To cite this document

Jan P. Warhuus, Rajiv Vaid Basaiawmoit, Entrepreneurship education at Nordic technical higher education institutions: Comparing and contrasting program designs and content, The International Journal of Management Education, Volume 12, Issue 3, November 2014, Pages 317-332,

ISSN 1472-8117.

http://dx.doi.org/10.1016/j.ijme.2014.07.004.

http://www.sciencedirect.com/science/article/pii/S1472811714000457

Entrepreneurship Education at Nordic Technical Higher Education Institutions: Comparing and Contrasting Program Designs and Content

Jan P. Warhuus*, Assistant Professor, Aarhus University
Department of Business Administration, School of Business and Social Sciences, Aarhus University.
Bartholins Allé 10, Bldg. 1327-118, Mail stop: 1326-219, DK-8000 Aarhus C, Denmark.
+45 87-166-041, jan.warhuus@badm.au.dk, http://www.au.dk.

Rajiv Vaid Basaiawmoit, Head of Open Innovation,
AU Centre for Entrepreneurship and Innovation, Aarhus University.
Finlandsgade 27, Bldg. 5361, DK-8200 Aarhus N, Denmark

ABSTRACT

In higher education (HE), science and technology (STEM) institutions were early adopters of entrepreneurship education; recognizing that STEM majors in particular have a disproportional potential to form high-growth ventures in high-tech industries with high-value prospects. Yet, only limited empirical work has been carried out to shed light on how these programs are developed and how and why they are designed and organized the way that they are. What we do know typically comes to us from single-case reports on isolated programs. This study aims to provide deeper insights through an innovative and comprehensive research design that provides a way to compare and contrast case studies of five programs, developed by different educators, in different Nordic nations, and at different HE STEM institutions. The study mainly aims to explore how these cross-case and cross-national studies can guide future entrepreneurship education program development. However, considering the deliberate selection of comparable cases, this study finds a striking diversity in effective and successful programs, and uncovers strong interdependencies between program design and inception and the program developers. As such, in addition to providing guidance for program developers, the study identifies implications for other stakeholders; including students, university management, and entrepreneurship education research.

KEYWORDS

Entrepreneurship education; STEM entrepreneurship; program design; progression in entrepreneurship education; program impact; higher education.

* Corresponding author

1 INTRODUCTION[†]

For university graduates, the Baby-Boom generation's ability to rely on large, mainly manufacturing corporations to provide attractive career paths and prosperity is long gone (Duval-Couetil, 2013; Matlay, 2011). Meanwhile, entrepreneurship education (EEd) as a Higher Education (HE) discipline has been stuck in neutral, concerned with whether entrepreneurship can be taught, and only recently moved in to gear and to focus on what and how it should be taught (Karlsson & Moberg, 2013; Kuratko, 2005; Lautenschläger & Haase, 2011; Mwasalwiba, 2010). For this and other reasons, only recently have HE stakeholders outside of walls of the business school begun to adopt an understanding of the importance of entrepreneurship (Carey & Matlay, 2010; Hindle, 2007) in preparing graduates for a changed economic infrastructure with significantly fewer career options in large organizations (Keogh & Galloway, 2006; Kirby, 2004).

In this development, Science, Technology, Engineering, and Mathematics (STEM) educations and institutions has been found to be an early adopters of EEd (Vesper & Gartner, 1997). STEM majors in particular have a disproportional potential to form high-growth ventures, because high-growth ventures are concentrated in high-technology industries (Autio, 2007; Parthasarathy, Forlani, & Meyers, 2012; Schøtt, 2007; Souitaris, Zerbinati, & Al-Laham, 2007) and because their technical training gives them access to "information corridors" and, thus, the prospect to recognize particular entrepreneurial opportunities (Shane & Venkataraman, 2000, p. 222), not readily available to the rest of the population. High-growth ventures are not only attractive prospects for potential STEM entrepreneurs. In a broader economic sense they are important, because the literature consistently finds these ventures to account for most of the new job creation in developed countries (Davidsson & Delmar, 2006; Morris, 2012; Wong, Ho, & Autio, 2005) and thus central to recent economic policy-making (Levie, Autio, Acs, & Hart, 2014; Stam, Suddle, Hessels, & Stel, 2009).

In addition, there exists a strong correlation between high-technology oriented and high-growth firms and the fundamental orientation of the startup as opportunity-based, rather than necessity-based (Hechavarria & Reynolds, 2009). Technology and industry ventures are started by individuals with higher levels of education (Autio & Acs, 2010; Blanchflower, 2004; Schøtt, 2011; Xavier, Kelley, Kew, Herrington, & Vorderwülbecke, 2012), indicating that pursuing opportunity-based industry and high-technology startups requires an entrepreneurial skill- and mind set, which can only be acquired prior to new venture formation through education and training. Yet, a person's level of education is not an indication of that person's exposure to entrepreneurship training. For example, in Denmark, Global Entrepreneurship Monitor (GEM) studies reveal that the higher a person's level of education, the less likely that person is to have received entrepreneurship education or training as part of their education or as an extracurricular offering (Schøtt, 2008). While education generally is regarded as a positive antecedent for entrepreneurial intentions, for HE levels of training, the situation is complex as the opportunity cost (Campbell, 1992) and the complexity of the image/payoff construct (Autio, Keeley, Klofsten, Parker, & Hay, 2001) increases to the point where, in certain situations, more education may have a negative effect on entrepreneurial intentions among technology students (Wu & Wu, 2008) and science and technology graduates may prefer unemployment over self-employment (Napier et al., 2012).

Furthermore, EEd programs can positively affect self-efficacy among a STEM student body that is trained to investigate before they act (Johnson, Craig, & Hildebrand, 2006) and help them take aggressive actions that will make their startup attempts more real to others and thus more likely to succeed (Carter, Gartner, & Reynolds, 1996). This belief and confidence in their intellectual capital should translate seamlessly to the step beyond opportunity recognition and exploitation—that of significant social capital (Ramos-Rodriguez, Medina-Garrido, Lorenzo-Gomez, & Ruiz-Navarro, 2011). Finally, EEd in STEM departments has the potential to stimulate cross-disciplinary action (Weaver, Marchese, Vozikis, & Dickson, 2010), which in turn would lead to more high quality opportunity recognition and pursuit.

Little empirical work has been aimed at understanding how EEd influences STEM students' entrepreneurial intentions in relation to program content, design, and development. The purpose of STEM-based empirical work most often has been to test and refine general entrepreneurship theories (for example entrepreneurial intentions/theory of planned behavior) on students and, out of convenience, the subjects selected were STEM students, even though the purpose of the study was not STEM specific (See, for example, Autio et al., 1997; Luthje & Franke, 2003; Souitaris et al., 2007). Yet, these studies reveal unexpected results (see below) that appear to be discipline specific in nature, which strongly suggest a need for more empirical evidence to inspire and drive further program development and refinement within science and technology.

[†] Abbreviations: HE: higher education; *STEM*: science, technology, engineering, and mathematics; *EEd*: Entrepreneurship Education; *GEM*: Global Entrepreneurship Monitor; *N5T*: "NordicFiveTech", a strategic alliance of leading Nordic technical universities; *DTU*: Technical University of Denmark; *Aalto*: Aalto University; *NTNU*: Norwegian University of Science and Technology; *AU*: Aarhus University; *Chalmers*: Chalmers University of Technology; *KTH* Royal Institute of Technology. *KU*: Copenhagen University; *SSES*: Stockholm School of Entrepreneurship.

The few STEM discipline-specific studies on EEd programs are most often single case studies. A group of studies report on the first two to five years of experience with formation of new programs (e.g., Bilán, Kisenwether, Rzasa, & Wise, 2005a; Jaszczak, Bouta, & Raber, 2013; Keogh & Galloway, 2004; Oden, O'Malley, Woods, Kraft, & Burke, 2012; Stone, Raber, Sorby, & Plichta, 2005; Uctu & Jafta, 2013), which may qualify them as single-case studies based on their longitudinal properties (Yin, 2009, p.49). Most other discipline-specific studies report on initiatives at single institutions; ranging from across campus (e.g., Parthasarathy et al., 2012; Smith, 2008), across STEM disciplines (Watts & Wray, 2012), and across engineering, law, and business disciplines (Sager, Fernández, & Thursby, 2006; Thursby, 2005), to single programs within STEM (Buijs & Beugels, 2007; Handscombe, Rodriguez-Falcon, & Patterson, 2008). A rare exception is Doboli, Kamberova, Impagliazzo, Fu, & Currie (2010) who compare the same program delivered at two different campuses. In addition, these studies share the common trend that the author(s) of these papers are local to the institutions that they research, and in many instances are active participants in the programs that they report upon. Thus, despite the significant growth in STEM EEd programs over the past decade, there appears to have been no effort to explore what knowledge may be developed by comparing and contrasting years of program development, refinement, and accumulated experiences across different STEM programs, developed by different educators, at different HE institutions in different countries, or any combination hereof.

The aim of this paper is two-fold. First, the aim to explore how EEd programs at Nordic STEM institutions have been developed, and how and why they are designed and organized the way that they are. Second, the aim is to use this insight to compare and contrast different programs, developed by different educators, in different nations, and at different HE institutions to explore what can be learned from these cross-case and cross-national studies to guide future STEM EEd program considerations.

2 FRAME OF REFERENCE

This section reviews prior research on discipline-specific EEd research on programs for STEM students at higher education institutions, and discuss the importance and potential for EEd for the STEM student body. This is done through a review of sampling, impact of programs, program focus and objectives, and teaching methods. In summary, this review will provide a theoretical frame of reference that will allow the reader to understand inherent biases among the research team, and informs the structure of the empirical study and case studies data collection.

Sampling patterns in studies on entrepreneurship education course and programs

With regards to sampling, most reporting to the EEd community on course and program development is done in the form of single cases; one university's program or one course. Many have been relatively descriptive in reporting on the history and development of a course or program. Often authors have been reporting on programs that they have been conducting themselves (see, for example, Dabić & Pietrzykowski, 2011; and Rasli, Khan, Malekifar, & Jabeen, 2013 for recent contributions along this trend.) Despite a converging trend toward a common understanding about what EEd is about (Katz, 2008), difficulties in standardizing EEd remains (Jones & Matlay, 2011) and often such studies are bound by national or regional stakeholders and cultures and institutional contexts with regard to definitions, constraints, and objectives, which along with self-reporting and self-assessment further isolates the individual study from a wider debate (Pittaway & Cope, 2007). As described above in the Introduction, these general trends are very apparent within the present discipline-specific STEM EEd literature. In this situation, convenience or opportunity-based single-case sampling and reporting from the field greatly complicates the kind of cross-case comparing and contrasting that teasing out propositions that are "deeply grounded in varied empirical evidence" and building theory requires (Eisenhardt & Graebner, 2007, p.27). While there can be good reasons to adopt single-case strategies (Flyvbjerg, 2006; Yin, 2009), in most educational situations, these strategies are increasingly hard to justify during times where EEd programs are becoming increasingly common (Yin, 2009). Despite their qualities (Flyvbjerg, 2006), single-case studies are vulnerable and considered less "compelling" and "robust" (Yin, 2009, p.53)—especially when additional cases exist and "a few additional cases can significantly affect the quality" (Eisenhardt & Graebner, 2007, p.27). In addition, it is reasonable to expect that a study based on a theoretical sampling of multiple cases would generate different knowledge about the phenomenon in quite the same way as multiple comparable experiments might reveal patterns that could not be observed from a single experiment—among other things because a concurrent analysis across material from multiple cases has the capability to reveal patterns that would escape a simple accumulation of isolated single cases analyses.

Measuring the impact of entrepreneurship education course and programs

With regards to measuring the impact of EEd programs, the evaluation has often been absent, anecdotal, and/or based on student evaluations because program assessment is highly complicated. Despite a growing need, this has left the field of EEd in an ongoing debate about the effectiveness of programs (Karlsson & Moberg, 2013;

Lorz, Mueller, & Volery, 2013; Rideout & Gray, 2010). In particular, the lack of longitudinal studies and the lack of use of control groups continue to fuel this debate (Duval-Couetil, 2013; Garavan & O'Cinneide, 1994). Although the use of the entrepreneurial intentions construct as a measure recently has been questioned (Davidsson, 2006; Lautenschläger & Haase, 2011; Pittaway & Cope, 2007), for education settings it still seems to be an operational construct in comparison to suggested alternatives (Karlsson & Moberg, 2013; Rasli et al., 2013; Souitaris et al., 2007). For example, the common recommendation (see e.g., [Lorz et al., 2013]) to focus on the acts of nascent entrepreneurs or "entrepreneurial commitment" (Fayolle, Basso, & Tornikoski, 2011) as a stronger behavioral construct than intentions cannot be operationalized (in the short term) in an action-based EEd program that requires students to partake in nascent entrepreneurial actions. As Fayolle and Liñán (2014) suggest, the "knowledge gap" to focus on in EEd research is how different types of programs and contents affect intentions, not to close the intention-behavior gap.

Further, little empirical work has been done to understand how EEd influences STEM students' entrepreneurial intentions in relation to program design and development. The purpose of STEM-based empirical work has generally been to test and refine standard models of entrepreneurial intentions (Autio et al., 1997; Luthje & Franke, 2003), derived from prior work on adult populations (Davidsson, 1995) or business students (Krueger, Reilly, & Carsrud, 2000); not to understand what educational content to emphasize or which pedagogical tools to utilize to meet the student specific needs, profiles, and program learning goals. Yet, when the intention construct is used to measure programs and their content in STEM EEd, research reveal unexpected results. In researching a program with 300 science and engineering students using an intentions-based construct, Souitaris et al. (2007), hypothesized a positive effect from: a) acquisition of entrepreneurship knowledge, b) utilization of a pool of "free" program resources and startup support, and c) inspiration in the sense of a change of hearts and minds towards entrepreneurship, and subsequently found that inspiration was the only significant source of difference for this group of engineering and science students' entrepreneurial intentions. In testing a similar model on a large group of science and technology students at MIT, Luthje and Franke found "that the perceptions of entrepreneurship-related barriers and supporting factors contribute a *direct* explanation" for the students' career preference between employment and self-employment (2003, p. 142, Luthje and Franke's emphasis)—barriers and supporting factors to entrepreneurship whereof entrepreneurship education has the potential to alter students' perceptions (Krueger et al., 2000). Finally, Johnson et al. (2006) found support for their hypothesis that there are variations in content needs within the STEM student body and that these are dependent on the line of work that graduates are likely to enter—for example, that a course in entrepreneurial marketing and sales is more central for pharmacy, veterinary medicine, and other profession-based disciplines than a course in intellectual property protection, a topic often associated with the STEM field. These findings strongly suggest a need for more empirical evidence to drive STEM program development and refinement (Krabel & Mueller, 2009; Rasmussen & Sørheim, 2006).

<u>Focus and objectives of entrepreneurship education course and programs</u>

With regards to program focus and objectives, the discussion in the literature has shifted from a focus on 1) knowledge and theories *about* entrepreneurship; and 2) skills needed *for* individuals to become and function as an entrepreneur (Kirby, 2004; Laukkanen, 2000; Levie, 1999; Rasmussen & Sørheim, 2006), to more recently a focus where the knowledge about entrepreneurship has been de-emphasized and replaced by more focus on the social component of an entrepreneurial mindset (European Commission, 2010), usually understood as increasing entrepreneurial attitudes or culture (Mathisen & Arnulf, 2013), or educating *in* or *through* entrepreneurship (Hannon, 2005). These three objectives (about, for, and in/through) can be seen as distinct (Fayolle & Gailly, 2008; Karlsson & Moberg, 2013) or the objectives of educating skills and mindset can be regarded as having an element of learning *about* entrepreneurship theories, not necessarily in the traditional sense of entrepreneurship as academic subject (Blenker, Dreisler, Færgeman, & Kjeldsen, 2006) but as a general understanding of the phenomenon. In relation to the individual-opportunity nexus (Shane & Venkataraman, 2000) the two major educational objectives differ in the sense that the former has a stronger focus on fostering the ability to identify, discover, or create innovative opportunities, and the latter has a stronger focus on the exploitation of that opportunity (Kuckertz, Kollmann, & Krell, 2012).

Regardless of a program's focus, in a systematic review of the literature Mwasalwiba (2010) found that programs will be involved with fostering sufficient intellectual capital and social capital among its students to meet the program goals (Eckhardt & Shane, 2003; Ramos-Rodriguez et al., 2011). While the roles of intellectual and social capital in the context of EEd have been explored, there are significant gaps in the literature with regards to how and when these can be triggered, and the pathways that EEd can take to achieve them. At an aggregate level, current GEM data illustrates the need to strengthen entrepreneurial capital, measured as perceived opportunities versus perceived capabilities for venture creation, when compared to the United States (see Figure 1, below). There is a clear role for EEd in addressing this apparent disconnect.

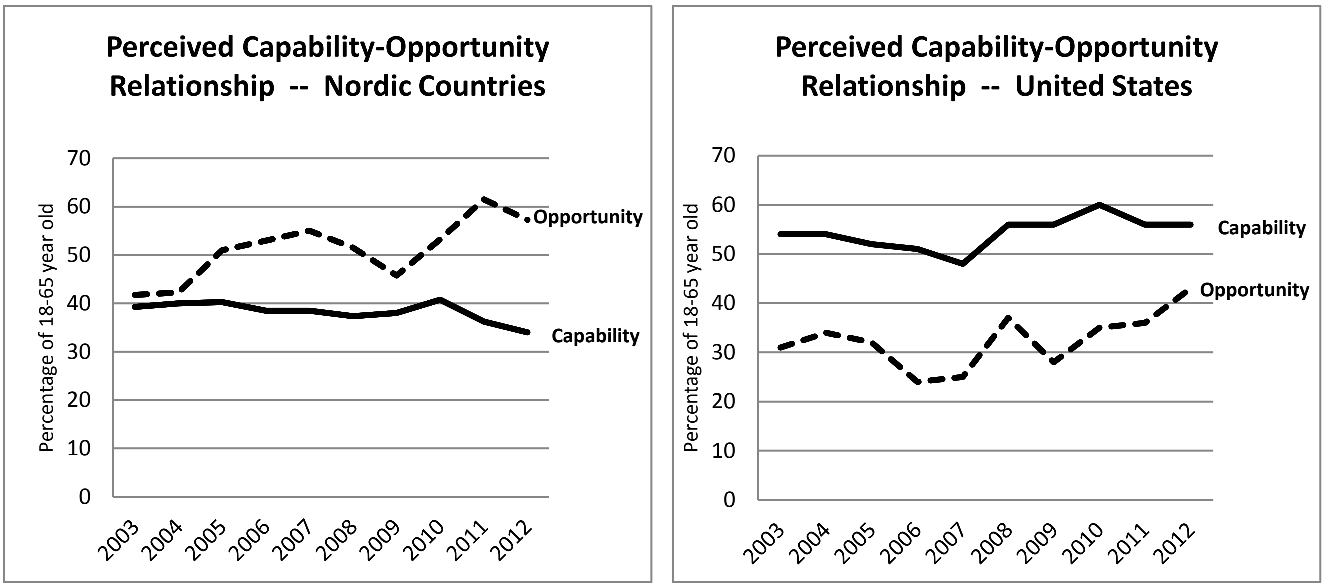

Figure 1. Perceived Entrepreneurial Capability and Opportunity, Nordic Countries vs. United States. Graphs developed by authors by collating GEM data. Data source: GEM Adult Population Survey (APS) Data from http://www.gemconsortium.org/Data

Teaching methods in entrepreneurship education course and programs

With regards to teaching methods, a traditional program aimed at teaching *about* and *for* entrepreneurship would be able to accomplish this by use of traditional teaching methods primarily aimed at knowledge presentation, explanation, and accumulation. However, entrepreneurship as an academic subject is not immediately relevant as part of a STEM education and programs are no longer as focused on teaching orientation and awareness or small business management (Lautenschläger & Haase, 2011; Mwasalwiba, 2010) and these programs are not regarded as effective (Ollila & Williams-Middleton, 2011) as they were in the past (Kirby, 2004). When the focus shifts from teaching entrepreneurship as a subject, to students learning to act entrepreneurial or as entrepreneurs, the traditional university teaching model comes up short (Krueger, 2007) and a number of dilemmas and challenges arise (Blenker et al., 2006). Although lectures and theory introduction are still heavily used (Pittaway & Edwards, 2012), other methods, such as alternative media use, cases studies, and guest speakers are also leveraged (Haase & Lautenschläger, 2010; Mwasalwiba, 2010; Nisula & Pekkola, 2012; Solomon, 2007).

In order to achieve changes in knowledge structures rather than knowledge content, participation in problem-based activities are required (Krueger, 2007). Often such activities are referred to as 'teaching through entrepreneurship' in the sense that they provide a "'feel' for the life-world" of the entrepreneur (Gibb, 2011, p.153). These methods stretch beyond traditional delivery of knowledge in higher education and typically adopt action-based learning methodologies. However, action-based programs that include real venture setup are challenging learning environments for both students and educators (Ollila & Williams-Middleton, 2011). In addition, they are resource intensive and often require commitment of resources from outside the university, which in a Nordic context can be a challenge (Rasmussen & Sørheim, 2006). Neck & Greene (2011) point out that, despite their significant value, the cost of failure in the real world can be too high. They suggest other ways to supplement more traditional methods, including design-based learning and serious simulations and games, and note that the emphasis should be on establishing a portfolio that is teachable and learnable, but not predictable (Neck & Greene, 2011, p. 68). Finally, some of these types of action-based learning projects may not be credit worthy at a Nordic HE institution context (Klofsten, 2000). In a wider context, they may be regarded more appropriate when provided as an extracurricular activity through which students can acquire a more in-depth understanding of the feasibility of their ideas (Frank, 2007), indicating that a real-world versus for-credit tension exists (Levie, 1999; Martínez, Levie, & Kelley, 2010) and, because the methods used are untraditional, the learning derived is considered 'training' rather than 'education' (Lautenschläger & Haase, 2011; Nisula & Pekkola, 2012; Ollila & Williams-Middleton, 2011).

As the GEM data indicates, education that can address the lack of perceived entrepreneurial capabilities in the Nordic countries may result in more entrepreneurial individuals who exploit the high level of perceived entrepreneurial opportunities. In this regard, there is a unique potential in the region for EEd and particularly within STEM educations.

3 METHOD

In response to the lack of comparable cases in the existing literature, a multiple case study was designed (Eisenhardt & Graebner, 2007; Rasmussen & Sørheim, 2006; Yin, 2009) to investigate the phenomenon of EEd within the real-life context of how it is currently offered to STEM students. This strategy addresses generalization bias (the tendency, in an attempt to summarize results, to forgo empirical details to uncover consistent patterns in the data [Flyvbjerg, 2006; Yin, 2009]) and allows for careful case selection. We followed the recommendations in the literature to develop a frame of reference through which relevant issues were identified and used as a guide for conducting semi-structured interviews. The design also allows for the use of a "replication logic", rather than a "sampling" logic (Eisenhardt, 1989, p.542; Yin, 2009, p.53-54) and avoids case selection based primarily on convenience or opportunity. In an effort to explore what can be learned from comparing and contrasting independent STEM EEd programs across nations and HE institutions, the replication logic was emphasized in careful selection of cases with the EEd program as the major unit of analysis, and the program directors as key informants and the secondary unit of analysis.

3.1 Case selection

In an effort to have a set of comparable cases for cross-case pattern analysis and replication, the strategy was to select one leading science and technology higher education institution that offers EEd to STEM students from each of the Nordic countries. Leading institutions were chosen because they set trends by educating more new educators than other institutions, and because other institutions often use these institutions to guide their initiatives in new and less traditional areas, such as EEd program development. We selected universities within the Nordic region because these institutions and their home countries are geographically closely related and share common traits of culture, social, economic development, framework conditions, and educational systems (Hofstede, 2001; House, Hanges, Javidan, Dorfman, & Gupta, 2004; Mensah & Chen, 2013; Napier et al., 2012; OECD, 2014). The rationale is that the commonalities will support the comparing and contrasting analysis, only at the possible expense of limiting the reach of any findings to within the region and institution in comparable regions.

In addition to comparing cases from each of the Nordic countries, the replication logic was used to select one contrasting case ("theoretical replication" [Yin, 2009, p.54]) in the form of a large, broad-based, traditional Nordic university. A traditional Nordic university is a contrasting case in the sense that STEM is not the sole or primary focus of the university and its identity; it is more traditional in its stronger focus on basic rather than applied research and teaching. Although not an extreme or "polar" case in comparison, this sampling strategy was chosen "in order to more easily observe contrasting patterns in the data" (Eisenhardt & Graebner, 2007, p.27). This case also provides a path to evaluate the applicability of any findings to a different setting than a STEM institution (Flyvbjerg, 2006) and help illustrate what traditional universities may be able to learn from leading STEM institutions in designing and developing discipline-specific EEd programs.

In researching qualifying Nordic HE institutions, it became clear that the largest, primarily technical universities in the Nordic region had formalized their working relationships in an alliance, the "NordicFiveTech" (N5T). N5T is an exclusive strategic alliance formed by the five leading (self-proclaimed) Nordic, predominantly technical, universities in 2006. At the time of its inception, the alliance members essentially represented the national-level technical universities of the Nordic countries. As cases for this study, in Denmark, Finland, and Norway the only member institution of the N5T alliance was selected; in Denmark, the Technical University of Denmark (DTU); in Finland, Aalto University (Aalto); in Norway, Norwegian University of Science and Technology (NTNU). This selection was guided by the N5T affiliation, ranking statistics and institution sizes, popular knowledge obtained about the reputation of the technical universities in the region, and the institution's willingness to self-identify as a leading technical university in their respective countries by way of N5T alliance participation. In addition, the N5T affiliation was a firm indication that these institutions, although not similar, were somewhat aligned in purpose and mission, and thus comparable case. Sweden has at least two leading science and technology universities in that both Chalmers University of Technology (Chalmers) and Royal Institute of Technology (KTH) are members of the N5T alliance. Chalmers was selected as the Swedish case. KTH is a founding member institution of Stockholm School of Entrepreneurship (SSES), which has five Stockholm-based HE institutions as members. These member institutions draw on, and contribute to, the privately funded SSES organization and there was no straight-forward way to control for this special situation and, thus, to distinguish the unique discipline-specific STEM/KTH account of EEd from the totality of SSES activities.

There are relevant contrasting-case candidates in all of the Nordic countries. Based on considerations regarding securing assess and leverage of prior knowledge, we decided to select a Danish university. In Denmark, Copenhagen University (KU) and Aarhus University (AU) are by far the two largest and oldest universities. With AU's recent mergers, AU and KU are comparable in academic breadth as well as size. Arhus University was included in this study over KU, mainly because of KU's immediate proximity (approx.15 km/10 miles) to DTU, already included in the study.

Today, many universities have more than one entrepreneurship initiative. At each participating institution, the most substantial collection of inter-related EEd activities offered primarily to STEM students was chosen as the focus and main unit of analysis. In the following, the term "program" refers to this selection regardless of whether the content of these collections of EEd activities in other contexts may be referred to as a department, package, concentration, course, school, or otherwise.

3.2 Case exploration and analyses

For each of the five cases in this study, the data collection is based on a three-phased approach. First, online presentations and material was used to review and get familiar with the universities, the entrepreneurship programs, and the key people involved.

Second, the Phase-One material and the literature review in the Introduction and Frame of Reference sections above were used to engage the institutions and program management, to prepare for site visits, and to develop an interview guide. The interview guide covered topics including the interviewee background; history of program; legitimacy/status/reputation of program within organization/education; organization and administration of program; place of program within overall education/institution; "size" of program (number of students/credits/course, etc.); student evaluation and other program assessments; pedagogies, didactics, and other methods used in the program; future prospects of the program including wishes-fears/best case-worst case scenarios; and how the program is different because of its focus on STEM students/existence within a STEM institution. In addition, the online material from Phase One was used during the interviews to seek clarifications, gauge responses when pointing out inconsistencies, confirm facts, and otherwise personalize and tailor the interview toward a more in-depth discussion.

Third, visits were paid to all five institutions and any entrepreneurship facilities related to the programs. As part of each visit a semi-structured interview was conducted with the director of the entrepreneurship program, lasting between one and two hours. In addition, at least one other key person to the entrepreneurship program at each institution was interviewed. This other key person was in one case a long-time course developer/teacher, in two cases an active PhD student who had previously participated in the EEd program in at their respective institutions as a master's student, in the last case an elaborate full 2-day visit with presentations by program administrators, teachers, support staff, and two PhD students, and many informal/not recorded interviews and discussions with all these program participants substituted for a recorded/formal interview. A number of less substantial informal conversations with other program participants and students were also part of the other site visits. For example, at one site the director had arranged for the co-founder of the program to join our conversation over lunch. AU did not have a STEM EEd director or equivalent. Instead, two people with experience in designing and running entrepreneurship courses at AU were selected as key informants and subjected to similar interviews as conducted at the other institutions. One author was present at all interviews and two authors were present at six out of the total of nine interviews.

The semi-structured interviews were recorded with verbal permission from the interviewee, obtained toward the tail-end of the initial greetings and pleasantries. After the interview, the recordings were transcribed, and the transcriptions were reviewed against the recordings as a first step in analyzing the interview data. Furthermore, the authors compared notes from the interview sessions and discussed their reviews of the transcribed interview data against their notes and data collected in Phase-One. The interview-guide topics were used to code the transcribed material. In this process, a software tool ("NVivo") was leveraged to facilitate the work and to structure the process. For the purpose of this study, NVivo was primarily used to align the spoken and written word into time slots and as an electronic highlighter.

As an example, in the Phase-One research the range of credits offered by the respective programs appeared to be "wide". Although this was unsurprising (based on a review of the literature referenced in the Introduction and Frame of Reference above) the range appeared peculiar and the subject was included in the interview guide. Subsequently, the transcribed interviews were coded bases on views on appropriate number of EEd credits for STEM students and program scope and size, as discussed above. The findings from following this cross-case finding in quantitative types of data further through to more in-depth qualitative data and discovering further quantitative data for each case is among the topics presented in the Findings section below.

4 FINDINGS

An overview of the case institutions of this study is provided in Table 1. Following the advice of, among others, Yin (2009), Flyvbjerg (2006), and Weick (2007), this section opens with an account of the background of each EEd program, and other significant entrepreneurship-related activities at each institution. This is done in an attempt to counter any generalization bias, to retain and give the reader access to some of the richness and density of the cases, and to keep the cases "open" and "diverse" (Flyvbjerg, 2006, p.238).

Aalto: A recent merger of the Helsinki based University of Technology, School of Economics, and University of Art and Design combined with a political push in Finland for more entrepreneurship initiatives (Kyrö, 2006), Aalto has a number of strategic initiatives that has been reinvigorated and renamed in the past few years. As such, the foundation for Aalto Ventures Program (AVP) dates back much further than its formal inception year of 2012. For example, the founder of the program has been a HE Helsinki-based entrepreneurship educator for 15 years and was the director of the broader-based Helsinki School of Creative Entrepreneurship founded in 2005. In addition to AVP, Aalto's business school offers a master's program in entrepreneurship for their business school students. Successful projects coming out of AVP have on-campus avenues for further development, including Aalto's Venture Garage, Start-Up Sauna, and Design Factory incubator facilities.

Chalmers: Based on a long tradition of close relations with the regional business sector and with a 16-year track record Chalmers has developed significantly over the years; from a one-year program for the first 10 years to a two-year full master's degree program, with its own in-house incubator (the "Encubator"), identifying technology transfer projects from academia and industry for match-making with student program teams.

DTU: In the 1980's DTU had a "project office" facilitating students that had ideas and wanted assistance building much-ups and prototypes. Inspired by watching teams of students make the same mistakes year after year, the project office's manager decided to offer the first course in business venturing in 1992 as a test run to gauge interest. In 1994 a new, more complete and permanent course was offered and two years later this elective had 60 students per year. Since then, the course has developed significantly in number of students, and departments at DTU have recently begun to require students to take the course.

NTNU: After decades of strong interaction with the regional business community and a period of offering single courses in entrepreneurship in the late 1990s and early 2000s, the team at NTNU consistently found themselves stuck with a group of motivated students wanting to learn and experience more; which became the inspiration for establishing a school of entrepreneurship and a complete master's program.

AU: AU does not self-identify as having an EEd program for STEM students. AU has a significant research focused science and technology faculty and has recently merged with the Danish Institute of Agricultural Sciences, the National Environmental Research Institute, Aarhus School of Engineering in addition to the Aarhus School of Business, the Danish University of Education, and others. While the staff to student ratio in Table 1 is an indication of the strong research focus at AU (compared to the traditionally more applied technically focused institutions), through the recent mergers, the AU science and technology faculty has become more diverse with respect to research versus applied objectives.

Table 1: Host Institution and Entrepreneurship Program Overview

Institution	Aalto	Chalmers	DTU	NTNU	AU
Institution size, (student/staff) thousands	20/3	10/3	8/2	22/3	38/5
STEM part of Institution, (student/staff) thousands	13/2	10/3	8/2	11/1	4/2
EEd program name	Aalto Ventures Program	Chalmers School of Entrepreneur-ship	Knowledge based Entrepreneur-ship	NTNU School of Entrepreneur-ship	Science and Technological Innovation & Entrepreneurship
EEd program organization	School of engineering	Dept. of Technology Mgt. & Econ.	Dept. of Mgt. Engineering	Dept. of Industrial Econ. & Technology Mgt.	-
EEd program level	Graduate	Graduate	Graduate	Graduate	Diploma and graduate
Year of inception	2012 (2005)	1997	1994	2003	2008
Founder and current director	Same person	Same person	Same person	Same person	N/A
Size of EEd program (students per year)	50 or less	50 or less	More than 300	50 or less	50 or less

Cross-case comparisons of the Table 1 data reveal three interesting patterns.

1. **Gestation period.** All the STEM-institution programs were initiated within the decade from the mid 1990's to the mid 2000's. (This observation is only correct if the reorganization of the Finnish institutions is interpreted as a reformulation, rather than a new program start in 2012.) The AU initiative was initiated just a few years outside of this decade. The pattern is interesting because these independent initiatives take place close in time throughout the region, and because this wave coincides with trends observed at North American STEM educations (Gartner & Vesper, 1994; Katz, 2003, 2008), where, for example, the Entrepreneurship Division of American Society for Engineering Education (ASEE) membership count grew from less than 20 in 2000 to over 500 in 2004 (Bilán et al., 2005); of which at least 341 ASEE members offered entrepreneurship education by 2008 (Shartrand, Weilerstein, Besterfield-Sacre, & Golding, 2010).

2. **Program creation and founder's continued involvement.** Three of the four programs were founded by more than one person; while the current director of all four programs is also one of its founders. This pattern is interesting in light of the fact the programs today, on average, have existed for more than a decade. The term "Academic Entrepreneurship" usually refers to commercialization of discoveries made by members of a research institution and the transfer of knowledge and technology that takes place in this process. "Entrepreneurship in Academia" as a term could refer to all other types of entrepreneurial acts that universities and academics undertake—in the case of this study, the creation of a new program that offers EEd, where no such program were before and delivered in a very different way in comparison to traditional technical knowledge. Within these cases of Entrepreneurship in Academia, two patterns can be observed. First, the coming into existence of the programs was in all cases highly dependent on the single person (an entrepreneur) or a few very dedicated people (an entrepreneurial team.) The key informants' accounts of the program creation phases show how the early struggles, the twist and turns along the way, and the

unforeseen amount of work and commitment are as typical for these accounts, as they are for so many other entrepreneurial endeavors. As one key informant put it, when looking back at the first three years: "I have never done as little research as I did during that time, because we were starting this program." The fact that all four founders of these programs are still running them a decade—or more—later is an indication of the personal investment, personal significance, and influence that these entrepreneurial acts have had on the founder's lives and careers. Second, the importance of active support from university management to these entrepreneurial acts was mentioned by key informants in all five cases. The key informants contributed both support and lack thereof as significant direct reasons for the development path of their programs. Strong, direct top management support and access to top management was reported in two cases. In one case the help and endorsement from a grand old professor with "political" experience and top management access played an important role. Similarly, the lack of management support had shaped two of the programs.

3. **When to educate STEM students in entrepreneurship?** All the EEd programs in this study are at the master's level. For five-year programs, this seems appropriate to all key informants—most often justified by the opinion that working up their vocational/professional identity and subject matter skills prior to embarking on a EEd program is important for STEM students. This is not an argument against undergraduate programs in entrepreneurship. But these action-based programs aim to train the student's ability to access their professional knowledge, explore their "knowledge corridors" (see Introduction), and act entrepreneurially on opportunities that this knowledge and skillset facilitates. Furthermore, the action-based approach demands a high level of maturity on behalf of the students.

In addition, the key informants at Chalmers and NTNU believe that their programs benefit greatly from having a dedicated space available for their student teams. The teams fuel off of each other and experience that they are taken seriously by staff and the university as a whole. While motivating, it also creates pressure to deliver. Aalto has adopted a follow-on strategy with their "Design Factory" and "Start-up Sauna" incubators. The same is in a sense the case at AU and DTU, although there is no formal relationship between the institution's entrepreneurship program and its incubator facilities.

In the following, cross-case analyses informed by the frame of reference presented above are discussed and the findings in Table 1 and the present section are further elaborated upon.

4.1 Program Scope and Size

The programs can be considered as part of a continuum from a single course in entrepreneurship at AU and DTU, to a minor within an engineering masters or other technology degrees at Aalto, to an engineering master with an entrepreneurship concentration at NTNU, and finally a master of science in entrepreneurship and business design offered by Chalmers with different concentration options.

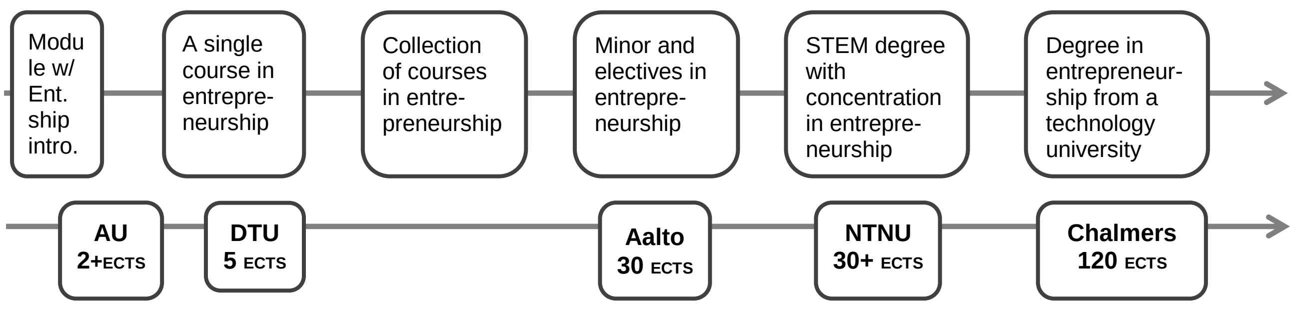

Figure 2: Program Scope of STEM Entrepreneurship Programs. All the institutions use the European Credit Transfer and Accumulation System (ECTS) standard. An academic year of full-time learning corresponds to 60 credits, which in the Nordic countries is equivalent to approximately 1600-1650 student work hours per year (European Commission, 2009).

In all cases the key informants believe that their programs have the right size to reach their goals and to service their STEM students with EEd offerings. With different program goals, these beliefs are not necessarily contradictory. Section 4.3 below explores further the common effectiveness of the programs despite their differences in scope and size.

4.2 Program Organization and Program Autonomy

Referring to Figure 2, above, and the continuum of scope of programs, with regards to program “embeddedness” (the extent to which programs are run from within STEM faculties or offered by outside departments [Gibb, 2011; Handscombe, Rodriguez-Falcon, & Patterson, 2005; Smith, 2008]) and program autonomy, the picture that forms is more of a dichotomy than a continuum. On the one side, the program offered by AU is “partly embedded,” in a hybrid format where both entrepreneurship center consultants and STEM faculty are involved in the administration and execution of the program. AU fits the general discussion about traditional, broad-based university settings, where scholars call for embedded programs (Gibb, 2005; Handscombe et al., 2008; Hindle, 2007; Shartrand et al., 2010). At DTU the program is embedded in the sense that DTU only offers STEM degrees, and at Aalto the program is embedded as it is part of the Aalto School of Engineering. On the other side, the programs at Chalmers and NTNU, which are comparable in embeddedness to DTU and Aalto, are fundamentally different in the level of autonomy that they enjoy within their STEM host organizations. AU, DTU and Aalto are less autonomous, in that they deliver entrepreneurship content into existing STEM educations. The programs at NTNU and Chalmers run their own master’s programs. At NTNU STEM departments delivers STEM content/courses into the entrepreneurship school’s engineering master. The situation is similar at Chalmers; although the Chalmers’ degree is in entrepreneurship. The principle difference is depicted in Figure 3 below.

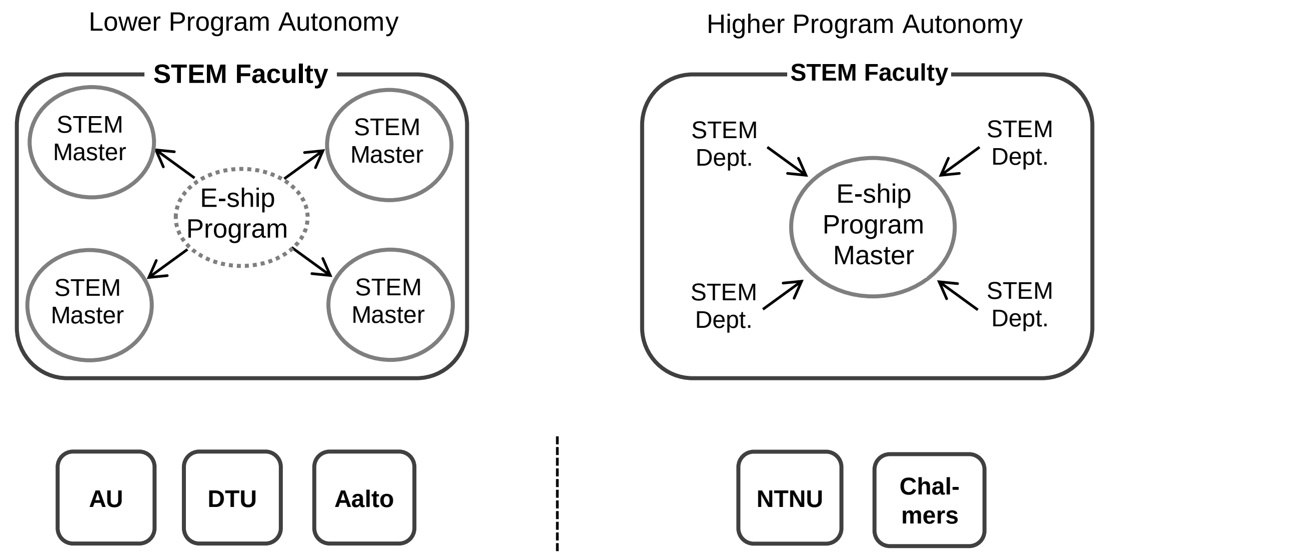

Figure 3: Similar Embeddedness—Different Autonomy.

Essentially, Aalto and NTNU are similarly sized programs, but very differently organized such that Aalto is on one side and NTNU is on the other side of this divide. This gives NTNU an advantage over Aalto in its ability to inject commercialization/entrepreneurship content into other parts of the education than the core entrepreneurship-oriented classes. For example, NTNU has developed its own version of a course that all STEM majors are required to take, called “Experts in Teams” and students often use topics from their real-venture project as topics for their master’s thesis; some even recruit outside-program students to write master’s theses on issues they need to resolve in their real-venture project. In contrast, at Aalto it is accepted and recognized among students that you fall behind by a semester if you get your project accepted into Aalto “Design Factory” or “Start-Up Sauna” facilities, because of the limited study credits accredited to these semi-extracurricular activities.

4.3 Program Scope, Reach, and Impact

The case analyses revealed a remarkable difference in program scope (measured as the amount of ECTS credits the program is providing) and program reach (measured as the number of students that the program is accommodating/attracting) of EEd programs, as well as focus areas of the different institutions in the cases. In describing the focus and scope/reach of a program, one key informant said: “it’s like a pyramid”, characterizing their offering as an “elite program,” others reflecting that “this is like extreme sports,” or “we do not just bring our students to the end of the runway but help them takeoff”, etc. about their top-of-the-pyramid programs, and one key informant, talking about an activity outside the program, as a place for “a more broader audience to get a touch of entrepreneurship.” This shared “pyramid” worldview of the key informants of narrow/elite vs. broad/nonelite reach is used in Figure 4 to place the programs relative to each other in how they are positioned in their home institutions. To the pyramid in Figure 4 are added two arrows suggesting a constraint, where a large entrepreneurship program at a mainly technical institution or department may not attract many students, while narrow-scope (low number of credits) modules or programs are easier to give a broader appeal. For example, one key informant was quite specific on this point, suggesting that we may “assume that there are 10 or 20 students among 1000 students … every year that might actually be both interested in and fit for” a STEM elite (wide-scope, narrow-reach) action-based type EEd program.

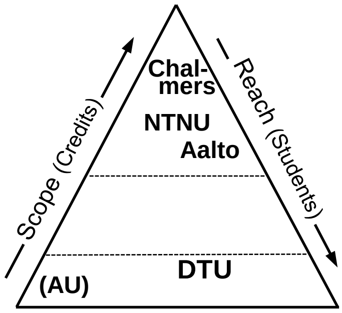

Figure 4: Program Scope and Reach, Key Informant’s Worldview**.**

Leaving the pyramid worldview of the key informants where their programs are positioned in their home institutions and within their student populations, and turning toward the relative scope and reach of programs as either low or high; each program can be placed in a simple two-by-two matrix. Although EEd programs can be assessed in many ways and on a multitude of dimensions, the immediate impact of the programs on the content of their students’ educations can be measured as the combination of scope and reach. Figure 5 maps this impact of the programs by placing them on the dimensions of program scope (credits) and program reach (students).

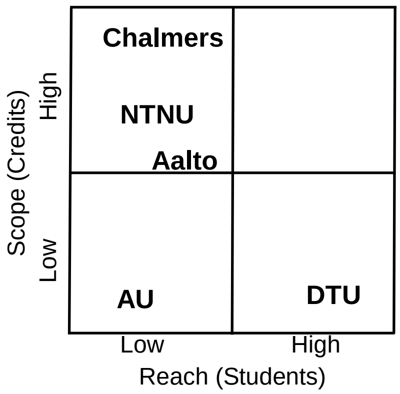

Figure 5: Program Scope-Reach Impact Map.

In further exploring the case data regarding program impact, three cross-case findings emerge. First, in addition to finding their programs to have the appropriate scope, program directors report high levels of satisfaction with the outcome of their efforts and use of resources and, thus, program impact. This is interesting because these consistent patterns are found across very different programs, yet in similar-type HE STEM institution cases. A view on how these programs may all be close to optimal in desired (reach/scope) impact is provided in the Discussion section below.

Second, none of the cases are occupying the high-scope/high-reach quadrant in Figure 5. Chalmers offers the most ECTS credits for its EEd program, but only to a small number of students, whereas DTU’s program has a far greater reach but much less scope (fewer credits.) Currently, there are about 15 courses descriptions available at the online DTU course catalogue that offer some form of EEd content, but all with a maximum of 5 credits each. AU has at least two EEd courses that target STEM students and both are 5 or less credit courses. Aalto’s program may be the program closest to the high-scope/high-reach quadrant because its minor program offers a substantial number of credits and may be more accessible for STEM student than a full master, as offered by NTNU and Chalmers. This simple two-by-two matrix suggests that the high-scope/high-reach "ideal" high-impact quadrant, where a program is reaching a large number of STEM students with a significant amount of student credits devoted to their "entrepreneurial pursuits," either has not been achieved in any cases in this study, or has not been deemed possible or desirable.

Third, graphical representation in Figures 4 and 5 provides a framework for exploring the case data regarding any derivative effects from the programs on the rest of the institution and student population. From its full master program, NTNU has isolated segments that are offered as an introductory module in a broader course and this way they are reaching a very large student population with a narrow scope outside of—but derived from—their main program. Similarly, as mentioned Aalto offers students outside the entrepreneurship minor some of the minor-program courses as stand-alone electives. At Chalmers new outreach attempts are trying to leverage the developed master program content to reach a larger STEM student population, both within and outside of Chalmers. Thus, the derivative efforts of these programs are aimed at the low-scope/high-reach quadrant (Figure 5) as way to cover more of the pyramid (Figure 4), but not the high-scope/high-reach quadrant. DTU and AU does not have the same ability to leverage program content to reach higher placed quadrants. But institutions can leverage EEd in other ways; at DTU the STEM departments taking delivery of the EEd program (see section 4.2 above) are combining it with a project management course for some of their master programs into a module of commercial(ization) content.

4.4 Program Content and Teaching Methods

A review of the case programs shown that course descriptions are dominated by traditional titles, content and topics. Yet, interview data reveal that this content is delivered using progressive methods, and the students are often asked to apply new knowledge to ill-defined, open-ended, unpredictable situations while also expected to conduct reflection-in-action (Heinonen & Hytti, 2010, p. 287) type assignments on both personal, team, and project development. This was summarized quite eloquently by one key informant as "politically correct content; politically incorrect delivery", other informants are talking about "forcing" students out in to "the real world" with one interviewee puts it "to pick up the phone, it's a way to get information. They become very good at that and we are forcing them to do it." This emphasis is not related to the scope or reach of the program but pattern observed across the cases. How these cases and future programs may reconcile this practice orientation with an academic HE setting is explored in the Discussion section below.

5 DISCUSSION

The development in the EEd discussion, from whether entrepreneurship can be taught towards how it should be taught, is more a reaction to the growth in entrepreneurship programs, courses, and initiatives in most universities, than an indication that the teachability question has been answered firmly and positively. There is simply a limit to how far program investments can move forward with a focus on assessment and teachability at the expense of refinement of pedagogies and didactics. This study is no exception, the case institutions show increased interest in larger student enrollments and courses that cater to larger student populations rather than purely designing and refining their current programs. However, the work is far from complete. This collection of cases does not offer students a continuum of EEd, where they can chose from, or experience a progression from introductory course through increased exposure to full program commitment. The cross-case pattern is more of a dichotomy of elite and broad-based programs. This dichotomy of STEM EEd in the Nordic region is depicted in Figure 4 as the empty middle space of the pyramid and in Figure 5 where the programs fall in the top-left or bottom-right quadrant. The fact that this observation is made in primarily STEM universities/institutions (an early adaptor of for EEd) is reason to suspect that the situation is similar or worse (as in the case of AU) across other broad-based universities and within disciplines more recently engaging with EEd.

Another clear result relates to entrepreneurship program impact. The empty top-right quadrant on the Figure 5 Impact Map may be justified by the inherent trade-offs between scope and reach, and needs for EEd. Plotting the program's position in a diagram with scope on the vertical axis and reach on the horizontal axis, the STEM cases fall along a tradeoff line between high-scope/low-reach and low-scope/high-reach; where the more mature programs at the core STEM institutions appear to be closer to the optimal set of tradeoffs and the AU program positioned as a less optimal tradeoff line. Borrowing from the language of economics, the STEM programs may, so to speak, lie approximately on the same 'indifference curve' and from different combinations of scope and reach deliver similar 'utility' toward their varying, individual program goals. This perspective is illustrated in Figure 6, with only the AU program being less effectual and efficient and the dotted line-section representing the vacancy in program designs. The Figure 6 diagram retains the tension between scope and reach suggested in the Figure 4 pyramid. The indifference-curve type tradeoff view better represents the dynamic nature of the programs, than the simple, static representation of the two-by-two matrix in Figure 5.

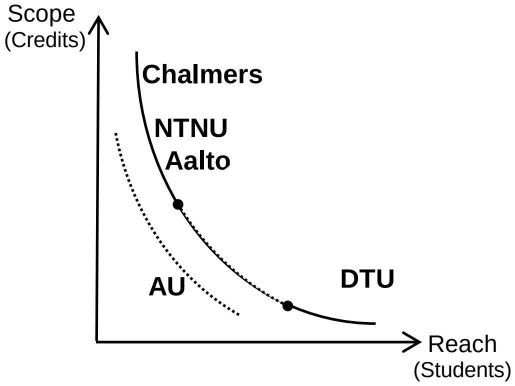

Figure 6: Program Impact: Scope-Reach Trade-Offs in Program Designs.

Turning focus to the finding that no programs were found to occupy or aspire for the top-right quadrant in Figure 5, the plausible explanations are that it is not a desirable or feasible program design option. Yet, a program in that position would potentially be attractive in terms of program impact. An alternative perspective on the empty top-right quadrant would be that, if scope were measured by number of ECTS that have a deliberate entrepreneurial approach embedded (Smith, 2008) in course didactics and pedagogy (e.g., teaching "through" entrepreneurship) despite the course's academic content, rather than ECTS where the academic content is "about," or "for" entrepreneurship, then the empty top-right quadrant in Figure 5 could represent the ideal entrepreneurial university from a teaching perspective.

Heinonen & Hytti (2010) suggest re-configuring EEd in the "entrepreneurial university" and releasing it from the traditional focus of the "triple helix" of university, industry, and government because this constellation has lost sight of teaching. Historically, universities have fostered two archetypes, research universities and teaching universities, and Heinonen and Hytti place EEds in the entrepreneurial university in this historical perspective as depicted in Figure 7.

UNIVERSITY MISSION	**Research university**	**Entrepreneurial university**	**Teaching university**
OBJECTIVE FOR TEACHING	"About"	"For"/"In"	"Through"
	Content →	↑ ↑	← Pedagogy

Figure 7: Rethinking Entrepreneurship Education in the Entrepreneurial University**.** Adapted from Heinonen and Hytti, 2010, p. 288.

With the entrepreneurial university as a conduit between the two historical models, teaching universities represent the teaching "though" entrepreneurship, as they have a tradition for experimenting with practice-based pedagogical approaches; and research universities represent "about" entrepreneurship, as they have established entrepreneurship as a research field and academic subject. In this context, the entrepreneurial university combines the best of both worlds, via teaching "for" entrepreneurship by combining the knowledge of entrepreneurship and business administration and management skills with pedagogical tools that aid entrepreneurial learning objectives. This aligns with Mwasalwiba's (2010) two major educational objectives, fostering sufficient intellectual capital and social capital in student to fulfil program goals.

In this perspective, with regards to teaching methods, these case institutions appear not to be broad-based entrepreneurial universities. Although, one could argue that by selecting programs within each university as the unit of analyses, through its design, this study has excluded itself from identifying such a broad-based entrepreneurial university. Furthermore, while there are recent advances reported in the literature in the measurement of impact of EEd (Karlsson & Moberg 2013; Matheisen & Arnulf, 2013), these studies remain to be connected to program design considerations. By trying to compare, albeit at a macro level, the impact of program design across 5 different universities across 5 different countries it is possible to analyze cross-case patterns that have so far been lacking in single-case or single-country studies.

Despite the significant difference in program reach among the case programs, in their quest to reach their respective, most impactful scope/reach trade-off point, all of the programs are largely based on traditional business school and "about" entrepreneurship content, while obliging students to create high quality ideas and engage intensely with real-world prospective stakeholders and customers through action-based courses and assignments. This combination facilitates learning and functions as a way to navigate the in-curricular vs. extra-curricular tension that EEd sometimes faces in academia. However, it requires a high degree of maturity among students and a high degree of flexibility and experience by the educators to achieve this.

Some may argue that the smaller elite programs are ineffective because their highly selective recruitment process means that their small student bodies are made up of individuals who are already highly likely to become entrepreneurs. However, the elite programs may have a larger, albeit hard-to-measure, impact on the entrepreneurial spirit of the overall university environment than the size of its program indicates; and the overall university environment is important for fostering entrepreneurial intentions among STEM students (Rasli et al., 2013). For example, NTNU only accepts about one-third of the applicants into the program. This broad-based popularity of the program is expressed, among other ways, by the fact that often outside-program students will write their thesis on topics derived from inside-program entrepreneurial projects. This way both outside-program students and their home departments are exposed directly to an entrepreneurial process while the inside-program students are recruiting resources and talent that furthers their entrepreneurial project and supports the academic level of their own thesis work.

5.1 Implications

For students, the primary implication appears to be that STEM educations in the Nordic region differ dramatically with regards to how important commercialization skills are considered to be and the ease of access the student will have to EEd at any given institution. If this is an area that the student believes will benefit her or his career path, the choice of university is important and options should be reviewed carefully.

For university management, there are two things to take away from this study. First, management should have a clear position on how they regard the importance of entrepreneurship and technology commercialization to their STEM educations. Second, if declaring support to a program initiative, university management needs to be aware of the consequences, which are likely to include being prepared to demonstrate this support publicly by, for example: removing or alleviating organizational and administrative barriers, participating in discussions with inside stakeholders on how to circumvent infrastructure barriers, and with inside and outside stakeholders on how to gain necessary financial support and ensure program success.

For program directors and aspirers, there are a number of implications from this study, which will vary in importance depending on the current state of the program or program *in spe*. First, it is important to seek, or at a minimum gauge, management support and understand how that will impact program design options in the short term and program success and development in the long term as management support may change. Support from outside stakeholders can be an important factor in achieving support from university leadership and other inside stakeholders. Second, in terms of program design, it is important to understand the consequences of the initial design because the design is unlikely to change in the short term and options for possible changes and developments are highly contingent on the initial setup. Third, even with management support in designing a larger-scale program, how the program is organized is important for the program's ability to reach specific goals, incorporate into existing STEM educations, maintain program autonomy, and allow for further development. Finally, undertaking the initiation of an entrepreneurship program at a STEM institution or education is bound to have long lasting impact on career direction, and at a minimum a significant short term impact on academic production and advancements.

For entrepreneurship research, the authors believe that the primary take away from this study is that cross-national patterns exist, and insights can be gained from them that otherwise would not be accessible. This conclusion suggests future research in at least two areas. First, a similar study in other regions can provide an overview that can be compared and contrasted to this Nordic account. Second, this study can justify conducting more elaborate and in-depth studies, which could include student accounts or other stakeholders (such as STEM technical staff, university management, outside stakeholders, etc.) accounts.

For other disciplines, the main implication may be related to the specifics of the STEM field and the field as an early adopter. Whether the findings and implications outlined appear STEM specific or not vis-à-vis a specific other home discipline is important to consider. In this paper, the implicit interpretation of "entrepreneurship" has been the common STEM interpretation of "technology commercialization." This is clearly not shared across non-technical disciplines and adaption of the findings has to take this and the related "action-based" approach into account.

This paper differs from the traditional single-case based paper, in which the people, that are the key informants in these studies, most often are the authors of the papers as well. Thus, in the single-case based papers, the authors often self-reflect on their programs. In this study, the author's participation adds an important dimension to the reflection process, and in all cases the impression has been that the key informants have been more direct and frank in interviews than they typically would be in writing up papers with an element of self-assessment. In addition to being able to compare across cases, the quality of the reflections may also have improved this process. Thus, the research design has had implications for both the researchers and key informants participating in the study.

5.2 Limitations & Future Studies

With its focus on programs and the people designing and running them, this paper pays less attention to other program features and qualities and the students' perspectives on the programs. Future cross-institutions and cross-nation studies could focus on these areas. In addition, it is known that, when entrepreneurship is understood as venture creation, programs will tend to "educate 'about' entrepreneurship and enterprise rather than educating 'for' entrepreneurship" (Kirby, 2004). Thus, understanding what is actually "going on inside" these technical oriented action-based types of programs is an important area to explore further. Further, the potential development of program assessment tools that can be used across programs of varying scope and reach could help improve case comparisons.

Including more interview subjects to the current cases, especially current students, but also faculty members not involved in the entrepreneurship program as well as university management would strengthen the study and potentially broaden the findings. Finally, in addition to the future research directly related to the current study, it is the authors' belief that the richness of the cross-case findings could justify similar studies to be conducted in other regions than the Nordic and in other disciplines than STEM.

5.3 Conclusion

With increased demand for EEd delivered outside of the traditional business school setting, there is a widespread need for educators with the ability to design effective educational programs that are "for" entrepreneurship and not limited to be "about" entrepreneurship. In the Nordic region, designing programs that leverage "through" entrepreneurship strategies and truly action-based programs is a challenge. A stronger commitment to a "for-real and for-credit" approach needs to be developed and the tension between for-real and for-credit needs to be relaxed. As for-credit international internships have become quite commonplace in the region, it is telling that the one company where students most often cannot spend their internship is their own. This exploratory study is the first of its kind in both scale and case diversity. There are very few multiple and comparative case studies at present and thus this work presents an important perspective for future program design. Considering the deliberate selection of our four comparable cases, the diversity in effective and successful programs is striking.

This study uncovered strong dependencies between program design and inception and the founders and academic entrepreneur(s) involved. While this pattern has its inherent advantages in terms of achieving success in the short-term and overcoming bureaucratic or institutional bottlenecks, the flip-side is an unresolved need for long-term institutionalization of EEd programs to overcome approaching succession issues.

ACKNOWLEDGEMENTS

This research was funded in part by a grant from the Danish Business Authority and the European Social Fund and a grant from the Danish Foundation for Entrepreneurship - Young Enterprise.

REFERENCES

Autio, E. (2007). *Global Entrepreneurship Monitor: 2007 Global Report on High-Growth Entrepreneurship*. *GEM Global Reports. London: GERA*. London.

Autio, E., & Acs, Z. (2010). Intellectual property protection and the formation of entrepreneurial growth aspirations. *Strategic Entrepreneurship Journal*, *4*(3), 234–251. doi:10.1002/sej.93

Autio, E., Keeley, R. H., Klofsten, M., Parker, G. C., & Hay, M. (2001). Entrepreneurial Intent among Students in Scandinavia and in the USA. *Enterprise and Innovation Management Studies*, *2*(2), 145–160. doi:10.1080/1463244011009463

Autio, E., Keeley, R. H., Klofsten, M., & Ulfstedt, T. (1997). Entrepreneurial intent among students: Testing and intent model in Asia, Scandinavia, and USA. *Frontiers of Entrepreneurship Research*, 133–47.

Bilán, S. G., Kisenwether, E. C., Rzasa, S. E., & Wise, J. C. (2005). Developing and Assessing Students' Entrepreneurial Skills and Mind-Set. *Journal of Engineering Education*, *94*(2), 233–243. doi:10.1002/j.2168-9830.2005.tb00844.x

Blanchflower, D. G. (2004). Self-employment: More may not be better. *Swedish Economic Policy Review*, *11*(2), 15–74. doi:10.3386/w10286

Blenker, P., Dreisler, P., Færgeman, H. M., & Kjeldsen, J. (2006). Learning and teaching entrepreneurship: dilemmas, reflections and strategies. In A. Fayolle & H. Klandt (Eds.), *International Entrepreneurship Education: Issues and Newness* (pp. 21–34). Cheltenham (UK): Edward Elgar Publishing.

Buijs, A., & Beugels, J. (2007). Moving From Management to Entrepreneurship: A Case Study About Training Science Students for the Business World. In *Proceedings of the 2nd European Conference on Entrepreneurship and Innovation. 8-9 November 2007* (pp. 1–8). Utrecht, The Netherlands: Utrecht School of Economics, University of Utrecht and Academic Conferences Limited.

Campbell, C. A. (1992). A Decision Theory Model for Entrepreneurial Acts. *Entrepreneurship: Theory and Practice*, *17*(1), 21–27.

Carey, C., & Matlay, H. (2010). Creative disciplines education: a model for assessing ideas in entrepreneurship education? *Education + Training*, *52*(8/9), 694–709. doi:10.1108/00400911011088999

Carter, N. M., Gartner, W. B., & Reynolds, P. D. (1996). Exploring start-up event sequences. *Journal of Business Venturing*, *11*(3), 151–166. doi:10.1016/0883-9026(95)00129-8

Dabić, M., & Pietrzykowski, M. (Eds.). (2011). *Forstering Education in Entrepreneurship*. Poznan: Bogucki Wydawnictwo Naukowe.

Davidsson, P. (1995). Determinants of entrepreneurial intentions. In *RENT IX Workshop in Entrepreneurship Research. Piacenza, Italy. November.*

Davidsson, P. (2006). Developments in the Study of Nascent Entrepreneurs. *Foundations and Trends in Entrepreneurship*, *2*(1), 1–76.

Davidsson, P., & Delmar, F. (2006). High-growth firms and their contribution to employment: The case of Sweden 1987–96. In P. Davidsson, F. Delmar, & J. Wiklund (Eds.), *Entrepreneurship and the Growth of Firms* (pp. 164–178). Cheltenham, UK and Northampton, Mass.: Edwarde Elgar Publishing.

Doboli, S., Kamberova, G. L., Impagliazzo, J., Fu, X., & Currie, E. H. (2010). A model of entrepreneurship education for computer science and computer engineering students. *2010 IEEE Frontiers in Education Conference (FIE)*, 1–6. doi:10.1109/FIE.2010.5673619

Duval-Couetil, N. (2013). Assessing the Impact of Entrepreneurship Education Programs: Challenges and Approaches. *Journal of Small Business Management*, *51*(3), 394–409. doi:10.1111/jsbm.12024

Eckhardt, J., & Shane, S. (2003). Opportunities and entrepreneurship. *Journal of Management*, *29*(3), 333–349. doi:10.1016/S0149-2063(02)00225-8

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532. doi:10.2307/258557

Eisenhardt, K. M., & Graebner, M. (2007). Theory building from cases: opportunities and challenges. *Academy of Management Journal*, *50*(1), 25–32. doi:10.5465/AMJ.2007.24160888

European Commission. (2009). *ECTS users' guide* (pp. 1–60). Luxembourg. doi:10.2766/88064

European Commission. (2010). *Towards Greater Cooperation and Coherence in Entrepreneurship Education* (pp. 1–137). Birmingham, UK.

Fayolle, A., Basso, O., & Tornikoski, E. T. (2011). Entrepreneurial commitment and new venture creation: A conceptual exploration. In K. Hindle & K. Klyver (Eds.), *Handbook of research on new venture creation* (pp. 160–182). Cheltenham (UK): Edward Elgar Publishing.

Fayolle, A., & Gailly, B. (2008). From craft to science: Teaching models and learning processes in entrepreneurship education. *Journal of European Industrial Training*, *32*(7), 569–593. doi:10.1108/03090590810899838

Fayolle, A., & Liñán, F. (2014). The future of research on entrepreneurial intentions. *Journal of Business Research*, *67*(5), 663–666. doi:10.1016/j.jbusres.2013.11.024

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*, *12*(2), 219–245. doi:10.1177/1077800405284363

Frank, A. I. (2007). Entrepreneurship and enterprise skills: A missing element of planning education? *Planning Practice and Research*, *22*(4), 635–648. doi:10.1080/02697450701770142

Garavan, T. N., & O'Cinneide, B. (1994). Entrepreneurship Education and Training Programmes: A Review and Evaluation – Part 1. *Journal of European Industrial Training*, *18*(8), 3–12.

Gartner, W. B., & Vesper, K. H. (1994). Experiments in entrepreneurship education: Successes and failures. *Journal of Business Venturing*, *9*(3), 179–187. doi:10.1016/0883-9026(94)90028-0

Gibb, A. (2005). *Towards the Entrepreneurial University: Entrepreneurship Education as a lever for change* (pp. 1–46). National Council for Graduate Entrepreneurship, Policy Paper #003.

Gibb, A. (2011). Concepts into practice: meeting the challenge of development of entrepreneurship educators around an innovative paradigm: The case of the International Entrepreneurship Educators' Programme (IEEP). *International Journal of Entrepreneurial Behaviour & Research*, *17*(2), 146–165. doi:10.1108/13552551111114914

Haase, H., & Lautenschläger, A. (2010). The "Teachability Dilemma" of entrepreneurship. *International Entrepreneurship and Management Journal*, *7*(2), 145–162. doi:10.1007/s11365-010-0150-3

Handscombe, R. D., Rodriguez-Falcon, E., & Patterson, E. A. (2008). Embedding enterprise in science and engineering departments. *Education + Training*, *50*(7), 615–625. doi:10.1108/00400910810909063

Handscombe, R., Rodriguez-Falcon, E., & Patterson, E. A. (2005). Embedded Enterprise Learning: About, Through, For and From. In *ASME 2005 International Mechanical Engineering Congress and Exposition* (Vol. 2005, pp. 305–314). ASME. doi:10.1115/IMECE2005-79878

Hannon, P. D. (2005). Philosophies of enterprise and entrepreneurship education and challenges for higher education in the UK. *The International Journal of Entrepreneurship and Innovation*, *6*(2), 105–114. doi:10.5367/0000000053966876

Hechavarria, D. M., & Reynolds, P. D. (2009). Cultural norms & business start-ups: the impact of national values on opportunity and necessity entrepreneurs. *International Entrepreneurship and Management Journal*, *5*(4), 417–437. doi:10.1007/s11365-009-0115-6

Heinonen, J., & Hytti, U. (2010). Back to basics: the role of teaching in developing the entrepreneurial university. *The International Journal of Entrepreneurship and Innovation*, *11*(4), 283–292. doi:10.5367/ijei.2010.0006

Hindle, K. (2007). Teaching entrepreneurship at university: from the wrong building to the right philosophy. In A. Fayolle (Ed.), *Handbook of research in entrepreneurship education* (1st ed., pp. 104–126). Cheltenham (UK): Edward Elgar.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations*. London, UK: SAGE Publications.

House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W., & Gupta, V. (2004). *Culture, Leadership, and Organizations, The Globe Study of 62 Societies*. Thousand Oaks, CA: SAGE Publications.

Jaszczak, J. A., Bouta, E. M., & Raber, M. B. (2013). Nanotech Innovations Enterprise at Michigan Technological University. *Journal of Nano Education*, *5*(1), 27–43. doi:10.1166/jne.2013.1035

Johnson, D., Craig, J. B. L., & Hildebrand, R. (2006). Entrepreneurship education: towards a discipline-based framework. *Journal of Management Development*, *25*(1), 40–54. doi:10.1108/02621710610637954

Jones, C., & Matlay, H. (2011). Understanding the heterogeneity of entrepreneurship education: going beyond Gartner. *Education + Training*, *53*(8/9), 692–703. doi:10.1108/00400911111185026

Karlsson, T., & Moberg, K. (2013). Improving perceived entrepreneurial abilities through education: Exploratory testing of an entrepreneurial self efficacy scale in a pre-post setting. *The International Journal of Management Education*, *11*(1), 1–11. doi:10.1016/j.ijme.2012.10.001

Katz, J. A. (2003). The chronology and intellectual trajectory of American entrepreneurship education. *Journal of Business Venturing*, *18*(2), 283–300. doi:10.1016/S0883-9026(02)00098-8

Katz, J. A. (2008). Fully Mature but Not Fully Legitimate: A Different Perspective on the State of Entrepreneurship Education. *Journal of Small Business Management*, *46*(4), 550–566. doi:10.1111/j.1540-627X.2008.00256.x

Keogh, W., & Galloway, L. (2004). Teaching enterprise in vocational disciplines: reflecting on positive experience. *Management Decision*, *42*(3/4), 531–541. doi:10.1108/00251740410519001

Keogh, W., & Galloway, L. (2006). The role and application of enterprise education in higher vocational study: an engineering case study. *International Journal of Continuing Engineering Education and Life-Long Learning*, *16*(5), 392–399. doi:10.1504/IJCEELL.2006.010961

Kirby, D. A. (2004). Entrepreneurship education: can business schools meet the challenge? *Education & Training*, *46*(8/9), 510–519. doi:10.1108/00400910410569632

Klofsten, M. (2000). Training entrepreneurship at universities: a Swedish case. *Journal of European Industrial Training*, *24*(6), 337–344. doi:10.1108/03090590010373325

Krabel, S., & Mueller, P. (2009). What drives scientists to start their own company? *Research Policy*, *38*(6), 947–956. doi:10.1016/j.respol.2009.02.005

Krueger, N. (2007). What lies beneath? The experiential essence of entrepreneurial thinking. *Entrepreneurship Theory and Practice*, *31*(1), 123–138. doi:10.1111/j.1540-6520.2007.00166.x

Krueger, N., Reilly, M., & Carsrud, A. (2000). Competing models of entrepreneurial intentions. *Journal of Business Venturing*, *15*(5-6), 411–432. doi:10.1016/S0883-9026(98)00033-0
Kuckertz, A., Kollmann, T., & Krell, P. (2012). Opportunity Recognition and Opportunity Exploitation-Two Validated Measurement Scales. *Available at SSRN 2099011*. doi:10.2139/ssrn.2099011
Kuratko, D. F. (2005). The Emergence of Entrepreneurship Education: Development, Trends, and Challenges. *Entrepreneurship Theory and Practice*, *29*(5), 577–597. doi:10.1111/j.1540-6520.2005.00099.x
Kyrö, P. (2006). Entrepreneurship Education and Finnish Society. *Tallinn University Working Papers in Economics*, *No. 152*, 63–81.
Laukkanen, M. (2000). Exploring alternative approaches in high-level entrepreneurship education: creating micromechanisms for endogenous regional growth. *Entrepreneurship & Regional Development*, *12*(1), 25–47. doi:10.1080/089856200283072
Lautenschläger, A., & Haase, H. (2011). The myth of entrepreneurship education: seven arguments against teaching business creation at universities. *Journal of Entrepreneurship Education*, *14*, 147–161.
Levie, J. (1999). *Entrepreneurship Education in Higher Education in England A Survey* (pp. 1–41). London.
Levie, J., Autio, E., Acs, Z., & Hart, M. (2014). Global entrepreneurship and institutions: an introduction. *Small Business Economics*, *42*(3), 437–444. doi:10.1007/s11187-013-9516-6
Lorz, M., Mueller, S., & Volery, T. (2013). Entrepreneurship Education: a Systematic Review of the Methods in Impact Studies. *Journal of Enterprising Culture*, *21*(02), 123–151. doi:10.1142/S0218495813500064
Luthje, C., & Franke, N. (2003). The "making" of an entrepreneur: testing a model of entrepreneurial intent among engineering students at MIT. *R and D Management*, *33*(2), 135–147. doi:10.1111/1467-9310.00288
Martínez, A., Levie, J., & Kelley, D. (2010). *Global Entrepreneurship Monitor special report: a global perspective on entrepreneurship education and training*. *GEM Global Reports. London: GERA*. London.
Mathisen, J.-E., & Arnulf, J. K. (2013). Competing mindsets in entrepreneurship: The cost of doubt. *The International Journal of Management Education*, *11*(3), 132–141. doi:10.1016/j.ijme.2013.03.003
Matlay, H. (2011). The influence of stakeholders on developing enterprising graduates in UK HEIs. *International Journal of Entrepreneurial Behaviour & Research*, *17*(2), 166–182. doi:10.1108/13552551111114923
Mensah, Y., & Chen, H. (2013). Global Clustering of Countries by Culture-An Extension of the GLOBE Study. *Available at SSRN 2189904*, *4*. doi:dx.doi.org/10.2139/ssrn.2189904
Morris, R. (2012). 2011 High-Impact Entrepreneurship Global Report. *Endeavor & GEM, Http://www. Gemconsortium. org/doc/download/295*.
Mwasalwiba, E. S. (2010). Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators. *Education & Training*, *52*(1), 20–47. doi:10.1108/00400911011017663
Napier, G., Rouvinen, P., Johansson, D., Finnbjörnsson, T., Solberg, E., & Pedersen, K. (2012). *The Nordic Growth Entrepreneurship Review 2012*. *http://www.nordicinnovation.org/Publications/nordic-growth-entrepreneurship-review-2012/*. Oslo.
Neck, H. M., & Greene, P. G. (2011). Entrepreneurship Education: Known Worlds and New Frontiers. *Journal of Small Business Management*, *49*(1), 55–70. doi:10.1111/j.1540-627X.2010.00314.x
Nisula, K., & Pekkola, S. (2012). ERP-based simulation as a learning environment for SME business. *The International Journal of Management Education*, *10*(1), 39–49. doi:10.1016/j.ijme.2012.02.004
Oden, Z. M., O'Malley, M. K., Woods, G., Kraft, T., & Burke, B. (2012). Outcomes of recent efforts at Rice University to incorporate entrepreneurship concepts into interdisciplinary capstone design. *International Journal of Engineering Education*, *28*(2), 458–462.
OECD. (2014). *Society at a Glance 2014: OECD Social Indicators*. OECD Publishing. doi:10.1787/soc_glance-2014-en
Ollila, S., & Williams-Middleton, K. (2011). The venture creation approach: integrating entrepreneurial education and incubation at the university. *International Journal of Entrepreneurship and Innovation Management*, *13*(2), 161–178. doi:10.1504/IJEIM.2011.038857
Parthasarathy, M., Forlani, D., & Meyers, A. (2012). The University of Colorado Certificate Program in Bioinnovation and Entrepreneurship: An interdisciplinary, cross-campus model. *Journal of Commercial Biotechnology*, *18*, 70–78. doi:10.5912/jcb.468
Pittaway, L., & Cope, J. (2007). Entrepreneurship Education: A Systematic Review of the Evidence. *International Small Business Journal*, *25*(5), 479–510. doi:10.1177/0266242607080656
Pittaway, L., & Edwards, C. (2012). Assessment: examining practice in entrepreneurship education. *Education + Training*, *54*(8), 778–800. doi:10.1108/00400911211274882
Ramos-Rodriguez, A.-R., Medina-Garrido, J.-A., Lorenzo-Gomez, J.-D., & Ruiz-Navarro, J. (2011). What you know or who you know? The role of intellectual and social capital in opportunity recognition. *International Small Business Journal*, *28*(6), 566–582. doi:10.1177/0266242610369753
Rasli, A., Khan, S., Malekifar, S., & Jabeen, S. (2013). Factors Affecting Entrepreneurial Intention Among Graduate Students of Universiti Teknologi Malaysia. *International Journal of Business and Social Science*, *4*(2), 182–188.

Rasmussen, E. A., & Sørheim, R. (2006). Action-based entrepreneurship education. *Technovation*, *26*(2), 185–194. doi:10.1016/j.technovation.2005.06.012
Rideout, E., & Gray, D. (2010). Does Entrepreneurship Education Really Work? A Longitudinal Outcome Study of Three University-Based E-ED Programs. *Frontiers of Entrepreneurship Research*, *30*(21), Article 3.
Sager, B., Fernández, M. G., & Thursby, M. (2006). Implications of a multi-disciplinary educational and research environment: Perspectives of future business, law, science, and engineering professionals in the technological innovation: Generating economic results (TI:GER ®) program. *Technology Analysis & Strategic Management*, *18*(1), 57–69. doi:10.1080/09537320500520577
Schøtt, T. (2007). *Growth-Entrepreneurship in Denmark 2007: studied via Global Entrepreneurship Monitor* (pp. 1–80). Kolding, Denmark.
Schøtt, T. (2011). *Entrepreneurial Work by Employees in Enterprises: studied via Global Entrepreneurship Monitor in Denmark 2011* (pp. 1–155). Kolding, Denmark.
Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, *25*(1), 217–226. doi:10.2307/259271
Shartrand, A., Weilerstein, P., Besterfield-Sacre, M., & Golding, K. (2010). Technology Entrepreneurship Programs in U.S. Engineering Schools: Course and Program Characteristics at the Undergraduate Level. *American Society for Engineering Education Annual Conference and Exposition*, *6*, 4527–4536.
Smith, K. (2008). Embedding enterprise education into the curriculum at a research-led university. *Education + Training*, *50*(8/9), 713–724. doi:10.1108/00400910810917082
Solomon, G. (2007). An examination of entrepreneurship education in the United States. *Journal of Small Business and Enterprise Development*, *14*(2), 168–182. doi:10.1108/14626000710746637
Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, *22*(4), 566–591. doi:10.1016/j.jbusvent.2006.05.002
Stam, E., Suddle, K., Hessels, J., & Stel, A. Van. (2009). High-Growth Entrepreneurs , Public Policies, and Economic Growth. In R. Baptista & J. Leitao (Eds.), *Public Policies for Fostering Entrepreneurship* (pp. 91–110). New York, NY: Springer US. doi:10.1007/978-1-4419-0249-8
Stone, D., Raber, M., Sorby, S., & Plichta, M. (2005). The enterprise program at michigan technological university. *International Journal of Engineering Education*, *21*(2), 212–221.
Thursby, M. (2005). Introducing technology entrepreneurship to graduate education: An integrative approach. *Advances in the Study of Entrepreneurship, Innovation and Economic Growth*, *16*, 211–240. doi:10.1016/S1048-4736(05)16008-1
Uctu, R., & Jafta, R. C. C. (2013). Bio-entrepreneurship as a bridge between science and business in a regional cluster: South Africa's first attempts. *Science and Public Policy*, 1–15. doi:10.1093/scipol/sct049
Vesper, K. H., & Gartner, W. B. (1997). Measuring progress in entrepreneurship education. *Journal of Business Venturing*, *12*(5), 403–421. doi:10.1016/S0883-9026(97)00009-8
Watts, C. A., & Wray, K. (2012). Using toolkits to achieve STEM enterprise learning outcomes. *Education + Training*, *54*(4), 259–277. doi:10.1108/00400911211236118
Weaver, K. M., Marchese, A., Vozikis, G. S., & Dickson, P. (2010). Promoting Entrepreneurship Across the University: The Experiences of Three Diverse Academic Institutions. *Journal of Small Business & Entrepreneurship*, *23*(sup1), 797–806. doi:10.1080/08276331.2010.10593518
Weick, K. E. (2007). The Generative Properties of Richness. *Academy of Management Journal*, *50*(1), 14–19. doi:10.5465/AMJ.2007.24160637
Wong, P. K., Ho, Y. P., & Autio, E. (2005). Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data. *Small Business Economics*, *24*(3), 335–350. doi:10.1007/s11187-005-2000-1
Wu, S., & Wu, L. (2008). The impact of higher education on entrepreneurial intentions of university students in China. *Journal of Small Business and Enterprise Development*, *15*(4), 752–774. doi:10.1108/14626000810917843
Xavier, S. R., Kelley, D., Kew, J., Herrington, M., & Vorderwülbecke, A. (2012). *Global Entrepreneurship Monitor: 2012 Global Report*. *GEM Global Reports. London: GERA*. London.
Yin, R. K. (2009). *Case Study Research - Design and Methods* (4th ed.). Thousand Oaks, CA: SAGE Publications.