environments is probably not limited to entrepreneurial learning outcomes only, it can probably be expanded into other domains of entrepreneurship research as well.

Limitations of the study

This study has some important limitations that should not be overlooked. It is based on three students' views only, selected for inclusion based on availability rather than being representative entrepreneurship students. The transferability of the results from this particular learning and research environment is difficult to assess at this stage, given that this is exploratory research. The coding procedure has been performed by one researcher only. In future studies all interviews should be coded by multiple researchers in order to increase inter-coder reliability.

The two theoretical coding frameworks used is another limitation. Frameworks for sources of strong emotion in entrepreneurial education is an under-researched area, and there are no other frameworks that the author knows of in this specific domain. The availability of frameworks for entrepreneurial competencies in previous research is higher, but there is no consensus among scholars as to what constitutes entrepreneurial competencies, which means that the researcher has had to construct his own framework.

Conclusion

Through a longitudinal mixed methods approach, this study has investigated links between strong emotions and entrepreneurial learning outcomes in an action-based entrepreneurship education program applying a venture creation approach (Ollila and Williams-Middleton, 2011), i.e. requiring student teams to start a real-life venture. A large number of links between strong emotions and entrepreneurial learning outcomes has been uncovered and/or comfirmed. Three thematic sources of emotions that seem to be particularly linked to entrepreneurial learning outcomes are interaction with outside world, uncertainty and ambiguity in learning environment and team-work experience.

Interaction with the outside world has for the students in this study resulted in increased entrepreneurial self-efficacy. Uncertainty and ambiguity in the learning environment frequently resulted

in students increasing their tolerance for uncertainty and ambiguity. Team-work experience frequently resulted in increased self-insight among students. There were other frequent links between strong emotions and entrepreneurial learning outcomes in the data from this study.

The study also found that the educational design of the program studied at times induced an emotional roller-coaster that led to increased entrepreneurial self-efficacy, increased entrepreneurial passion and build-up of entrepreneurial identity. Another finding was that capability to envision and communicate an initial and vague idea was improved by the program studied, leading to improved marketing skills, resource acquisition skills and capacity to tolerate uncertainty and ambiguity.

These findings represent a novel approach to assessing learning outcomes within entrepreneurial education. They also represent early empirical evidence for three effective design principles of entrepreneurial education. Educators aiming to develop entrepreneurial competencies should try to design a learning environment ripe of uncertainty and ambiguity where students frequently are able and encouraged to interact with the outside world in a working environment emphasizing a team-based approach. This study also represents an attempt to open the "black box" of entrepreneurial learning, since it has been possible to uncover some mechanisms behind the links observed between emotions and learning.

Some important limitations of this study include a limited number of interviewees, unknown transferability of results to other contexts and learning environments, risk for individual bias in data coding procedures and a lack of suitable theoretical frameworks for strong emotions and learning outcomes within the domain of entrepreneurship education.

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