Innovation education programs: toward a conceptual framework

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Abstract

Purpose – Innovation education has been identified as a key contributor to enhancing the innovative behavior of individuals, organizations and economies; yet very little literature exists on the development and assessment of innovation education programs (IEPs). This is particularly so in the higher education and vocational education domains. The purpose of this paper is to bridge the gap in the literature, by proposing a conceptual framework of a multi-dimensional IEP.

Design/methodology/approach – The paper employs a transparent and reproducible procedure and critical appraisal of the literature; coupled with emergent inquiry and case study implementation of a leading international IEP.

Findings – The study provides a framework by which innovation education facilitators may develop and evaluate their IEPs. The proposed framework provides a thematic appreciation of the multi-dimensional relationships between components.

Research limitations/implications – Limited within the context of this case study, geographical context and scant literature on IEPs and reproducible procedure.

Originality/value – The study provides a conceptual innovation education framework, based upon a successful international innovation management program.

Keywords Education, Innovation, Entrepreneurship

Paper type Conceptual paper

Introduction

A considerable literature has accumulated on the discipline of innovation and innovation management (Crossan and Apaydin, 2010; Adams *et al.*, 2006; Ortt and van der Duin, 2008); yet sparse in the area of innovation education and innovation education programs (IEPs). Even more fragmented, is literature in the domain of higher education and vocational innovation education and training (Jarvi, 2012; Canen and Canen, 2002). An extensive literature search has identified a distinct gap in the body of knowledge regarding the development and measurement of IEPs, and this research aims to bridge that gap. To date, no widely recognized and accepted IEP framework exists in the literature. The purpose of this paper is to develop an IEP framework, for use in vocational training and higher education settings. We define IEPs as any pedagogical program or process of education for innovation capabilities and skills, which involve personal, technical and organizational qualities; designed to

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empower both innovators and non-innovators with the tools necessary to undertake innovative activities (Lewrick *et al.*, 2010).

An analytical review scheme is necessary for systematically evaluating the contribution of a given body of literature, and involves a critical appraisal of the literature (Shane, 2012). While apparent in the breadth of the innovation field, such review is scant in the area of IEPs. As such, we employed a transparent and reproducible procedure (Transfield *et al.*, 2003) from the entrepreneurship discipline (Jones *et al.*, 2012; Gregson, 2013); more specifically, entrepreneurship education programs (EEPs) (Maritz and Brown, 2013; Fayolle, 2010; Edwards and Muir, 2012; Matlay, 2009; Rae, 2010). We identified substantial synergies between the innovation and entrepreneurship literature (Lewrick *et al.*, 2010; Crossan and Apaydin, 2010; Shane, 2012), and found using an explicit algorithm, as opposed to a heuristic, to perform a search and critical appraisal of the literature most appropriate (Transfield *et al.*, 2003). As a result, we used the EEP framework of Maritz and Brown (2013) as a base upon which to implement reproducible procedure.

Maritz and Brown (2013) developed a conceptual EEP framework through which entrepreneurship education may be evaluated and developed. Our systematic review evaluated this contribution, and applied it within an innovation education context. We then integrated the scholarly work of Donovan *et al.* (2013); who identified innovation training within the advanced manufacturing industry. In particular, their research involved innovation training, IEP evaluation and effectiveness and curriculum development. The EEP components identified by Maritz and Brown (2013) included context, outcomes, objectives, assessment, content, audience and pedagogy. These components were then integrated within an innovation education context, using emergent inquiry and case study approach.

The case-in-point examined an IEP, the joint MSc in Global Innovation Management (GIM), designed and delivered by a consortium of four universities. The collaborative program was developed in the spirit of European Commission's vision of an excellent and unified European Higher Education Area (EHEA), which aligns with the objectives of the European Consortium of Innovative Universities of which all program partners are members. Key to realizing these objectives are the mechanisms of the joint degree. These focus on integration of regulatory and academic systems of all participating institutions to provide unique and excellent learning opportunities and highly valued joint qualifications for students. Given the variance of perspective detectable within innovation management education, for the right partnerships, the joint degree presents an opportunity to provide IEPs with the expanded perspectives sought (Yanez *et al.*, 2010), for example, multi-national and multi-faculty, within a single study program.

Notably GIM was funded by the European Commission's Erasmus Mundus program from 2008 to 2012. The requirements of this scholarship mechanism ensured particularly multi-national student cohorts, which further enhanced the "global" learning environment and broad perspectives of innovation. The program aims to develop in participants the requisite skills and knowledge for effective technology and innovation management practices in different global regions and technology organization contexts. Such integration between EEPs and this case provided methodological sophistication as a tool for generating and testing theory (Gibbert *et al.*, 2008).

The GIM program was developed through a collaborative process addressing learning outcomes to be achieved as well as skills and knowledge to be attained. This approach is formalized through the EC's EHEA framework (Bologna Working Group, 2005) and the

national higher education frameworks of the participating institutions. This framework is widely accepted at national, institutional and academic levels as means of making academic course offerings explicit to students, academia, industry and other stakeholders.

Where evolving disciplines, such as innovation management and entrepreneurship, are required to address new specific learning and industrial challenges, identification of further specific development and assessment parameters may usefully supplement existing generic academic frameworks.

Components of IEPs

We consider IEPs as educational programs focussing on a management process that considers "changes in market, technology and organization" in an "integrated" way. IEPs often identify specific contexts within which to frame the "integrated" process addressing specific bodies of knowledge emerging within innovation (Yanez *et al.*, 2010; Boutellier *et al.*, 2008). Such specializations represent the perspectives and expertise of the institutions delivering the IEP and can make it challenging to develop a singular development and evaluation framework that is relevant to all IEPs. However, given the "integrated" process that is common foundation of all IEPs, there appear opportunities to explore a more specific framework that could assist stakeholders in developing and evaluating programs alongside established academic course development frameworks such as those based on learning outcomes (Allan, 1996).

More precisely, we define IEPs as any pedagogical program or process of training for innovation capabilities and skills, which involve personal, technical and organizational qualities; designed to empower both innovators and non-innovators with the tools necessary to undertake innovative activities (Lewrick *et al.*, 2010). We provide an analytical review scheme from the scholarly EEP work of Maritz and Brown (2013) as a guiding reproducible procedure (Transfield *et al.*, 2003). This study identified the following components, inherent to understanding the inter-related nature of relationships between such components: context, outcomes, objectives, audience, content, pedagogy and assessment. We apply the reproducible procedure method after an intensive literature review within an innovation-training context.

In all, seven components of the IEP have been identified, with relationships between components mostly reciprocal in nature. In specifying basic questions such as why (objectives), what (content), how (pedagogies) and for whom (audiences), IEPs are likely to run more effectively and efficiently, as well as being more susceptible to assessment measures, which will ideally improve programs over time (Maritz and Brown, 2013). Such programs consist of various components, containing far-reaching content (O'Connor, 2013; Neck and Greene, 2011), designed to meet program goals (Jones, 2010). We proceed with the reproducible procedure by delineating the components.

Context

A variety of contextual approaches are identified in education programs, ranging from higher education institutions (Neck and Greene, 2011), training and development (Jones, 2010), vocational education (Jarvi, 2012), non-business disciplines (Jones *et al.*, 2012), international contexts (Fayolle, 2010; Canen and Canen, 2002), gender (Colley *et al.*, 2003), diversity (Fayolle *et al.*, 2006), competitive offerings, culture (Rae, 2010), organization type, outcomes (Matlay, 2008;

Ortt and van der Duin, 2008), audience (Fayolle and Gailly, 2008), student and educator diversity (Jones, 2010), skills, knowledge and attitudes (Matlay, 2008), type of innovation/innovator (Crossan and Apaydin, 2010), teaching methods and pedagogy (Fayolle, 2010) and evaluation (Harte and Stewart, 2012) to name but a few. We have provided such contextualization as the guiding coalition; as the first component on our conceptual framework in Figure 1.

The second component, outcomes, may well represent contextualization in its own right (Harte and Stewart, 2012), but we believe inclusion of outcomes to be integral and a distinct component of IEPs.

Outcomes

The terms outcomes and objectives are often integrated in education programs (Balan and Metcalfe, 2012); we, however, identify these as separate components in IEPs. Objectives refer to the IEP goals, broadly described as pedagogical, social and/or economic (Fayolle and Gailly, 2008; Matlay, 2009). Outcomes on the other hand, refer to the actions and activities of participants after intervention in IEPs (Jones, 2010). Matlay (2008) found that IEPs do not necessarily match outcomes in terms of skills and knowledge of participants, despite overall satisfaction with the outcomes in relative and absolute terms (Donovan *et al.*, 2013). Outcomes are predominantly identified among: skills, knowledge and attitudes (Matlay, 2008), participant careers (Nabi and Linan, 2011), self-efficacy and intentionality (Douglas, 2013; Volery *et al.*, 2013), competitiveness (Jones, 2010) and practical learning (Rae, 2004). Student predominantly consume knowledge in the classroom, and we propose a notion of student knowledge creation (Sawyer, 2006). We also place emphasis on the importance of stakeholders regarding outcomes; particularly the influence they may have on such outcomes (Matlay, 2009).

The next section on IEP objectives provides a robust discussion leading from outcomes.

Objectives

Often regarded as one of the first steps in innovation training, objectives lead to improved design and evaluation of such programs (Maritz and Brown, 2013). Objectives of IEPs may be defined into general groupings: pedagogical, social and economic (Fayolle, 2010; Matlay, 2009). Pedagogical IEP goals help potential innovators learn about innovation and innovation management (Lewrick *et al.*, 2010). Social goals may include innovations in sustainable ventures and activities, and economic goals may include innovation as a critical source of competitive advantage, enhancing capabilities for sustainable growth, economic activity and the wealth of nations (Crossan and Apaydin, 2010; O'Connor, 2013). In this context, we see innovation as the production, adoption, assimilation and exploitation of value-added novelty in economic and social spheres; a key factor for competitiveness and growth (Crossan and Apaydin, 2010; Lewrick *et al.*, 2010).

We now explore the diversified stakeholders of IEPs.

Audience

Audience and stakeholders are usually inter-related in IEPs, and we take cognizance that the student is not the only stakeholder in the education process. Matlay (2009) identifies primary, secondary and tertiary stakeholders, capturing the heterogeneity of all stakeholders (Penaluna *et al.*, 2012). Understanding the demands of the audience has

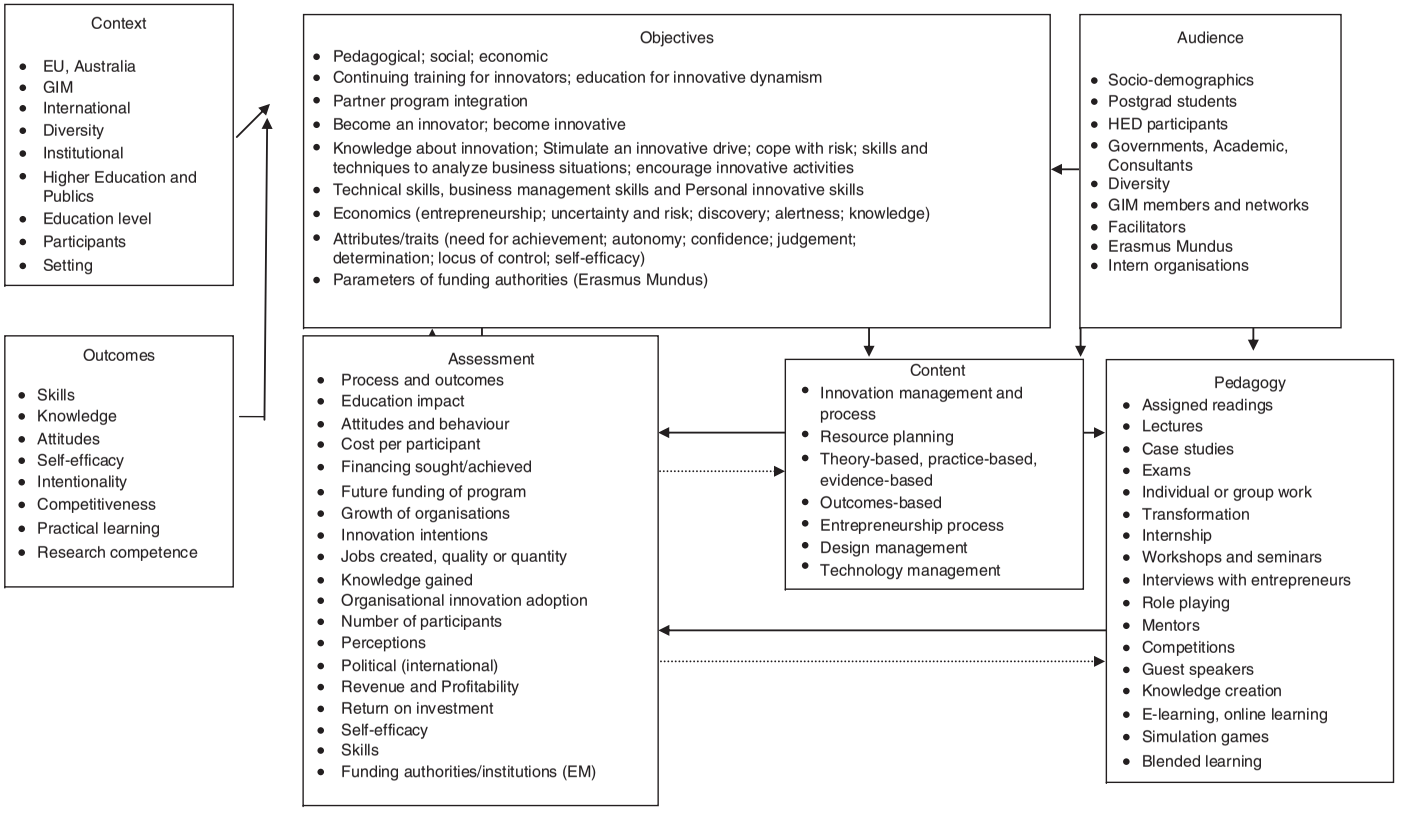

Figure 1.
A multi-dimensional framework of an innovation education program (IEP)

Source: Adapted from Maritz and Brown (2013)

a direct effect and influence on the objectives of the program (Fayolle and Gailly, 2008). Jones (2010) identified the context from the perspective of student/participant and educator/trainer diversity. Despite diversity and heterogeneity of audience, objectives and audience should be linked to one another (Maritz and Brown, 2013). The content of the IEP should be designed to meet audience and objectives of the program, discussed hereafter.

Content

Depending on the objectives of the IEP, content will be delivered to a defined audience to achieve such objectives and outcomes. Due to the extant nature of innovation, content may vary substantially between programs (Lewrick *et al.*, 2010). Such typology of innovation is identified across process, product and relational innovations (Zhaou, 2005; Ortt and van der Duin, 2008). He further identifies sub-types including: radical, incremental, disruptive, continuous, open, technological and frugal to name but a few.

O'Sullivan (2003) identified content around the innovation process, topics included: systems design, systems theory and engineering, knowledge management, innovation management, socio-technical systems design, strategic planning, quality function deployment, project portfolio management, project teams and workgroups, enterprise modeling, product design and creativity and ideas generation. Johnson (2001) provided specific inputs for innovation education and training including: research and development (R&D) product development, new usage of established product or service, changes in markets exploited, operational and logistical innovations and business model innovation. Yanez *et al.* (2010) provide a technical perspective, highlighting: an accepted range of management specialties, knowledge of technology and innovation and related management procedures and topics covering the contextual setting of management of technology and innovation. They include a process that would enable their students to develop and implement new technologies. Specific curricula include: innovation management, R&D, technology management, product development, knowledge management, technology transfer, project management, intellectual property and entrepreneurship. Management subjects are offered on an individual and elective basis.

Notwithstanding specifics and contextualization, content is generally technology based and specifically designed around technical and personal skills (prominence on the former). We next discuss the mode and method by which such content is delivered in IEPs.

Pedagogy

Pedagogy should be seen as a means to achieve the objectives of the program, and not as an end in themselves (Fayolle and Gailly, 2008). Pedagogical initiatives are far reaching in innovation education (Lewrick *et al.*, 2010), and may include formal and informal approaches (Fayolle, 2010). Matlay (2008) identifies pedagogical initiatives based upon outcomes, whereas Balan and Metcalfe (2012) postulate that despite the particular pedagogy, student engagement remains paramount in education programs. Scholars place emphasis on the theoretical underpinnings of pedagogy (Rae, 2004), including network theory and resource-based view (Ireland *et al.*, 2005), practice-based view (Crossan and Apaydin, 2010) and knowledge management (Adams *et al.*, 2006). It is important to emphasize that theoretical content does not necessarily lead to more "traditional" teaching methods (such as lectures), and, similarly, practical content is not

always taught with more experimental methods (such as business simulations) (Maritz and Brown, 2013).

Traditional pedagogy includes: lectures, seminars, workshops, case studies, teamwork, group work, guest speakers and interviews with innovators (Fayolle, 2010; Canen and Canen, 2002). Less traditional pedagogy includes experiential learning, action learning, simulation, blended-learning and online techniques (Pittaway and Cope, 2007; Maritz *et al.*, 2011). Due to competence-based education (Biemans *et al.*, 2009), many scholars believe innovation education necessitates a custom-designed pedagogy approach (Jossberger *et al.*, 2010; Jarvi, 2012). In particular, Avis (2012) relates to the ambiguities and challenges of learning in innovation and the knowledge economy, placing emphasis on transformation, innovation and capital. This resonates well with the notion of employing pedagogical initiatives based upon program objectives. Assessment of programs always takes cognizance of pedagogy, and we discuss the final component of the IEP in the following section.

Assessment

Since innovation is both process and outcome (Crossan and Apaydin, 2010; Shane, 2012), it makes sense that assessment should be all embracing to capture process and outcome. It is important that the individual components of an IEP add value to the entire program, and when viewed as an integrated whole, the components show their influence on one another. Assessment is influenced by stakeholder involvement (Matlay, 2009), yet we need to differentiate between the terms assessment and student evaluation. Assessment of IEPs refers to the overall measurement of effectiveness of programs (Jones, 2010); whereas assessment of student learning refers to methods of evaluating individual student competencies and understanding of content by way of assessment items such as assignments (Maritz *et al.*, 2011). This study places emphasis on the former; due to the pragmatic and practice-based outcomes of IEPs (Rae, 2004).

Assessment is driven by program objectives, content and pedagogies. Assessment is at various critical points throughout the program, differentiated by short and long-term assessment. The most challenging of assessment criteria is that of contextualization (Maritz and Brown, 2013), and assessment of programs has proven one of the most challenging components of education programs (Fayolle, 2010; Jones *et al.*, 2012). This research provides a framework, whereby IEPs may be evaluated.

The GIM program

The MSc in GIM is a unique two-year program, jointly offered by the Department of Design Manufacture and Engineering Management (DMEM) at the University of Strathclyde (UofS, Scotland), The Center for Industrial Production (CIP) at the Aalborg University (AAU, Denmark), the Institute of Technology and Innovation Management (TIM) at the Hamburg University of Technology (TUHH, Germany) and the Australian Graduate School of Entrepreneurship (AGSE) at the Swinburne University of Technology (SUT, Australia). The program was first delivered in 2008, seeking to enable graduates with first degrees in engineering, science and technology to develop skills to successfully manage the innovation process across international boundaries. Students study at two different universities, and the two-year duration of the program allows a greater depth of learning, industrial engagement and a rich cultural experience.

Program aims and objectives includes equipping students with skills to transform research outputs into innovative products and services with an emphasis on learning

the soft skills and techniques for working globally. Students are able to apply this knowledge practically, while working on industrial projects in different countries. This further enhances their understanding of international business. GIM addresses new challenges in innovative global enterprizes by addressing the following: a practical and global perspective of innovation management, through industry-based modules; skills applicable for larger multi-national organizations to smaller enterprizes; expanded perspectives of innovation management including technology management, R&D and product/service development with focus on the interface between disciplines involved in the process; and increased research capability focussed on activities at the periphery of the innovation process.

Core modules include design methods, global design, innovation management, strategic technology management, international management, supply chain management, people organization and technology, product development project, business planning, product planning and marketing for innovation. Various elective options are available at each of the international institutions.

Methodology

An interpretivism philosophical standpoint (Richardson, 2012) was adopted for this research, with an inductive research approach (Samkin and Schneider, 2008) to explore IEP components. We implement an analytical review scheme for systematically evaluating the contribution of the innovation and entrepreneurship literature, involving critical appraisal (Shane, 2012). We employ a transparent and reproducible procedure using explicit algorithm (Transfield *et al.*, 2003) from the entrepreneurship education discipline in particular (Maritz and Brown, 2013). We then provided a case study to provide methodological sophistication as a tool for generating and testing theory (Gibbert *et al.*, 2008), using the process of emergent inquiry (Keegan, 2009).

The case-study method (Donovan *et al.*, 2013) included semi-structured interviews, respondents consisting of the program directors or coordinator of each of the higher education partners' of the GIM program. Semi-structured content was developed from the components of IEPs (Maxwell, 2013). Pre-testing was conducted via a control group (Rampersad *et al.*, 2010), with the qualitative data allowing discovery, exploration and theory building (Hampton *et al.*, 2011). Data were edited and categories prepared (Marshall and Rossman, 2006), with transcription for categorization and relationships between components. Manipulation of textual data were formatted to eliminate outlying and non-categorized data (Hampton *et al.*, 2011).

Data collection was primarily online using technological media and digital communications, complemented by narratives, various electronic databases and visits between the partner institution program members. Data were centrally stored and collated by the lead investigators at Swinburne University. Respondents included program directors and innovation management staff at each of the partner universities. The research component took place between January and May 2013.

Emergent inquiry was used to describe collaborative or participative action research (Keegan, 2009). In essence, this emergent process was viewed to share ongoing, iterative learning between the partner universities. The analysis involves results from semi-structured interviews and/or iterations with program leaders at each of the partner institutions, in addition to monographs, commentaries and narratives. Emergent themes were coded to avoid replication and bias (Fischer and Reuber, 2011).

Case study analysis

We provide data within components of context, outcomes, objectives, audience, content, pedagogy and assessment. The rationale was not to intrinsically compare the institutions against these components, but to place emphasis on the integration and applicability of innovation mode of delivery across borders and contexts. Integration of content and context (Maritz and Brown, 2013) is paramount between these institutions, which is highlighted in the scholarly activity between the institutions. Learning and teaching and research leadership is personified throughout; student mobility is not the only exchange; but staff mobility has seen an abundance of integration by visiting professors and academics by the partner institutions. What follows is a brief overview of each program, post semi-structured interviews. Cognizance is taken that the overall degree or award for the GIM program is a Master of Science (MSc) in GIM, awarded as a joint degree between the applicable participating institutions. Technology and innovation management programs typically are delivered by business faculties, engineering faculties and/or specialized centers (Yanez *et al.*, 2010). All three identified institution types are integrated in this consortium approach to an IEP.

UofS

The UofS is an explicitly "technological" university that places importance on the integration of teaching, research and knowledge exchange across faculties, disciplines and with industry. Demonstrating progress in achieving such integration is the significant investment in the Technology and Innovation Center; a high-end hub for world-leading research collocating academics, business, industry and the public sector on the campus. The progressive institutional strategy evidenced in tangible outputs has been recognized in the Times Higher award for university of the year in 2012.

In the context of teaching, emphasis is placed on continual curriculum renewal to effect a stimulating and challenging learning environment and the development of problem-solving skills, independent and critical thinking as well as ethical practice to meet the needs of global industry.

The DMEM of the Faculty of Engineering at UofS is responsible for the GIM curriculum. Fundamentally DMEM is concerned with making organizations perform better through product, process and business development. The department treats innovation management at the following levels: practical (in particular design), operational and strategic. The relevant key departmental competences are: processes including design, production, systems thinking and process excellence, technology development, business strategy, coordination and collaboration, knowledge and information management and organizational performance. The GIM curriculum at UofS aims to address the core elements of an IEP and the specific challenges of innovation in a global context.

The arrangement of modules in the curriculum is unique to the GIM program. The core intention is a foundation in the innovation management process, and essential practical experience of working within creative globally distributed teams (global design module) and with industrial clients on product/service development briefs (group industry-based project). Where design is viewed as the activity which links creativity to innovation (Cox, 2005) and design thinking is increasing viewed as an approach within mainstream business, the curriculum seeks to introduce the IEP student to design process.

Optional modules are then selected from a range of complementary subjects, which allow candidates, to an extent, to tailor their learning program.

Pedagogically the department holds "learning-through doing" and project-based learning at its core. As well as the aforementioned project and team-based modules, key features are a business simulation-based project in the management of innovation class and an emphasis on critical analysis through the design management module.

Observed outcomes following year 1 of the program are that:

- learning in innovation management is enhanced through a relevant business simulation, progressive topics and case studies;
- experience of synchronous and asynchronous global collaboration/coordination is consolidated;
- a broadened perspective of innovation that includes the design process and associated activity, strategic technology management and operations management issues is attainable;
- students are practiced in critical thinking prior to the year 2 thesis project;
- the project-based learning experience provides foundation for more immersive problem-based learning (PBL) in year 2 at AAU;
- project management skills are developed through in an industrial, team-based context;
- students are gain summer employment on research projects or industry internships; and
- themes from the curriculum are evident in the employment attained by graduates.

Once completing the first year of study, students continue to year 2 of the GIM masters program at one of the partner institutions. Mobility routes are based on student preference and input from the program coordinators.

AAU

The degree is offered within the CIP of the Faculty of Engineering, Technology and Medicine at AAU. In this instance, students apply skills and knowledge in an industrial internship at Aalborg, followed by finalizing their master theses. The program is delivered in English and intended for graduates of first degrees in engineering, science and technology. GIM students spend one year of full-time study at AAU by entering at the graduate diploma level at third and fourth semester. The third semester is allocated to gaining practical international experience, with aims including: practical experience, analyses and reflection on educational experiences and professional practice and to clarify the masters thesis. This is carried out in collaboration with an industry partner. During the fourth semester, a masters thesis is completed.

Overall, the master of Operations and Innovation Management is a two-year master specialization. The OIM program is designed to develop both the theoretical understanding of international aspects of strategy, innovation and change processes, as well as international practical experience hereof in either SMEs or larger organizations. The OIM program is closely connected to the research center, CIP. The program has an annual uptake of approximately 35 students. Integration of the GIM program involves students undertaking an industrial internship at a Danish company to gain relevant GIM work experience, and to consolidate the taught content

delivered at the UofS. Each internship is designated to best reflect students' interests within the available placements from a secured list of Danish companies.

The pedagogical approach is based on PBL, with close interaction between theory and practice. The program's content is predominantly structured around global operations and innovation, including global operations development, organizational analysis and design, innovation and change management, global performance management and global implementation. Content is delivered around key knowledge, skills and competencies. Outcomes include the application of new knowledge and skills in the defined facets of innovation and operations.

TUHH

The degree is offered by the TIM of the Mechanical Engineering School at TUHH in Hamburg, Germany. TUHH has developed various academic and industry-related program elements, concentrating on innovation and competitiveness. To activate this, they provide the expertise for stakeholders, namely students, scientific partner institutions and partner companies. The second GIM year at TUHH provides candidates with a truly global perspective of innovation management focussed both on working on a global scale and on experience of study and industry. It provided students with an understanding of the vast differences in global approaches to innovation management depending on the context; emerging economies, transitioning economies, industrial economies and knowledge-based economies. Various content-related paradigms are offered, from front-end innovation, product development, industrial projects, to intense innovation management projects over geographical and functional borders. TUHH, in particular, use expert visiting academic scholars to provide international innovation management scenarios. TUHH has the added advantage of integrating their Institute for Marketing and Innovation and Institute for Technology and Innovation Management to provide exceptional student outcomes in innovation management.

In essence, this phase of the GIM program looks at early and late phases of the innovation management process. It concentrates on market research for (radical) innovation, cross-functional cooperation at the front end of the innovation process, managing innovation projects over geographical and functional/divisional borders and preparing the market introduction of new products and services.

SUT

The academic ranking of world universities and renowned for excellence in science, technology and innovation rank SUT in the top 400 research-intensive universities. The degree is housed within the AGSE, Faculty of Business and Enterprise at SUT in Melbourne, Australia. The Master of Entrepreneurship and Innovation (MEI) is a leading, internationally awarded and accredited entrepreneurship and innovation masters by coursework degree program, and has been recognized as the leading entrepreneurship postgraduate by coursework program in the southern hemisphere, ranking in the top five in the world. The program was a finalist in the 2010 United States of America Small Business and Entrepreneurship (USASBE) Global Entrepreneurship Education Awards (Global Awards, 2010; Maritz and Gillin, 2010; Mudge, 2007). The degree is aimed at graduates from multiple disciplines who can demonstrate entrepreneurial behavior over a period of three years prior to admission. The MEI's pedagogical approach is based on a theory for practice sake. The program places high importance on participation in networks and collaboration within teams, across business functions and organizations, and indeed across international borders.

Increased levels of self-confidence and entrepreneurial efficacy, energy and motivation, inevitably drive students to pursue new opportunities and overcome greater challenges. Content is predominantly structured around entrepreneurial and innovative behavior, highlighting commercialization of high growth ventures. A particular pedagogy employed is the notion to produce new student knowledge, as opposed to traditional student knowledge consumption (Sawyer, 2006). In particular, the MEI has been successful with integrating GIM students in coursework units, particularly in the discipline of applied research, in the form of a minor thesis. Over the past three years, approximately 15 GIM students have completed the MEI program.

At SUT, GIM students develop skills in entrepreneurship and innovation, and the practice of innovation leadership. The learning goals and objectives are based around assessing new ventures and opportunities, planning and managing rapid growth, integrating interdisciplinary approaches and applying innovative solutions. Interactive modules are delivered by academics that are also practitioners in the relevant areas.

Applications

We provide a practice-based view (Rae, 2004, 2010) to facilitating the development of an IEP framework (see Figure 1). This is facilitated by the intensive literature review conducted, providing a transparent and reproducible procedure (Transfield *et al.*, 2003) from the entrepreneurship discipline (Jones *et al.*, 2012; Gregson, 2013); more specifically, EEPs (Maritz and Brown, 2013; Jones *et al.*, 2012; Fayolle, 2010; Edwards and Muir, 2012; Matlay, 2009; Rae, 2010). We provide case study methodology (Gibbert *et al.*, 2008), providing an in depth analysis of the Global Innovation Program. We delineate the components of the proposed IEP, based upon our case study analysis.

Context and audience

The GIM program is contextually rooted in postgraduate higher education in the discipline of innovation management. Context and audience are intrinsically integrated due to the partner institutions, student diversity and stakeholder heterogeneity. Further diversification is in European Union funded higher education initiatives (Erasmus Mundus specific). Further integration of context is within the components to follow. From an audience perspective, student diversity and internationalization is a distinct characteristic of the program. Stakeholder heterogeneity is again emphasized, consisting of academic institutions/partner institutions, students, internship organizations, funding organizations (Erasmus Mundus specific), GIM members and networks, governments, facilitators and researchers.

Outcomes and objectives

GIM equips students with skills to transform research outputs into innovative products and services. Learning the tools and techniques for working globally, students apply this knowledge practically by working on projects with industry contacts in different countries, further enhancing their understanding of international innovation business. GIM addresses new challenges in innovative global enterprize, and includes a practical and global perspective of innovation management through industry-based modules, skills applicable for larger multi-national organizations to smaller enterprize, expended perspectives of innovation management including technology management, R&D and interface between elements of the innovation process, and increased research capacity focussed on activities at the periphery of

the innovation process. Each partner institution has specific outcomes. Strathclyde in particular provide the theoretical base for the program, specifically from a design, engineering and new product development perspective. Aalborg and Hamburg Universities provide a GIM perspective, coupled with industrial internships. SUT provides an entrepreneurship perspective to innovation management.

Content and pedagogy

The core of the content is initially delivered to students through theoretical foundations at Strathclyde University. Such content includes innovation management, strategic technology management, design management, design methods, supply chain management, people organization and technology, product development project and global design. Optional modules are then selected from a range of design, technology and innovation subjects, including: product design techniques, enterprise resource planning, engineering risk management, systems integration, information management, sustainable product design and manufacturing, product costing and financial management, fundamentals of lean six sigma and systems thinking and modeling. Various pedagogical initiatives are used, such as experiential learning, transformation, problem-based view, practice-based learning, theory based, evidence based, lectures, case studies, exams, role-playing, guest speakers, internship, simulation, blended learning and individual and group work. Further content is delivered at the partner institutions, such as entrepreneurship, technology, GIM and research methodology. A content and pedagogy moderator unique to the GIM program is the varying content and pedagogical initiatives across the partner institutions. Not only are innovation and entrepreneurship two different disciplines, their content and pedagogy varies significantly, often similar to inter-disciplinary business education (van Baalen and Krsten, 2012).

Assessment

Assessment of the GIM program should be embracing to capture process and outcome. We refer to assessment of the GIM program, not assessment items to test knowledge and skills of students. Such assessment forms an integral component of pedagogy. Assessment of the GIM program includes assessment of process, outcomes, impact, behaviors of students, financial, innovation intentions, knowledge gained and return on investment and skills. Of significant and unique value, is assessment against parameters of the funding authorities. Assessment is driven by program objectives, and this component has proven to be one of the most challenging in IEPs.

Conclusion

Using the practice-based view (Rae, 2010) we now integrate the expansive literature review and GIM case findings to develop a conceptual framework of an IEP. The framework is multi-dimensional due to the multiple relationships and dimensions within each program component. Please refer to Figure 1, which provides a conceptual framework of an IEP.

The framework is certainly not exhaustive of all components and sub-components of IEPs, but provides an analytic review scheme of an IEP. Since such frameworks are scarce in the innovation literature, we believe this framework adds to the body of knowledge, particularly regarding the assessment of IEPs. Figure 1 also identifies the interdependencies between the various components.

This study has provided a distinct addition to the body of knowledge in the development and measurement of IEPs, bridging the gap between components

and dimensions of IEPs. Such components included context, outcomes, objectives, assessment, audience, pedagogy and content; together with the inter-relatedness of the components. The study provides a framework by which innovation education facilitators may develop and evaluate their IEPs. The proposed framework provides a thematic appreciation of the multi-dimensional relationships between components.

Limitations of the framework are based on the transparent and reproducible procedure (Transfield *et al.*, 2003) followed and the case of a leading innovation management provider. As such, this framework is specific to the GIM program, and it is difficult to make generalizations from a single case study (despite multiple institutions involved). Similar conceptualization is recommended for other IEPs. We recommend a follow-up study to empirically assess the provided IEP within the innovation education domain.

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