Entrepreneurship in Geospatial Education

A Bridge Towards Sustainable Development

Entrepreneurship in Geospatial Education: a Bridge Towards Sustainable Development

Senior University Teaching Qualification

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1. Introduction

Today we face a range of complex and wicked problems, from climate change to sustainable development of resources and the well-being of citizens and their environments. Geospatial education programmes are confronted with the challenge of graduating professionals that are capable of using geospatial science to address these eminent problems while contributing to economic and social gains.

The field of geospatial science can conceptually be divided following the 3P principle (Elkington 1997) into People, Planet and Profit. Therefore, geospatial education programmes mainly focus on mapping and analysing people and earth's systems, with the profit component being mainly centred on generating environmental benefits. A specific example for this study is the education programme on Geoinformation Science and Earth Observation (M-GEO) of the University of Twente, The Netherlands. The M-GEO programme is directed towards capacity development of less-developed countries (LDCs). Ultimately the M-GEO education should stimulate the creation of socio-economic profits to accelerate the sustainable development of targeted LDCs. Ameliorating socio-economic revenues of LDCs through M-GEO education could be achieved through incorporating entrepreneurship education (Kuratko 2017, Lu et al., 2016, Bonnet et al., 2007, Smith et al., 2006). In this context, entrepreneurship is much broader than the creation of a new business venture (Shane and Venkataraman, 2007, Stevenson and Jarillo 1990). It is also a mind-set – a way of thinking and acting (Karatko and Morris 2018). It is about imagining new ways to solve problems and create value (Neck and Greene 2011).

Fostering entrepreneurial mind-set in M-GEO education can help promote a balance of economic, social and environmental outcomes benefiting multiple-stakeholders in a sustainable manner (Morris et al., 2013, Vidic 2013, Lourenco et al., 2012). The importance of stimulating entrepreneurship mind-set in a non-business education has been recently reinforced by the European reference framework (COM, 2018, and previously COM 2008) whereby entrepreneurship and a sense of initiative is identified as one of eight key competences required for lifelong learning and initiating a knowledge-based society. The later component, of originating a knowledge-based society, is one of the prime objectives of M-GEO, as it forms the seed towards socio-economical sustainable development, particularly in less-developed countries (Ortiz-Medina et al., 2014). For example, Malaysia Higher Education Blueprint 2015- 2025 (MEB 2015-2025), requires non-business academic institutions to incorporate entrepreneurship into their academic programmes in order to produce graduates with socio-economic growth-potential (Abdul Karima, 2016). On the other hand, Sule (2015) and Bukola (2011) argued that incorporating entrepreneurial mind-set in the education system of Nigeria will be vital to enhance the sustainable development in the country.

In the context of changing paradigms in development corporation, giving a mayor role to the private sector in the aid to trade agenda, this entrepreneurial mind-set will empower geospatial and engineering students (Lu et al., 2016; Mäkimurto-Koivumaa and Belt 2016) with the skills to innovate solutions that are trans-disciplinary and sustainable (Morris et al., 2013).

The short-term question of this research is: *What are the characteristics of an entrepreneurship course, optimal for M-GEO education and students?*

Whereas the long-term question of this research is: *Would incorporating entrepreneurial mind-set in the M-GEO education programme contribute to the creation of industrial innovation and the establishment of a knowledge-based society, ameliorating thereby sustainable developments in targeted countries?*

The **main objective** of this study is to identify the characteristics of an optimal design for an entrepreneurial education for the M-GEO students.

2. Approach

Students enrolled in the M-GEO programme (Master and Postgraduate levels) at the ITC faculty of the University of Twente, The Netherlands, are the targeted group of this research. The employed approach hereafter follows Bishop- Clark and Dietz-Uhler (2012) and is a cyclic process iterating on five main phases (see Figure 1):

1. Collect data: Surveys were collected from the students, with the number of respondents in the range 30-700. The surveys were cross sectorial and based on Ross (2005) and de Leeuw et al., (2008) methods.
2. Analyse the data: collected data were analysed to understand the needs of M-GEO students and to establish the design requirements of the course. The analysis made use of the European Statistics Code of Practice (COM 2017). Survey data were, therefore, categorized into numerical and textual data. Numerical data were analysed using the statistical measures of Presser et al., (2004), whereas textual data were analysed qualitatively, i.e. reading.
3. Design: the course was designed by integrating students' needs with design requirements obtained from the data analysis, using the double diamond model (Design Council 2007) to identify and realize the best design.
4. Prototype: Realize the best design and make use of available materials and develop new if necessary.
5. Test: the prototype of the course was tested through peer-evaluation from NIKOS and ITC peers and self-reflection (Fry et al., 2009). The results of the teste were analysed and used to refine the design of the course.
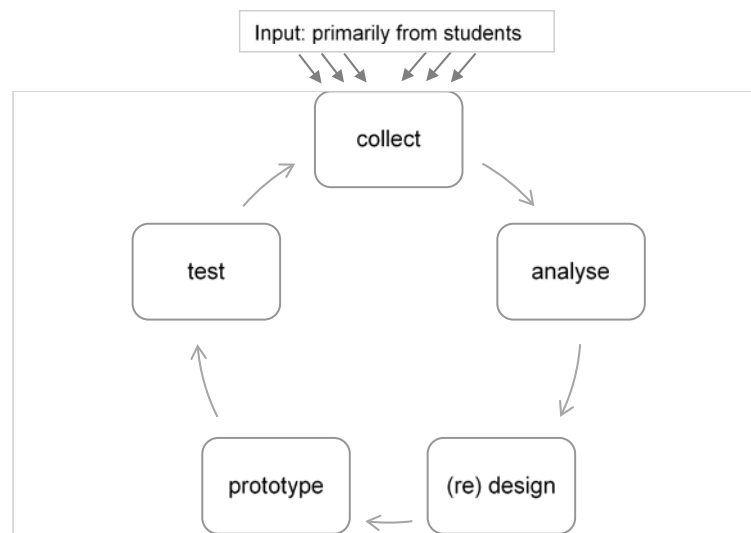

Figure 1: Schematic illustration of the followed approach.

3. Data collection

The ITC strategic vision states that "entrepreneurship and innovation will be specifically targeted in the new capacity development activities and education programs". Several surveys and meetings were conducted to give shape to this aim. For this study, data from surveys and meetings are collected and analysed with the objectives of:

1- Understanding the need of the M-GEO students for additional entrepreneurial skills.

2- Formulating, from 1, the requirements for a course on entrepreneurship.

Four surveys were organized at ITC, a brief description of these surveys is found in Table 1, more details on these surveys are found in Appendix A, section 9. In addition to the surveys, two meetings were organized, to design the entrepreneurship course and to evaluate the design. A brief description of these meetings is provided in Table 2.

Table 1: Overview of surveys collected for this research.

Date	Objective	Targeted audience	Design method	Outcomes	Appendix
2018	Understand the students' expectations regarding entrepreneurship education for societal impact.	M-GEO students that are studying in the second year of the Master programme 2017-2018	Cross-sectional survey (Scheuren, 2004)	34 respondents. Primarily numeric data.	9.1.
2017	Periodic survey to assess relevance of M-GEO education for further career of ITC alumni and to improve the M-GEO programme.	ITC, alumni from 2008 to 2017.	The framework of Salant and Dillman (1994), i.e. specification, coverage, sampling, response, and measurement and the techniques of Ross (2005) and de Leeuw et al., (2008).	710 respondents Numeric and textual data.	9.2.
2014		ITC, alumni from 2007 to 2011.		71 respondents Numeric and textual data.	9.3
2013	How to improve the education programme of M-GEO	ITC alumni and students in 2013, specialized in one discipline	One question survey	68 respondents out of 85 participants. Numeric and textual data.	9.4.

Table 2: Overview of meetings from which data were collected for this research.

Date	Objective	Attendees	Outcomes
2018	Define course's components	Staff from ITC, and NIKOS	The major components of the course were identified
2018	Peer evaluation of the course	Staff from NOVELT, NIKOS and ITC	First evaluation of the course

4. Data analysis

In this section I will analyse the collected data from the surveys (Table 1) and meetings (Table 2) and summarize the main outcomes.

4.1. Surveys

Surveys among students and alumni have the potential to generate very relevant information for among others marketing, accreditation, quality assurance, curriculum development and benchmarking. Over the last years a number of surveys among ITC students and alumni have been conducted by different groups for different purposes (Table 1).

a. Survey 2018

Description: During the first meeting of the working group entrepreneurship on December 7, 2017 it has been decided to collect input from M-GEO students that are studying in the second year of the Master programme to better understand their expectations regarding this course in terms of content (objectives, themes) approach (teaching and learning modality) and their interest to follow this course. A cross-sectional survey (Scheuren, 2004) was designed to collect data from the participants about their interest in entrepreneurship and innovation for societal impact. The survey is placed in Appendix A, section 9.1.

Objective: Understand the students' experience and expectations regarding entrepreneurship education for societal impact.

Targeted audience: M-GEO students that are studying in the second year of the Master programme 2017-2018.

Design method: Cross-sectional survey (Scheuren, 2004).

Outcomes: 34 respondents out of 34 participants from five specialization at ITC. Analysis of this survey showed that 34 participants (29% female) took the survey in January 2018 with 6% working in the private sector. The survey consisted of 10 questions (Q), all being focused on aspects of entrepreneurship and tailored by each specialization at ITC. This tailoring results in numeric and textual answers of the same questions. Analyses of this survey showed that (Q3-Q7) 62% of the participants are considering starting a new business in geospatial domain. With 88% of participants supporting the inclusion of entrepreneurship education in M-GEO. At the same time, all participants stressed that entrepreneurial skills – like communication with stakeholders, valorisation, recognising opportunities – are essential to enable them contributing to the socioeconomic development in their countries. Speaking of the structure of the course (Q8) the participants suggested a mix between theory and practice with more focus on practical knowledge and skill, e.g. as part of an internship.

b. Survey 2017

Description: In 2017 an elaborated survey was carried out to probe the consequence of having ITC diploma and how it has shaped alumni's careers. The survey is periodic (~3 years) and serves as a quality check of M-GEO programme. The survey is placed in Appendix A, section 9.2.

Objective: The objectives for the Alumni Survey 2017 were the following:

    i.   Assess relevance of ITC education for further career of ITC alumni;

    ii.   Identify some trends in the type of alumni;

iii.   Identify ways for effective and efficient involvement of alumni;

iv.   Make alumni aware of new developments in ITC's education.

Targeted audience: ITC alumni from 2008 to 2017 (in total 2045 alumni were approached).

Design method: The framework of Salant and Dillman (1994), i.e. specification, coverage, sampling, response, and measurement and the techniques of Ross (2005) and de Leeuw et al., (2008).

Outcomes: The survey was sent out to 2045 ITC's graduates with PhD, MSc, Master and PGD degrees in the years 2008 until 2017. 759 alumni from 89 different nationalities, 63% male and 37% female, responded to the survey. From the analysis of question 12 (see Appendix 9.2, 196 respondents), one could observe (Figure 2) that from 2009 to 2017 the percentage of M-GEO graduates working in the private sector has increased from ~10%/year to ~20%/year. This increasing trend is maintained for those "entrepreneurial" graduates starting their own business. The trend values were estimated using type I regressions (Presser et al., 2004) with zero intercept. The data points on both axes were first adjusted by the first values, i.e. X and Y were forced to have zero origin. The trends were found to be 1.76 /year (R^2 = 0.42), of graduates working in the private sector and 0.37/year (R^2 = 0.45) for entrepreneurial graduates starting up their own business.

Few questions were on the content of additional courses that ITC should offer. One question (Q23) explicitly targeted entrepreneurship, whereby respondents could choose it among the existing specializations of M-GEO. With a response rate of 95% (710 response out of 759) 68% of the respondents indicated entrepreneurship as a "must to offer" course by ITC (Figure 3). More than 70% of survey's participants also indicated usefulness of providing online courses. This percentage became 90% for the group who choose of entrepreneurial skills.

The presented survey contained many open-ended questions, one of which (Q26) was analysed in the course of this work. Although tools do exist to automatically analyse textual data (e.g. Yahya et al., 2013 Gomaa and Fahmy 2013, Chavan et al., 2014, Manning et al., 2014, Chaudhari and Govilkar 2015), the manual analysis of the textual data (i.e. reading) permitted the empathic understanding of students' needs, opinions, emotions and appraisals, as suggested by Pombo and Tschimmel (2005).
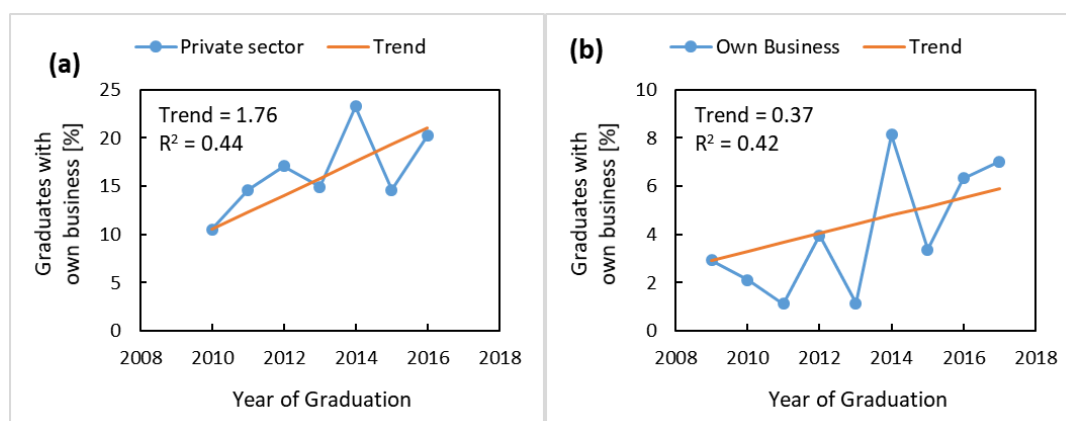
Figure 2: Graduates: a) working in the private sector, and b) starting their own business.
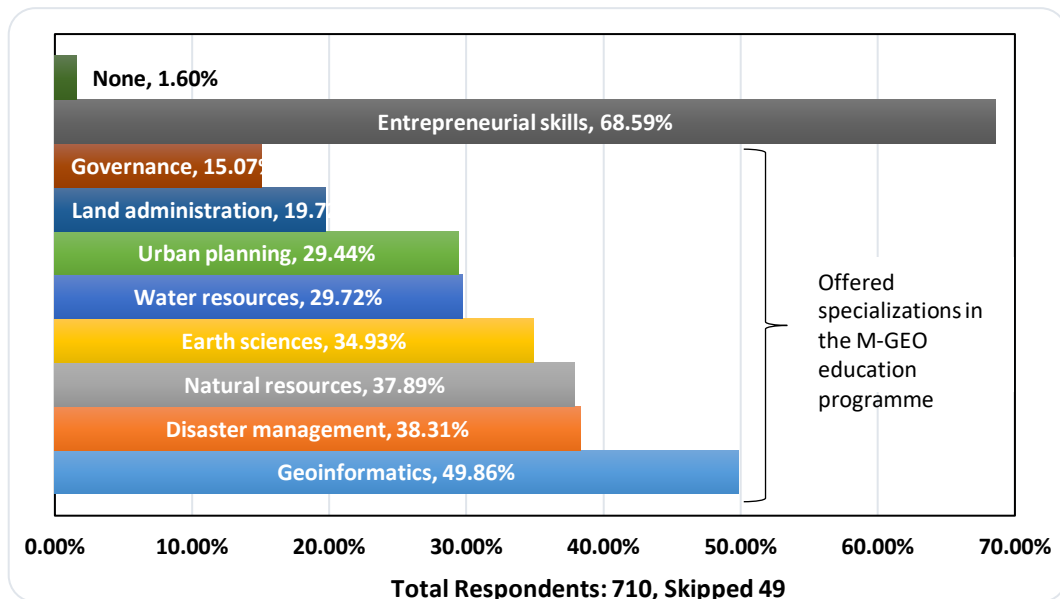
Figure 3: The result of analysing Q23 of the survey (Appendix 9.2) carried out in 2017.

Specific to this research, one open-end question (Q26) that received 431 answers, mounting to 10,508 words. I read the answers and performed a qualitative analysis. From the textual analysis of Q26, I could categorize the answers in four main classes, described in the list below:

1. *Content*:
    a.   Adding more practical exercises
    b.   Enhancing the teaching method
    c.   Adding new topics
    d.   Supervision quality of the end work
    e.   Duration and load of the programme
2. *Follow ups*:
    a.   Continuation of higher studies, i.e. PhD
    b.   Refresher courses
    c.   Alumni network
    d.   Scholarships
3. *Compliments and complaints*
4. *General/others*

The main focus of the textual analysis is on the class *Content* with its three sub-classes (1.a, 1.b and 1.c). The remaining classes are thought of being irrelevant to the subject matter of this research. From the textual analysis of the answers in the category *Content*, the followings were deducted:

-   Adding practical exercises concerned two main topics: practical exercises in the form of internship and exposure to industrial solutions of real-world problems.
-   Enhancing the teaching method included: online course content, using open source tools, allowing peer to peer and panel discussions, more time for self-reflection, project-based education, flexibility in tailoring specialization, more students centred education
-   The suggested new contents included project management skills, valorisation skills, (e.g. designing infographics or how to pitch), designing industrial solutions and recognizing business opportunities.

c. Survey 2014

Description: This periodic survey is similar to the one carried out in 2017 but targeted alumni graduated between 2007 and 2011, i.e. in the period when ITC was independent of the University of Twente. The survey is placed in Appendix A, section 9.3.

Objective: Probe the career perspective of ITC graduates and improve the education programme of M-GEO.

Targeted audience: ITC alumni and students from 2007-2011.

Design method: the framework of Salant and Dillman (1994), i.e. specification, coverage, sampling, response, and measurement and the techniques of Ross (2005) and de Leeuw et al., (2008).

Outcomes: 70 out of 71 respondents participated in the survey. Specific to this research is question 28 which is similar to Q26 of the 2017 survey. 37 responses (52%) were received (423 words), with three suggestions on including business elements in M-GEO education programme (~9%).

d. Survey 2013

Description: This survey was sent to 85 ITC alumni and students in 2013, studied at two departments in ITC (Earth Observation Science and Geoinformation Processing), with a question on how to improve the education programme of M-GEO with a rank from 1 to 10, using 10 as highest priority, and 1 as lowest.

Objective: How to improve the education programme of M-GEO.

Targeted audience: ITC alumni and students in 2013, specialized in one discipline.

Design method: One question survey.

Outcomes: 64 out of 85 (from which 80% are alumni) respondents participated in the survey. The participants were asked to rank six component that should be included in the M-GEO programme. The results of this survey are presented in Figure 4.
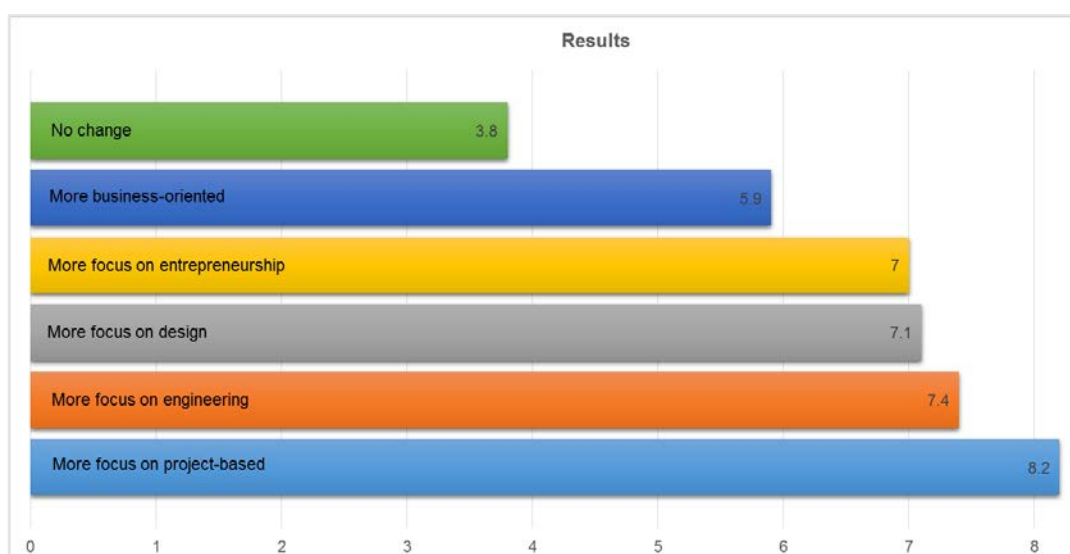

Figure 4: The result of analysing one-question survey carried out in 2013, 64 respondents.

4.2. Meetings

Hereafter, only the first meeting, in Table 2, will be discussed, the other meeting will be analysed in the evaluation section (6.1).

Objective: Define the components for an entrepreneurship education for ITC.

Attendees: NIKOS, ITC Staff.

Outcome: NIKOS has argued that working on a real business-case is one of the most effective ways to learn about entrepreneurship. ITC argued that entrepreneurship mind-set is the one that should be nurtured with focus on valorisation of research. The main conclusions of this lengthy meeting are summarized hereafter. The majority of M-GEO students are from developing countries where the private sector is still underdeveloped. In some countries, e.g. Rwanda, private sector is still considered equivalent to poverty and the society has developed a risk-avoiding attitude. This means that the psychology of risk management (Trimpop, 1994) needs to be developed to create the fertile soil that new enterprises require. The positive side of this observation is that risk management differs per culture and country. For example, private sector activities in East Africa are mostly executed by Kenyans, as well as a few Ugandan companies. The course for M-GEO should thus utilize this cultural difference, e.g. through internationalization, and target the role that entrepreneurship education can have in sustainable development in general.

4.3. Merging

The results of the surveys clearly indicate that there is a need to include elements of entrepreneurship into M-GEO curriculum. This need originates from the intrinsic desire of M-GEO students and alumni to be more employable and involved in creating socioeconomic revenues for their communities. The discussions during the meeting with NIKOS, made it clear that the course should focus on nurturing entrepreneurship mind-set and targeting the role that entrepreneurship education can have in sustainable development. The results from the surveys and the meeting can be summarized as follows:

- Through the years, more M-GEO alumni are working with the private sector. The last survey, in 2017, showed that 20% of M-GEO alumni are working in the private sector with 6% having their own business and 62% of the students (participants that were studying at ITC) are considering starting up a new business in geospatial domain.
- There is a shift in the interest of ITC graduates towards the necessity of mastering entrepreneurial skills in the M-GEO programme, which has increased from 9% in the survey of 2014 to 68.6% in the survey of 2017.
- The majority of participants requested adding entrepreneurial mindset skills – like communication with stakeholders, valorisation, recognizing opportunities – to the M-GEO programme.
- The majority of participants considered entrepreneurial mind-set as being essential and it will help them contributing to the socioeconomic developments in their countries.
- Teaching method of entrepreneurial mind-set should make use of online course content, using open source tools, allowing peer to peer and panel discussions, more time for self-reflection, project-based education, flexible and student- centred.

5. Define & design

5.1. Define

Data analysis of section (4) identified the main ingredients for the course design. I used the design thinking approach of Val et al., (2017) to define the course which also includes attitudinal and behavioural skills that are required for entrepreneurship education (Karatko and Morris, 2018):

a)- Cognitive / behavioural skills: understand and apply entrepreneurship concepts of opportunity identification, assessing business ideas, project management, business development, and strategy growth.

b)- Non-cognitive / attitudinal skills: creativity, self-reliance, lateral thinking, and translating ideas into action.

This is depicted in Figure 5. It is anticipated that targeting these attitudinal and behavioural skills in the course will stimulate lifelong learning and ultimately establish a knowledge-based society promoting thereby sustainable developments.
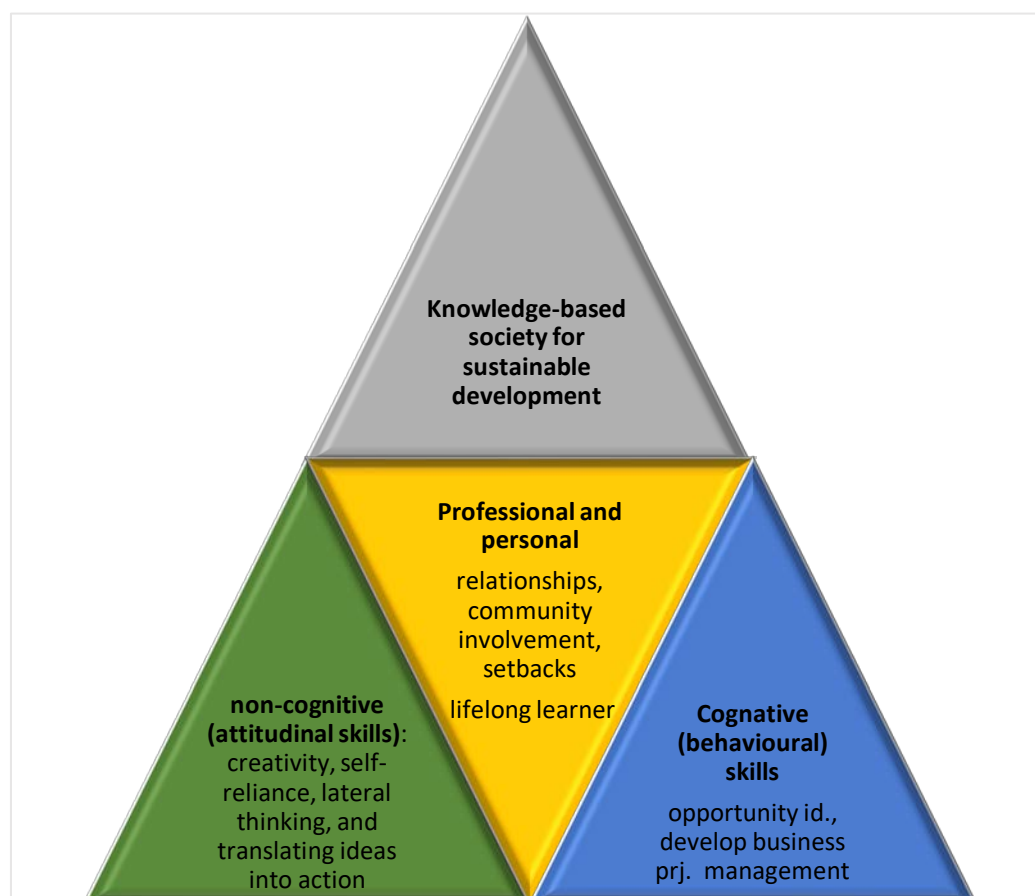
Figure 5: Schematic illustration of the proposed concept of entrepreneurial mind-set in M-GEO.

5.2.   First design

The course was then designed by integrating students' requirements, obtained from data analysis, and the defined skills in Figure 5, using the double diamond model (Design Council 2007). The double diamond model was update for this study as shown in Figure 6.

The first stage of the diamond (define strategy) was carried out (Figure 6), whereby the needs for an entrepreneurship course were analysed (in sections 4) and the main ingredients of the course were defined (in Figure 5). From this phase, the first design of the course was executed. The design followed the constructive alignment method of Biggs, (2003) which included three major steps:

1. Define the intended learning outcomes (ILOs);
2. Choose teaching/learning activities likely to lead to the ILOs;
3. Align the assessments with the intended learning outcomes.

The first design of the course is presented in Table 3. This first setup of the course was focused on two disciplines in ITC, namely water and agriculture specializations with an additional component on internationalization. To move from declarative knowledge to functioning knowledge (Biggs and Tang 2011) the teaching/learning activities were defined to be of five categories: (a) four frontal teaching lectures; (b) online tutorials, (c) two progress meetings; (d) projects realized by groups of students and (e) poster presentation of the final project. In this setup the students would move steadily from passive (building the declarative knowledge) to active learning (put that knowledge to work and make it function). The assessment was also aligned with the learning outcomes, not shown here to avoid repetition, but it is similar to those presented for the 2^{ed} redesign in Table 5 and Table 6.

Figure 6: Adapted Double Diamond Model to design the course.

Table 3: First design of the course Entrepreneurship for M-GEO.

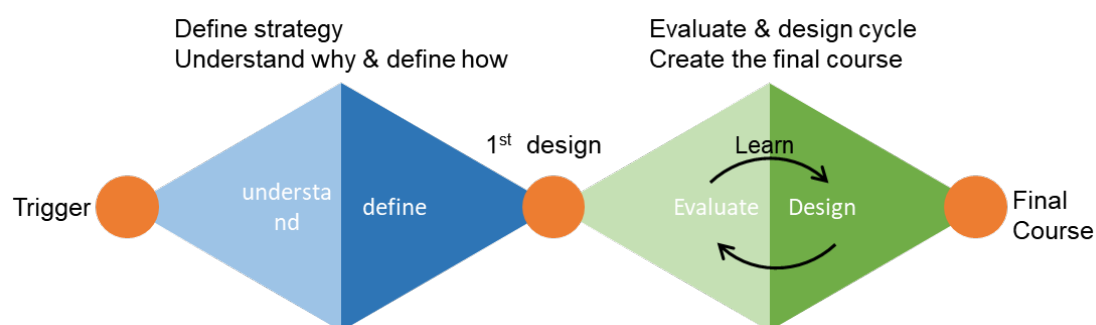| 1.	Year	year 2
2.	**Quartile**	Q6
3.	**Course type**	Common / Elective
4.	**Course title**	Entrepreneurship and internationalization for the sustainable development of water and agriculture
5.	**Credits (ECTS)**	5
6.	**Coordinator**	Suhyb Salama (WRS)
7.	**Examiner**	Suhyb Salama
8.	**Other staff**	Rolf Deby (GIP), Rogier van der Velde (WRS)
9.	**Introduction (summary)**	This course will prepare the students to become enterprising individuals who have the attitudes, skills and know-how necessary for providing value-adding solutions overarching political and cultural differences.
10.	**Learning outcomes**	Upon completing this course, the students are able to: 1- understand and apply the concepts of entrepreneurship and internationalization; 2- identify water or agriculture related problems in a specific region. 3- analyse and integrate different sources of (geo)information needed to address the problems in (2); 4- create and/or evaluate solutions that have economical value, societal & environmental relevance using entrepreneurial and internationalization skills; 5- work with a multinational group and present the outcomes to the public defines.
11.	**Content**	The objective of this course is to equip the students with entrepreneurial and internationalisation skills and coach them to apply these skills to address water and/or agricultural problems using geoinformation science. Entrepreneurship is defined within the context of course as the students' ability to turn geoinformation science into value adding applications with societal & environmental relevance. It includes creativity, innovation and risk taking, as well as the ability to plan and manage projects in order to address wicked problems. Internationalization in the context of this course is the ability to provide geoinformation-based solutions that benefit different nationalities overarching political and cultural differences, e.g. transboundary water issues. This also include the student skills to operate professionally in a multi-cultural environment, act adequately on cultural differences and express her/himself adequately to colleagues of different nationalities. The course is structured as follows: (a) four frontal teaching lectures; (b) online tutorials, (c) two progress meetings; (d) projects realized by groups of students and (e) poster presentation of the final project. A. Face-to-Face Lectures The course starts with an introductory lecture whereby the learning objectives and assessment method are highlighted to the students. In the second lecture, nr.2, we will explain the concepts of entrepreneurship and internationalization and how they are employed in the field of geoinformation for water and agricultural management. Subsequently, in lecture nr.3 different case studies will be presented that facilitate the

definition of the project. In lecture nr.4 the requirements and expected outputs of the project will be presented and student groups will be identified with their case studies.

B.   Online tutorials and research

Few online materials "named tutorials" are provided to the participants through which, in addition to own research initiatives, they will be coached to enhance their competencies in the subject area and derive questions guiding their learning process. Each group will autonomously be working on: (i) problem definition; (ii) data retrieval and method selection; (iii) designing integrated solutions; (iv) analysing and discussing the results; and (v) communicating the findings to the broader audience.

C. Progress meeting

Two progress meetings are foreseen to monitor and stimulate the progress of the students. The student groups will be presenting their progress, identifying the challenges and possible solutions. The students will have the opportunity to comments on each other's works and ask questions to the scientific consultants.

D.   The Project

The scope of each of the designed projects should covers the two subjects of entrepreneurship and internationalization as key components in developing a sustainable solution for water and agriculture resources using geoinformation.

E.   Poster presentation

A poster will be designed whereby the project's objective, data, method, results and discussion are presented in a scientific and clear manner.

12. Key words	Entrepreneurship, internationalization, water, agricultural, geoinformation
13. Teaching and learning approach	This course integrates blended learning with project-based teaching approach. Blended learning combines face-to-face lectures with tutorials. Tutorials are self-learning online materials that stimulates learning by doing with some limited coaching. The students will work, hereafter, in multinational groups (consisting of 3-4 persons) on a project and present their results in a "simulated" public hearing setup.

14. Allocated time per teaching and learning method (*hours*)	Lecture	*8 hours*
	Supervised practical	*0 hours*
	Tutorial	*16 hours*
	Study trip	*8 hours*
	Written/oral test	*8 hours*
	Individual assignment	*0 hours*
	Group assignment	*60 hours*
	Self-study	*40 hours*
	*Total (= #ECTS*28 hrs)*	*140 hours*

15. Tests	Project presented as a poster
16. Test Plan	Similar to Table 5, but based on assessment of the project presented as a poster
17. Compulsory Textbook(s)	There is no compulsory text book since this course is largely based on the students' initiative to gather the needed references for their projects.

18. Other study material	- Some relevant papers and handouts will be distributed before the lectures.	
19. Entry requirements	Affinity with the use of geoinformation science	
20. Organization and Planning	Since the frontal teaching is minimal a "practical" room is requested	
21. Link between the learning outcomes of the course and of the programme	Similar to Table 6	

6. Evaluate & design cycle

The 1st design (Table 3) was then fed to the second diamond (Figure 6: evaluate & design cycle) which consists of: two iterations: evaluate-2^{ed} design and evaluate-3rd design.

For the evaluation I used two recognised sources of assessment (Fry et al., 2009): i-) feedback from teaching colleagues and professional peers; and ii-) self-generated feedback, i.e. self-reflection.

Within the timespan of this project, feedback from students (which form the third source of evaluation in Fry et al, 2009) was only possible to establish the need for a course on entrepreneurship (presented in section 4). Peer's evaluation was based on three groups:

- UT group carried out by the Netherlands Institute for Knowledgeintensive Entrepreneurship (NIKOS). Critical appraisal of NIKOS serves as scholastic review of the designed course and its prototype.

- ITC group carried out by colleagues working at ITC. This review measures whether the designed course and its prototype are fit to M-GEO students.

- Independent group specialized in entrepreneurship education, carried out by anonymous reviewers from the scientific committee of the European Council for Small Business and Entrepreneurship (ECSB) conference on Entrepreneurship Education. This review measures the degree of maturity of this research.

Reflection, on the other hand, involves consideration of the design-prototype experience as to enhance understanding and inform the redesign. I will use the recommendations of Fry et al., (2009) for enhancing the credentials of self-reflection. Self-reflection will be discussed in section 7.

6.1. First Iteration

6.1.1. Evaluation

The first design in Table 3 was evaluated by NIKOS during the meeting (see Table 2) on the 5th of Jun 2018. Joost Brinkman from NIKOS argued that internationalisation could be removed in favour of focusing the course on entrepreneurial mind-set. In addition, the use of online content should be encouraged, in particular the Massive Online Open Course (MOOC, Downes 2011) of the UT-NIKOS. This MOOC offers excellent opportunity to address different types of learners, regardless of their background and thus could be used by M-GEO students from all specializations. In addition, the assessment should be richer with different tests. Finally, we agreed that the course should be distributed over two quartiles to allow M-GEO students to digest the new materials and to offer more time for group interactions.

6.1.2. Second design

According to the evaluation in section 6.1.1 the course was redesigned with more focus on entrepreneurship as shown in Table 4, the changes are highlighted. The assessment plan and how it is aligned with learning outcomes of the M-GO programme are presented in Table 5 and Table 6, respectively.

Table 4: Second design of the course Entrepreneurship for M-GEO.

1.	Year	year 2
2.	Quartile	Q6 – Q8
3.	Course type	Elective
4.	Course title	Entrepreneurship: a Bridge Towards Geospatial Innovation
5.	Credits (ECTS)	5
6.	Coordinator	Suhyb Salama (WRS)
7.	Examiner	Joost Brinkman (BMS), Valentijn Venus (NRS), Suhyb Salama
8.	Other staff	Joost Brinkman, Valentijn Venus (NRS), Yola Geogiadou (PGM), Rolf de By (GIP)
9.	Introduction (summary)	The objective of this course ~~will prepare~~is to equip the students ~~to become enterprising individuals who have the attitudes,~~with entrepreneurial skills ~~and know-how necessary for providing value-adding~~enabling them thereby to seamlessly combine disciplines in order to design solutions ~~overarching~~that have economical, environmental and societal values. Hence, the focus of this course lies on creating an entrepreneurial mind-set to (i) identify and developed business cases from geoinformation science that have economical, societal & environmental values , and (ii) create and evaluate transdisciplinary solutions fostering stakeholder-partnerships that overarches political and cultural differences.
10.	Learning outcomes	Upon completing this course the students are able to: 1- ~~understand~~ Present and apply ~~the concepts of~~ entrepreneurship concepts and ~~internationalization;~~mechanisms; 2- ~~identify water&/or agriculture related problems in a specific region.~~ 3- ~~analyse and integrate different sources of (geo)information needed to address the problems in (2);~~ 4- ~~create and/or evaluate~~ Valorise geoinformation-based solutions ~~that have~~: international, economical ~~value,~~, environment and societal ~~& environmental relevance using entrepreneurial and internationalization skills;~~ values; 5- ~~work with a multinational group and~~ 3- Identify and develop business opportunities from geoinformation science; 4- Create and/or evaluate solutions fostering stakeholder-partnerships that overarches political and cultural differences; 5- Self-reflect on the learning process supported with evidence; 6- Present the outcomes in a simulated public hearing with an international character.
11.	Content	~~The objective of~~ This course ~~is to equip~~will prepare the M-GEO students ~~with entrepreneurial and internationalization~~to become enterprising individuals who have ability, attitudes, skills and ~~coach them to apply these skills to address water and/or agricultural problems using geoinformation science~~know-how necessary for providing a transdisciplinary solutions that overarch political and cultural differences. ~~Entrepreneurship is defined within the context of course as the students' ability to turn geoinformation science into value adding applications with societal & environmental relevance. It includes creativity, innovation and risk taking, as well as the ability to plan and manage projects in order to address wicked problems.~~

The course is structured as follows: (a) basic theory (frontal teaching) ; (b) advanced concepts (flipped classroom), (c) projects to be realized by groups of students, (d) progress meetings (e) poster presentation of projects and (f) Self-reflection report.

A. Basic theory

The course starts with frontal lectures consisting of traditional and guest lectures.

A.1 Traditional lectures

i-) Innovation & Entrepreneurship Theory (Inn&Ent):

Next to the innovative entrepreneurial process, we will discuss how innovation can be managed in large firms and show you how you can contribute to their innovation processes. The main aim of the Inn&Ent component is that you learn how to develop a business model. To this end, we introduce the idea of the Lean start-up approach using the Lean Can and discuss each of the elements of the Lean Canvas starting from the general environment in which a company will be operating and ending with the topic of finance.

ii-) Internationalization ~~in the context of this course~~ & Valorisation (InterVal):

We will explain the concept of internationalization from an entrepreneurial view point which is ~~the ability to provide~~providing geoinformation-based solutions that benefit different nationalities overarching political and cultural differences , e.g. transboundary water issues. ~~This also include the student skills to operate professionally in a multi-cultural environment, act adequately on cultural differences and express her/himself adequately to colleagues of different nationalities.~~Valorisation concepts and techniques will be explained and illustrated by making scientific knowledge suitable and available for economic and societal utilisation.

~~The course is structured as follows: (a) four frontal teaching lectures; (b) online tutorials, (c) two progress meetings; (d) projects realized by groups of students and (e) poster presentation of the final project.~~

~~A.   Face-to-Face Lectures~~
~~The course starts with an introductory lecture whereby the learning objectives and assessment method are highlighted to the students. In the second lecture, nr.2, we will explain the concepts of entrepreneurship and internationalization and how they are employed in the field of geoinformation for water and agricultural management. Subsequently, in lecture nr.3 different study cases will be presented that facilitate the definition of the project. In lecture nr.4 the requirements and expected outputs of the project will be presented and students group will be identified with their study cases.~~

~~B.   Online tutorials and research~~
A.2. Guest lectures
A series of guest lectures will be organized from UTwente alumni who have started up a successful business.

B. Advanced concepts: flipped class room

Few online martials ~~"named tutorials"~~ are provided to the participants through which ~~, in addition to own research initiatives,~~ they will ~~be coached to~~ enhance their competencies in ~~the subject area and~~ a specific topic related the selected project (case study), the aim is to derive questions guiding ~~their~~students' learning process during the project phase in C.

C. Project

	. ~~Each group~~In this project you get to improve your professional and academic entrepreneurial and valorisation skills by working a real-life entrepreneurial problem based on geoinformation science. This requires that you use multiple theories and tools from entrepreneurship in an integrated fashion.
	Four elective projects (study cases) are presented to students, whereby groups of students will be formed to realize the selected projects:
	1. Business model based on an opportunity;
	2. Opportunities and threats of solutions that foster stakeholder-partnerships and overarch political and cultural differences;
	3. Proof-of-concept;
	4. Valorise geoinformation-based solutions: Geo journalism, branding and augmenting the societal impact;
	In each project, the students will autonomously be working on: (i) problem definition; (ii) data retrieval and method selection; (iii) designing integrated solutions; (iv) ~~analyzing~~analysing and discussing the results; and (v) communicating the findings to the broader audience~~.~~; (vi) applying the theory learned
	~~C~~The design cycle is an iterative process. This means that throughout the project you will improve each design step by going back and forth between steps until a satisfactory result is achieved, and checked by a potential client. This means design iterations and rework are a natural part of this design cycle, all with the sole goal of improving your final project results.
	D. Progress ~~meeting~~meetings
	~~Two~~ Progress meetings are foreseen to monitor and stimulate the progress of the students. The student groups will be presenting their progress, identifying the challenges and possible solutions. The students will have the opportunity to comments on each other's works and ask questions to the scientific consultants.
	~~D. The Project~~
	~~The scope of each of the designed projects should covers the two subjects of entrepreneurship and internationalization as key components in developing a sustainable solutions for water and agriculture resources using geoinformation.~~
	E. Poster presentation
	A poster will be designed whereby the project's objective, data, method, results and discussion are presented in a scientific and clear manner.
	F. Self-reflection report
	A written self-reflection report (max 400 words) on the learning process within the context of the learning outcomes of the course and the contribution to the case studies supported with evidence (individual & mark)
12. Key words	Entrepreneurship, ~~internationalization, water, agricultural~~innovation, geoinformation
13. Teaching and learning approach	This course integrates blended learning with project-based teaching approach. Blended learning combines face-to-face lectures with flipped classroom via Tutorials. Tutorials are self-learning online materials that stimulates learning by doing with some limited coaching. The students will work, hereafter, in multinational groups (consisting of 3-4 persons) on a

		project and presentsubproject, combine their results and present in a "simulated" public hearing setup.	
14.	Allocated time per teaching and learning method (*hours*)	MOOC	*16 hours*
		Lecture	*814 hours*
		Supervised practical	*014 hours*
		Tutorial	*1610 hours*
		Study tripGuest lectures	*8 hours*
		Written/oral test	*80 hours*
		Individual assignment	*026 hours*
		Group assignment	*6026 hours*
		Self-study	*4026 hours*
		*Total (= #ECTS*28 hrs)*	*140 hours*
15.	Tests	The assessment will consist of 3 tests: • Test 1: Mooc assignment and tracking, need to finish the training (complete / fail) • Test 2: Theory 1 written test (and 1 resit); 30% of the final mark • Test 3: Project presented as a poster assignment (60% of the final mark): 1- Poster; 40% of the final mark 2- Presentation; 20% of the final mark • Test 4: self-reflection report 10% of the final mark	
16.	Test Plan	Similar toSee Table 5	
17.	Compulsory Textbook(s)	There is no compulsory text book since this course is largely based on the students' initiative to gather the needed references for their projects.	
18.	Other study material	Some relevant papers and handouts will be distributed before the lectures., however examples are provided hereafter: Books: Baringer & Ireland; Articles: e.g.: - Blank, S., 2013. Why the lean start-up changes everything. Harvard Business Review, 91, 64-68. - Investment methodology in Geo-information - Maine, E., Garnsey, E., 2006. Commercializing generic technology: The case of advanced materials ventures. Research Policy, 35, 375-393. - Maurya, A., 2012. Running Lean. O'Reilly, Sebastopol. - Moogk, D.R., 2012. Minimum Viable Product and the Importance of Experimentation in Technology Startups. Technology Innovation Management Review, March, 23-26. - Münch, J., Fagerholm, F., Johnson, B., Pirttilahti, J., Torkkel, J., Järvinen, J., 2013. Creating Minimum Viable Products in Academia-Industry Collaborations. Lean Enterprise Software and Systems Conference, 167, 137-151.	
19.	Entry requirements	Affinity with the use of geoinformation science and entrepreneurship	
20.	Organization and Planning	Since the frontal teaching is minimal a "practical" room is requested to carry out group assignments.	
21.	Link between the learning outcomes of the course and of the programme	Similar toSee Table 6	

Table 5: Assessment plan and alignment matrix.

Learning outcomes (LO) of the course:	MOOC	Written test	Poster	Presentation	Report
LO1	x				
LO2		x			
LO3			x		
LO4			x		
LO5					x
LO6				x	
Test type (descriptive)	**Assignment and tracking**	**Written test**	**poster**	**oral**	**repot**
Weight of the test (in %)		30%	40%	20%	10%
Individual or group test	individual	individual	individual/group	individual/group	
Paper based/oral/digital test (*if applicable*)	finish the training	paper-based	oral	oral	paper-based
Type of marking: 1-10 or completed/fail	completed/fail	0-10	0-10	0-10	0-10
Required minimum mark per test (*optional*)		5.5			
Number of test opportunities per academic year	1	2			

Table 6: Alignment of the course LOs with those of the M-GEO programme (see section 13).

Learning Outcomes	Domain/Academic				Scientific					Internationalization		General	
	1	2	3	4	5	6	7	8	9	10	11	12	13
LO 1	x												
LO 2		x											
LO 3			x	x	x								
LO 4						x	x		x				
LO 5								x			x	x	
LO 6													x

The main differences between the first (Table 3) and second (Table 4) design comply with the evaluation in section 6.1.1 and emphasis developing entrepreneurship skills and entrepreneurial mindset in the course. The changes in the new design can be grouped into three categories:

1- Learning outcomes: with more focus on entrepreneurship for all M-GEO specializations;
2- Teaching/learning activities: diversified teaching activities, adding MOOC, guest lecture and reflection report;
3- Assessment: diversified test opportunities with three additional tests (MOOC, written test and a reflection report).

6.2. Second iteration

6.2.1. Evaluation

a) Dr. van der Velde (Appendix B, section 10)

The new design was sent to Dr. van der Velde, assistant Professor at ITC, for peer evaluation. Dr. van der Velde provided a full-fledged evaluation report (section 10) on the 7th of February 2019. The evaluator assessed the course in Table 4 based on four criteria and found that:

- The course on entrepreneurship fits the mission of ITC and national policy on development cooperation in which entrepreneurship is recognized as vehicle towards environmental, social, and economic growth in develop countries.

- The learning outcomes of the course have a wide coverage, covering 12 out of the 13 LOs of the M-GEO programme (see Table 6). Dr. van der Velde raised the concern that this wide coverage can indicate that the course is out of focus.

- Regarding the content, the assessor has the following comments:

  o recognizing opportunities' and 'risk management' are missing from the entrepreneurial skills needed for M-GEO students, also trans- discipline is mentioned but does not fit nor it is explained.

  o the poster presentation and reflection report are part of the assessment and should not be included as content.

  o learning by doing should be emphasized on the cost of reducing frontal teaching. The assessor suggested a project-based learning approach for the course and to better explain the roles of the MOOC and tutorials.

  o identifying the Bloom's levels of the course and make sure that they do not differ too much among the LOs.

- Regarding the learning outcomes, the assessor has the following questions:

  o LO2: the assessor questioned the nature of valorising geoinformation, and whether or not geo-based solutions are too complex and restrictive;

  o LO3: the assessor questioned the benefit of providing education on starting up a new business;

  o LO4: the assessor found this LO to be vague and stressed the difficulties of dealing with different types of stakeholders and evaluating this LO;

  o For LO6 the assessor indicates that public hearings are meant to announce sensitive information of national importance.

- Regarding the assessment, the assessor questioned whether the test plan fit the LOs referring to UT policy of having weight of 60 % to individual test and 40 % for group work and

questioned the high weight of 40% for the poster. Further he advised to consider an oral test or a defense of a business proposal (instead of a written test) as they better reflect the competency on entrepreneurial mindset.

b) Mr. Venus (Appendix C, section 11)

The new design was sent to Mr. Venus, lecturer at ITC and founder of the RAMANI B.V. spin-off, for peer evaluation. Mr. Venus provided his feedback by email (section 11) on the 12th of February 2019. The evaluator assessed the course in Table 4 based on three criteria:

Learning outcomes and teaching activities: here the assessor raised the concern on how practical work and active learning activities are linking the assessment of course contents with the learning objectives. He gave an example of Millar's (2010) approach and suggested to follow it. In addition, the assessor found the focus of the LOs to be broad and ambitious. He suggested to focus on few aspects of entrepreneurship and entrepreneurial mindset. For example, transdisciplinary, stakeholder partnership and culture difference should be removed.

Fit to M-GEO students: the assessor is not convinced that the broad scope of the course is helpful for M-GEO students. A solution to that is to focus the course on entrepreneurial business model.

Fit to sustainable development (long term objective of this project): the assessor advised to start small and aim at consolidating entrepreneurial business models for M-GEO students.

c) Conference 3E (Appendix D, section 12)

On the 21st of January 2019 I received an anonymous peer-review on the abstract (section 12.2) submitted to the European Council for Small Business and Entrepreneurship (ECSB) conference (3E Conference). The received evaluation is provided in section 12.3.

The assessors acknowledged that teaching entrepreneurship to geospatial science students is relevant and serves the creation of sustainable solutions with social and environmental impact. The abstract sets an aim to identify characteristics of an optimal design for entrepreneurship education in the niche of geospatial science. The assessor commented that the current version of the abstract is still under the development phase and therefore is not delivering concrete results. The assessor questioned the analysis of the survey and its limitation to 2017 and 2018 graduates. The assessor finally recommends to better focus the results and contribution of the work for a future round.

6.2.2. Third design

From the evaluations presented in the section 6.2.1 I prepared few points to be considered in the new design. Following the constructive alignment of Briggs (2003) these points of consideration are grouped in to three categories: i-) Learning outcomes; ii-) teaching/learning activities; iii-) assessment:

Learning outcomes: the learning outcomes (LOs) are too broad and should be focused on stimulating entrepreneurial mindset and translated into an activity:

1. Understand entrepreneurship concepts and mechanisms;
2. Apply entrepreneurship concepts and mechanisms;
3. Recognize and develop business opportunities (including project and risk management) from geospatial science;
4. Present entrepreneurial business models to wider audience;
5. Self-reflect on the business model supported with evidence

Teaching/learning activities: the course is re-structured as follows: (a) basic theory (MOOC and frontal teaching, 16 + 16 hours); (b) advanced concepts (MOOC 8 hours), (c) projects to be realized and presented by groups of students (40 hours). Teaching activities are now more focused on gaining practical experience to help students improve their understanding of entrepreneurship and not simply to increase their factual knowledge. The Practical Activity Analysis Inventory (Millar 2010) is used to engage active learning activities which are aligned with the LOs, as:

A. [Teacher Objective] develop knowledge and understanding of entrepreneurship, MOOC, lectures and tutorial
B. [Teaching Activity] learn how to build business models and present as an entrepreneur, tutorial and practical
C. [Group Assignment] develop and present business opportunities, group assignment
D. [Learning Outcomes] self-reflection, individual reflection on the learning outcomes.

Assessment: The assessment of the 3rd design consists of three tests: MOOC project, and reflection. The written exam is canceled with more weight to the project. We could not find a clear policy on the weight of individual and group assignment, so we keep the weight as 40% to 60% respectively.

The constructive alignment between LOs, teaching activities and assessment are presented in Table 7. The new learning outcomes of the 3rd design cover only three (6, 7 and 8) LOs of the M-GEO programme (Appendix E, section 13). With the new (3rd) design, the course is more focused on entrepreneurship, constructively aligned and follows the learning-by-doing approach.

Table 7: Alignment between LOs, teaching activities and assessment of the 3rd design.

	I designed educational activities for the students to:			
Category of teaching activities	**A**: Develop knowledge and understanding of entrepreneurship	**B**: Learn how to build business models and present as an entrepreneur	**C**: Develop and present business opportunities	**D**: Self-reflect on their own learning process
LOs	1	2,4	3,4	5
Bloom's Taxonomy	Understand,	Apply	Evaluate and create	Evaluate
Approach	MOOC, frontal teaching	Tutorial, exercises and practical	Group work on the project	Individual assignment
Assessment	Formative Complete the MOOC	Summative 20% Group assignment & presentation	Summative 40% Group assignment poster (LOs 4 is not assessed here)	Summative 40% Self-reflection repot

The project in the 3rd design includes three parts:

- **Developing phase**, apply entrepreneurship concepts and mechanisms to recognize and develop business opportunities.
- **Reporting**, provide a poster summarizing the main features of the developed business model.
- **Presenting**, present the project as entrepreneur.

The reflection report in the 3rd design includes:

- **Process**, reflect on the process which led to choosing the business idea and developing the canvas model with discussion of faced challenges
- **Sources**, discuss the learning activities and which one has contributed to better understanding and achieving the learning outcomes. Discuss the sources for the market study, strategy of growth and presentation skills.
- **Opinion**, express your opinion on the above components and provide supports.
- **Conclusion**, write 1-2 sentences in which you reflect on the overall course

The test rubric of the whole course is provided in Table 8.

From Table 7 and Table 8 the **validity** of the assessment is ensured as it measures students' achievement of the intended learning outcomes. The assessment is also diversified to avoid compromising the validity. For example, I removed the written exam and focused on the project, as suggested by Dr. van der Velde (section 10.2), to enhance the assessment of how well the students have developed entrepreneurial mind set. Here I recognize the difficulty in testing "mindset", but the alignment of teaching activities with learning outcomes and assessment and its test rubric (Table 7 and Table 8) will ensure evaluating cognitive (behavioural) and non-cognitive (attitudinal) skills (Karatko and Morris, 2018). The self-reflection shall make students think about the processes underlying the results they got. The rubric in Table 8 provides **reliable** (fair and consistent) assessment of the intended LOs and it will be shared with the students to assure the **transparency**. The reduced number of tests (one formative and two summative) will improve the **manageability** and reduce the risk of surface-learning mode, i.e. learning things rapidly just for the exam or assignment as suggested by Dolmans et al., (2016).

Table 8: Test rubric of the course.

		fail	6-6.4	7-7.4	7.5-8.4	9-10
Project	Developing phase	The business idea is unrealistic and/or wrong The market does not exist Entrepreneurship skills were not correctly applied resulting in incorrect business model	The business idea is acceptable but may not be sustainable The market (number of clients) serves at least 3 clients Entrepreneurship skills were correctly applied Business model is developed in a correct manner	The business idea is realistic The market (number of clients) serves at least 5 clients Business model is good Strategy of growth was discussed The results are validated or at least an attempt is made to provide evidence of validity Risk mitigation and project management plans were discussed	The business idea is creative The market (number of clients) is wide serving at least 10 clients Business model is realistic Strategy of growth was discussed Business model has the potential to be scalable to wider market The results are validated or at least an attempt is made to provide evidence of validity Risk mitigation and project management plans were fully developed	The business idea is creative and innovative The market (number of clients) is wide serving entire community/region/country Business model is realistic with high potentiality for successes as start up Business model is scalable to other community/region/country Combination of data sources was made for the strategy of growth The results are validated or at least an attempt is made to provide evidence of validity Risk mitigation and project management plans were fully developed
	Reporting	The poster is not understandable. Figures are wrong/copied without referencing + captions are messing There are many typos.	The poster is difficult to follow and understand. Figures are not well organized and copied from other sources with referencing Some captions are messing	The poster is easy to follow and understand. Figures + captions need slight improvement to be meaningful and understandable.	The poster is easy to follow and understand. Figures + captions are meaningful and understandable Creative graphic techniques are used to enhance the understanding	The poster is easy to follow and understand. Figures + captions are meaningful and understandable. Creative graphic and branding techniques are used to enhance the understanding The poster can be used to be presented in a conference or to investors

Presentation	The presentation skills and answering of questions are unacceptable. Wrong answers were provided.	The presentation skills and answering of questions are acceptable. The presentation is scientific.	The presentation skills and answering of questions are good. The presentation is still related to the scientific idea used to develop the business model	The presentation skills and answering of questions are very good. Some practice is still needed before pitching for investors	The presentation skills and answering of questions are excellent and reflects lateral thinking. The presentation is can be used to pitch for investors
Reflection	No self-reflection is provided/ or the reflection report is unauthentic without evidences and many grammar and editing error	Self-reflection on the learning process The report is with grammar and editing error	Self-reflection on the learning process Evidence is there but incomplete The report is acceptable regarding grammar or editing errors	Critical self-reflection on the learning process Easy to follow and understand report Evidence was provided from existing literatures or own experience Authentic report with some grammar or editing error	Critical self-reflection on the learning process Very easy to follow and understand, with scaffolding approach being used Evidence was provided from existing literatures or own experience Authentic report with minimal grammar or editing error

7. Reflection

The contemplation provided hereafter addresses three main components: i-) **Description**: reflection on the SUTQ idea and short/long term objective; ii-) **Analysis**: reflection on collected data and their analysis; iii-) **Outcome**: reflection on the end-product of this work and the learning process. Finally, I close the section and this report with a short conclusion.

7.1. Description

The strategic vision "ITC 2020: More space for global development" states that ITC will continue to interact closely with its alumni as preferred partner in capacity development activities, and that Entrepreneurship and innovation will be specifically targeted in its new capacity development activities and education programs. In the section on capacity development, it further states that in order "*to develop our entrepreneurial core value we intend to actively engage with the private sector and take on the role of gateway organization*" and that "*we will actively explore the possibility of contributing to local and regional (small and medium) business development*". Including entrepreneurship in M-GEO is, therefore, a natural evolution of ITC strategy and reflects the growing tendency of ITC graduates in becoming active in the private sector and as business owners.

In addition to these two factors, of ITC strategy and graduates' tendency to become entrepreneurs, I have a personal interest stemmed from my own experience when I lived in Syria. In the 80's Syria was under economic embargo from almost all Western countries. The main damage was collateral, but one thing the government did, was to impose self-sufficiency policy. The concept is simple yet innovative, in particular for less developed countries. It was an attempt to marginalize the import and rely on local resources to achieve goods and food security. The slogan was*: eat what you cultivate & dress what you fabricate.*

In the 90s the concept of self-sufficiency was in full swing and resulted in developing the private sector. However, looking back at these days and analysing the current situation, I can conclude that the current Syrian crises has been, in-part, initiated by poor design and implementation of the self-sufficiency concept (Karimi and Shafaee, 2018). When I started with this trajectory, I wanted to investigate this aspect, of sustainable self-sufficiency. After deeper investigation I came to the conclusion that entrepreneurship is not only a key driver of economic growth, but it can also serve as a pathway to self-sufficiency (Barr, 2015, Edmiston 2008). Now there is a difference between conventional entrepreneurial — which is concerned about achieving economical goals — and sustainable entrepreneurship — which strikes a balance between economic-social and environment profits. For example, Cohen and Winn (2007) proved that conventional entrepreneurial contributed to environmental pollutions and called for a sustainable entrepreneurship model. Recently, Dhahria and Omri (2018) showed that although conventional entrepreneurial, in less developed countries, positively contributes to the economic and social dimensions, it has negatively contributed to the environmental dimension. The solution to this, is proper education on sustainable entrepreneurship as recently advocated (Fichter and Tiemann 2018, Hesselbarth and Schaltegger 2014). That is why my short-term goal, the objective of this work, was focused on identifying the ingredients of entrepreneurship education necessary for sustainable development. Now answering the question of: *does entrepreneurship contribute to sustainable dedevelopment?* lies outside the reach of this research and I've placed it as the long-term goal of incorporating entrepreneurship in M-GEO. One of the reviewer (section 11), however raised his doubt about answering this long-term question at all "*Oef, these are very ambitious statements: so, keep dreaming*". Since this statement, from the reviewer, criticises the core idea of this research, I investigated the literatures for evidences. I found an interesting MSc work at Aalto University, Helsinki, for which Moshina (2015) carried out a systematic literature review to answer the specific question: "*does entrepreneurship contribute to sustainable development?*". In

Table 9 (page 39-40), Moshina (2015) reviewed 27 articles from 1999-2015 and found that 23 articles (82%) supported the positive answer to this question. To conclude, piling evidences from literatures are supporting the long-term goal of this work.

7.2. Analysis

For this research I used available surveys that were designed and carried out by the education team of ITC. Yet one thing that I have learnt in this trajectory, is that survey has an inherent component of measurement error (Lietz et al., 2017). I recognize how difficult it is to avoid measurement errors, particularly in the alumni surveys of ITC. These surveys were general (not designed to investigate entrepreneurship education), long (few questions were relevant) and cross-national (different cultural backgrounds). Long surveys often lead to larger errors as respondents might not give their best performance in answering. On the other hand, short surveys (due to the limited number of relevant questions) have the risk of being biased (Sjoberg 2007). In addition, most of the answers were textual, which involved my own "biased" sentimental appreciation of students' opinions. I did not take these measurement errors and biases into consideration as they are difficult to be quantified, see for example Schnepf (2018).

Quantitative analysis of the alumni surveys showed that there is an increased tendency of M-GEO graduates to become entrepreneurs. My findings are consistent with the observation from Global Entrepreneurship Monitor (GEM) which reported that the rates of entrepreneurial activity in developing countries are higher compared to those in developed ones (Vivarelli, 2013). The qualitative analysis of the textual data, however, involved my own understanding of students' opinions. To minimize the bias that could be introduced by the interpretation of one person, I compared my own categorization of the answers with those produced by the ITC Education Officer. Although there were some discrepancies, the questions related to students' suggestions on how to improve the M-GEO programme were very easy to distil by both analyses (the one carried out by ITC and myself). In addition, and since entrepreneurial skills are not part of the current M-GEO programme, I am confident that the qualitative analysis of these surveys is trustworthy and reproducible.

One thing that I was not aware of, is the student desire to learn by themselves. This was apparent from the surveys, whereby the students stressed their desire to have more eLearning (or online resources) of the M-GEO programme. The challenge stays in engaging active learning of the students through online resources, this will be discussed further in following sections.

7.3. Outcomes
7.3.1. The course

The proposed course has passed through three stages of (re)design and (re)evaluation. In the design phases I tried to use the design thinking approach of Buchanan (1992). I think that the students will benefit from the application of design thinking when moving through a creative process of problem solving, or when looking for new opportunities and challenges (see for example, Val et al., 2017).

The evaluations were all performed using feedbacks from four different sources: i-) experts in entrepreneurship education for business innovation, ii-) peer with geospatial-educational experience, iii-) peer with entrepreneurial experience in the geospatial field, iv-) anonymous reviewer experts in entrepreneurship education for non-business students. The current course, although have the same objective as my initial thoughts, it focuses more on entrepreneurial skills through learning by doing. It challenges the students to develop entrepreneurial skills of multi-actor, multi-purpose, multi-level and multi-disciplinary nature of geospatial innovations. The

students learn to unravel and deal with the complexity and large variation of entrepreneurships as applied to the many geospatial disciplines. This is achieved through diversifying the teaching/learning activities: face-to face lectures, MOOC, groupwork, discussions and self-reflection, with the ultimate aim of engaging students' active learning.

The reason behind the MOOC is to address different types of students, regardless of their background, status, resources, time, or location. The MOOC will also address competences specific to the main objective of this course. For example, Welsh and Dragusin (2013) argued that MOOCs are capable of nurturing entrepreneurship mind-set as they address specific competences of creativity, self-reliance, lateral thinking, and identifying opportunities. Romero and Usart (2013), have integrated serious gaming (Ritterfeld et al., 2009) into a MOOCs to engage active learning. For this specific feature of engaging students' active learning, I did not use serious gaming but rather focused on groupwork. To justify that groupwork will engage active learning, I carried out two discussion-sessions with 17 students from the Geoinformatics specializations of the M-GEO programme on the 14th of February 2019. In each session the students would first attend a keynote lecture on a subject outside their specialization and after that they would gather under my supervision (as I am specialized in the topic of the lecture) to answer few questions posed during the lecture.

During each discussion session, I asked the students to form four groups whereby each group should answer one question. Then I formed two clusters from these groups, and I sked the groups, in each cluster, to peer-review each other, summarize and present their findings to the other cluster. The first intra-group discussion round was very interactive, and each student actively participated in the discussion of his/her group. The second inter-groups round of peer-review, each group would choose one spokesperson and those two spokespersons carried out most of the discussions. In the third round of panel presentation, there was little interaction between the clusters.

From this I could observe that intra-group discussion was the most efficient one. In this setup the group members engaged in active learning: researched online materials, exchanged thoughts and consolidated their findings. This was followed by the inter-group discussions, which were also lively, but each group would insist on its findings. I asked the students the question of which setup was more efficient and why? My interpretation is as follows:

> The groups were formed by the students themselves, so presumably they teamed up with the ones that they felt comfortable with. The size of each group was about 4 persons which allowed more interactions among them. The students researched online recourse drew conclusion and reflected on each other's thoughts and ideas and consolidated their answers. At the end of each session the students were able to present their answers to questions outside their specialization in a profound and skilful manner. This is precisely what active learning is all about (see Allen and Tanner 2005). This small experiment, together with advice from Dr. van der Velde (to put more weights on the project) and Mr. Venus (to align teaching activities), has consolidated my initial throughs to focus on stimulating active learning through groupwork. The reflection report, although it is an assessment item, is an essential part of the learning process, as it shall help the students to develop a habit of careerlong learning (Beavers, 2009), one of the long term objective of this course (Figure 5).

The assessments of the learning achievements from the course are perfectly aligned with the teaching activities and the LOs. Three tests are suggested and have been checked for reliability, validity, transparency and are manageable. However, as most students will move in an unpredictable way from their previous mind-state of being geospatial scientise/engineer towards being entrepreneur it will be difficult to measure the effectiveness between intended and actual learning in the short-term of this project. On the long-term, I can use students' evaluation of the course and future alumni surveys to assess the effectiveness of the course and probably to retune it. The course is now part of the study guide and planned as an elective course for November

2019. The choice of offering the entrepreneurship course as an elective serves two purposes: i-) it will not interfere with the main learning outcomes of the M-GEO programme (Appendix 13); ii-) it will form a test-bed to incorporate entrepreneurship as a compulsory course, i.e. become part of the learning outcomes of M-GEO for the future accreditation.

7.3.2. Learning Process

Here I reflect on what I have learnt in the course of this research and how it has transformed my views and practices to education.

As OLD

Once I was attending a meeting at ITC with objective to review the core course of M-GEO programme. One of the presenters argued that using ILWIS, an in-house software to process geospatial data, would be desired. I asked him whether this desirability means that it enhances the learning of the students, and the answer was yes. Before following this SUTQ trajectory, most likely, I would stop the debate. But after following this trajectory things become clearer to me. I continued, therefore, with argument that for me as Education Director to accept changing the exercises to be ILWIS-based, the presenter and his team should prove that ILWIS enhances the understanding of the subject matter. I continued, following the example of Bishop- Clark and Dietz-Uhler (2012), this could be through designing groups of students, two doing the same exercise with different tools and a third one carrying out the exercise with all available tools. Only based on the analysis of results obtained from these three groups, one can draw a conclusion.
Basically, my view to education has changed from being a teaching activity, to a scientific journey of continuous discoveries and enhancement. Personally, I find this to be a leap-forward transformation in my view and practice to education.

As teacher

A tendency among teachers at ITC is to stuff their curriculum with content. This was evident from the alumni surveys, which has led to change M-GEO to 24-months instead of 18-months programme. With the new setup, 24-months, time-wise nothing really changed, only in the summer there are no teaching obligations.

My teaching style has also witnessed a leap forward in constructing the teaching activities. In quartile 2 of the academic year 2018, I contributed to the creation and teaching of the course "Earth Observation of Water Resources, EO4WRS". Here with the course coordinator we tried to focus on threshold concepts, pieces of information that are fundamental to a grasp of the subject. The approach followed in this course was 'less is more' (Meyer and Land 2003). For each concept I designed an exercise, that by doing it the students will fully learn, i.e. learning-by-doing. The exercises were all linked to each other, so the students could move from a concept to another in a chain. At the end of this chain came the group's assignment, whereby the students could engage active learning. Although this design was not part of this SUTQ project, it reflects how I am using the skills gained during this trajectory to my own practices. For example, read how threshold concepts increase active learning (Zepke 2013, Land and Rattary 2017).

It was the first run of the course, and I think all involved teachers have learnt from this experience and I will refine my teaching style and content in the next run of the course, for now we are still awaiting for the students evaluation. In case positive, I will spread the word, may be leading to a new SUTQ project, to use the threshold concepts to (re) design geospatial education of M-GEO.

7.4. Conclusion

I started this trajectory with the hypothesis (long-term question) that incorporating entrepreneurial mind-set in the M-GEO education programme will contribute to the creation of industrial innovation and the establishment of a knowledge-based society, ameliorating thereby sustainable developments in targeted countries. The first step to address this question was to identify the ingredients for entrepreneurship education that are suitable for M-GEO programme and students. The course went through cyclic process of design and evaluation and presented in this report. To this end I am even more convinced that the inclusion of entrepreneurial skills into the M-GEO education programme is expected to unleash new capabilities. The proof to this statement will take several cycles of evaluation, adjustment and assessment. Nonetheless, this trajectory was a conceptual gateway, it has caused a significant shift in my perception of education, has exposed the previously hidden features of teaching effectiveness and it is unlikely to be unlearned.

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9. Appendix A: Surveys

9.1. Student Survey 2018: Entrepreneurship

1. Currently employed by:

   Governmental organization: ___   Knowledge / research institute: ___

   NGO: ___   Private sector: ____   Other: _____

   Unemployed: ___

2. What is your gender?
3. Have you ever considered establishing your own business once you return to your home country? If yes, have you identified already a business opportunity.
1. Do you foresee you will have close interaction with the private sector in your future job which re-quires better understanding of stakeholders' interests and needs?
2. How relevant do you consider the introduction of an elective course on entrepreneurship in your master study and for your future career?
3. How likely will it be that you would select an elective course on entrepreneurship?
4. What are the skills (*) you consider most relevant to be included in the course on entrepreneurship which supports you in your future job or business opportunity?
5. Should the course focus on theoretical knowledge or on the development of a concrete business opportunity?
6. ITC, with support from the entrepreneurship centre of the UT, is considering providing further support to the development of business cases in your home country by offering extra-curricular activities during your study and coaching / refresher courses after graduation. How relevant do you consider this additional support by ITC?
7. As future graduate of ITC you think you will make use of this type of support?

(*) e.g. entrepreneurial skills: identification of business opportunities / market analysis, business (plan) development, client needs analysis, communication skills, marketing and financial skills, partnership building, etc.

9.2. Alumni Survey 2017

Q1 Please indicate your gender

Q2 What is your nationality?

Q3 What is your country of residence?

Q4 What was the highest level of your educational background upon arrival at ITC?

Q5 How many years of relevant working experience did you have upon arrival at ITC?

Q6 What was your course domain/specialisation at ITC

Q7 What is the highest degree/level which you obtained at ITC ?

Q8 Have you continued your studies elsewhere after graduating from ITC?

Q9 What was the reason not to continue at ITC?

Q10 In which year did you graduate from ITC?

Q11 How long did it take you to find a relevant job after you graduated?

Q12 In which type of organization are you working?

Q13 What is the geographic focus of your responsibilities in your job?

Q14 What is your professional position now? (e.h. head of department, researcher, lecturer, CEO

Q15 Please indicate to what extent you agree or disagree with the following statements about the study programme that you have followed at ITC.

Q16 Please indicate to what extent you agree or disagree with the following statements.

Q17 How did you learn about this development? (multiple answers possible)

Q18 How did you learn about this development? (multiple answers possible)

Q19 In the new 2-year MSc on Spatial Engineering students learn through problem based learning. Problem-based learning (PBL) is a student-centered pedagogy in which students learn themselves about a subject through the experience of solving an open-ended problem found in trigger material. The PBL process does not focus on problem solving with a defined solution, but it allows for the development of other desirable skills and attributes. Would this problem based teaching and learning approach be suitable for you and your colleagues? (multiple answers possible)

Q20 What is your main reason to stay in contact with ITC?

Q21 If there is a reason NOT to stay in contact with ITC, please specify

Q22 We periodically offer information through various media channels (website, newsletter and magazine). Which information has your main interest? (Please select max. 3 options)

Q23 We offer refresher courses and we will offer thematic Alumni events in which we address recent developments at ITC or interesting local initiatives. Please indicate in which domain(s)/topic(s) you would like to deepen your knowledge at such occasion? (multiple answers possible)

Q24 Please specify which specific subject has your interest?

Q25 What do you, as alumnus, see as the main goal of a worldwide alumni network? And what is your role in this matter?

Q26 As alumnus can you give us any further suggestions to improve our education and keep it attractive for the future generation (developments, trends on content and teaching methods, dissemination etc)?

Q27 We expect that you as alumnus know colleagues or friends who have obtained their degree at other universities. What were their most important motivations to study elsewhere? Please select max. 3 options.

Q28 We appreciate your role as alumni of ITC and would like to strengthen this relationship. Can we contact you in case we need you or your professional network to distribute for example job positions, new courses and alumni gatherings.

Q29 Contact information: In order to be able to contact you, we need your name, address and email address. These credentials will only be used to contact you as mentioned in the previous question. We will not use them for other purposes and will not distribute them to other external parties.

Q30 Do you want to participate in the raffle for the 'ITC 65 Year' hoodie?

Q31 Please enter your email address (it will only be used for the raffle):

Q32 This is the end of the survey. If you have any further comments, please write them below.

9.3. Alumni Survey 2014

Q1 Which year did you start your studies at ITC?

Q2 In which domain/specialization did you study at ITC?

Q3 Which programme did you study at ITC?

Q4 Are you presently employed in your home country?

Q5 Were you employed in another country after completing your studies at ITC?

Q6 You indicated you were employed in another country after completing your studies at ITC. Please indicate which country:

Q7 What type of organization are you working for?

Q8 What is the title of your current (or last) occupation?

Q9 Does this occupation lie in the domain you studied at ITC?

Q10 You indicated your occupation lies in the domain you studied at ITC. Please specify the domain (more answers are possible):

Q11 You indicated your occupation lies not in the domain you studied at ITC. Please describe your current domain

Q12 Which tasks do you perform in this occupation? (more answers are possible)

Q13 Which competences of the professional Master programme do you apply in your work? (more answers are possible)

Q14 In case you cannot apply the mentioned competences of your course please explain why?

Q15 The content of the ITC professional Master programme is relevant for the professional field in which I am working.

Q16 The content of the ITC professional Master programme is state of the art

Q17 Knowledge and skills learned in the professional Master programme have helped me to execute my work successfully

Q18 The ITC professional Master programme helped me in my career (I have obtained a better position)

Q19 The professional field in which I am working is willing to employ graduates from the ITC professional Master programme

Q20 Studying with students from other countries and other cultures helped me to understand better the global problems in my field of studies/interest

Q21 Students from other countries and cultures helped me to understand the problems my own country is facing

Q22 The education environment, offered by ITC, has developed an international orientation in me

Q23 I will recommend the ITC professional Master programme to my colleagues

Q24 I would like to continue my education

Q25 I would like to continue my education in the following fields of interest:

Q26 I would like to continue my education on the following level:

Q27 What are the strengths of the ITC professional Master programme?

Q28 What should ITC do to improve the its professional Master programme?

Q29 How could ITC further improve recognition of its professional Master programme in the Geoscience world?

Q30 Are you presently employed in your home country?

Q31 Were you employed in another country after completing your studies at ITC?

Q32 You indicated you were employed in another country after completing your studies at ITC. Please indicate which country:

Q33 What type of organization are you working for?

Q34 What is the title of your current (or last) occupation?

Q35 Do you consider this an academic oriented employment?

Q36 Does this occupation lie in the domain you studied at ITC?

Q37 You indicated your occupation lies in the domain you studied at ITC. Please specify the domain (more answers are possible):

Q38 You indicated your occupation lies not in the domain you studied at ITC. Please describe your current domain

Q39 Which tasks do you perform in this occupation? (more answers are possible)

Q40 Which competencies of the Master of Science programme do you apply in your work? (multiple answers are possible)

Q41 In case you can't apply elements of your course please explain why?

Q42 The topic of my thesis research is relevant for my (present) job

Q43 Did you continue to PhD?

Q44 You indicated you continued to a PhD, please specify your topic/field:

Q45 I would like to continue my education

Q46 I would like to continue my education in the following fields of interest:

Q47 I would like to continue my education on the following level:

Q48 The content of the ITC Master of Science programme is relevant for the professional field in which I am working.

Q49 The content of the ITC Master of Science programme is state of the art

Q50 The ITC Master of Science programme devotes sufficient time to subjects of the specializations (domains)

Q51 Knowledge and skills learned in the Master of Science programme have helped me to perform at sufficient academic end level

Q52 The ITC Master of Science programme programme helped me in my career (I have obtained a better position)

Q53 The field in which I am working is willing to employ graduates from the ITC Master of Science programme.

Q54 Studying with students from other countries and other cultures helped me to understand better the global problems in my field of studies/interest

Q55 Students from other countries and cultures helped me to understand the problems my own country is facing

Q56 The education environment, offered by ITC, has developed an international orientation in me

Q57 I will recommend the ITC Master of Science programme to my colleagues

Q58 What are the strengths of the ITC Master of Science programme?

Q59 What should ITC do to improve the its Master of Science programme?

Q60 Three random drawn respondents will win a distance education course of choice. To get a chance on winning the course please leave a valid email address below. The winning respondents will receive an email with the procedure to receive the course, further announcements about the prize will not be made.

10. Appendix B: Peer-evaluation, Dr. R. van der Velde

10.1. The assessor

Rogier van der Velde, is an assistant professor ITC. He is the coordinator of two courses in two educational programmes at ITC, namely Spatial Engineer and M-GEO. Rogier has extensive experience in Public-Private partnership, scientific valorisation and in teaching and education coordination.

10.2. Feedback

Entrepreneurship: a Bridge Towards Geospatial Innovation

Evaluation

Rogier van der Velde February, 2019

Geo-Information Science and Earth Observation (M-GEO) Master's Programme

Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente

Contents

3

1. Introduction

This document serves as evaluation of the course 'Entrepreneurship: A Bridge Towards Geospatial Innovation' of the Master's programme Geo-Information Science and Earth Observation (M-GEO). I have been asked by Dr. Salama to perform this as part of his Senior Teaching Qualification (STQ). I will evaluate the course based on the following criteria:

- Fit for purpose, Does the course fit within the mission of the Faculty ITC as part of which the M-GEO programme was developed?
- Final qualifications, Are the learning objectives with the final qualifications of the M-GEO programme?
- Content and Learning objectives, Is the content appropriate for achieving the learning objectives?
- Assessment, Is the test plan appropriate for testing the learning objectives?

2. Fit for purpose

The mission of ITC is focused on capacity building in developing countries as part of the Dutch policy on development cooperation. In line with this mission, the M-GEO programme and its predecessors were developed to educate mid-career professionals from developing countries in Earth Observation and Geo-Information Science. In the past decade the national policy on development cooperation has made the transition from aid to trade. This is again reflected in the 2018 note 'Investeren in Perspectief' from the Minister of Trade and Development Cooperation, in which entrepreneurship is recognized as vehicle towards environmental, social, and economic growth in develop countries. Startups following from entrepreneurship of individuals are the source of innovation within society. The individuals engaged in these startups create for themselves when successful a form of independency and an ability to sustain in their own livelihood.

In this context, education with an emphasis on to entrepreneurship in the M-GEO programme is urgently needed as it provides M-GEO students with a background on how to engage in entrepreneurial activities.Moreover taking up entrepreneurship in the M-GEO curriculum is strategically important for the Faculty ITC as it is one of the spearheads of the national policy on development cooperation.

3. Final Qualifications

The test plan, given in Entrepreneurship_M_GEO_TestPlan_Final.xlsx, suggests that the 6 course learning objectives cover 12 out of the 13 final qualifications of the M-GEO. On the one hand this is good from a programme perspective. On the other hand, it can also suggest that either the final qualifications are not very well defined or that the course has not enough focus.

4. Content and learning objectives

The course is designed around entrepreneurship and entrepreneurial skills, and from the introductory text I also deduced that trans-disciplinary is also a core value

Comment i) From the text it is not clear what entrepreneurial skills are. 'Risk taking' is mentioned, but I think there are more entrepreneurial skills, for instance 'recognizing opportunities' and 'risk management'.

Comment ii) In the course description the following structure of activities is provided

'The course is structured as follows: (a) basic theory (frontal teaching) ; (b) advanced concepts (flipped classroom), (c) projects to be realized by groups of students, (d) progress meetings (e) poster presentation of projects and (f) Self-reflection report.'

Comment ii) I think that (e) and (f) are assessments and do not really have to be in the structure.

Comment iii) The introduction mentions that Entrepreneurship is about a mindset, e.g. risk taking & management. In sense I wonder whether the format should not be even more focused on doing instead of frontal teaching, MOOC and tutorials. You could think of one overarching project with every week a new entrepreneurial theme, e.g. recognizing opportunities, risk taking. It is not that you learn how to recognize opportunity and take risks by watching a video.

Comment iv) I do not see where trans- disciplinarity has a place in course.

Comment v) A MOOC and tutorials are mentioned the content of these are not clear.

Comment vi) The course is an advanced course in M-Geo programme. It would be good to indicate how this is reflected in learning objectives by identifying the Bloom's levels and it would be good if the Bloom's levels would not differ too much among the learning objective

Comment vii)

> *'LO2 Valorise geoinformation-based solutions: international, economical, environment and societal values;'*

> Is the geo-information based solution not too complex and restrictive? .
> What should the students be able to do with the 'values'?

Comment viii)

> *'LO3 Identify and develop business opportunities from geoinformation science'*

> Is the 'business' needed? In the introduction you mentioned that 'entrepreneurship is much broader than the creation of a new business venture'
> Are you going to provide students with education on how to set up a business?

Comment ix)

5

'LO4 Create and/or evaluate solutions fostering stakeholder-partnerships that overarches political and cultural differences;'

This LO4 is not clear. Do you want to students how to engage with stakeholders? What should this be at the level of creation/evaluation? I think that it would be already something if the students could apply methods to engage with stakeholders? Moreover you could also vary in different types of stakeholders, e.g. scientists, professionals, citizens.

Comment x)

'LO6 Present the outcomes in a simulated public hearing with an international character.'

Why a 'public hearing'? Public hearings you have with big scandals of national importance. I think that for entrepreneurial skills it is more relevant to be able to defend a business proposal in front of a group investors.

5. Assessment

The test plan holds five different assessment: four summative and one formative with a weight of 40 % for individual tests and 60 % for group work. I thought that it was UT policy to have a weight of 60 % to individual test and 40 % for group work.

Further I would recommend considering an oral test or a defence of a business proposal and consider dropping the written test because you would like to test whether students have an entrepreneurial mindset.

A weight of 40% for poster feels as a bit too much.

11. Appendix C: Peer-evaluation, Mr. V. Venus

11.1. The assessor

Valentijn Venus is a GeoEntrepreneur and a lecturer at ITC. He is the founder of Ramani B.V., a spin-off company of ITC, University of Twente. Valentijn has extensive knowledge of business incubation as key technology provider for international competition events in GeoEntrepreneurism.

11.2. Feedback

Hi Suhyb,

See my comments inline below.

Cheers Valentijn

> **From:** "Salama, S. (ITC)" <s.salama@utwente.nl>
> **Date:** Tuesday, 5 February 2019 at 12:02
> **To:** Valentijn Venus <v.venus@utwente.nl>
> **Subject:** RE: feedback
>
> Hi Tyn,
> Thank you for your prompt reply:
>
> The following points could be addressed in the feedback:
> 1- Constructive alignment between LO and assessment (I attached the course with xsl sheet, so you do not have to serach for it)

In your LO and assessments I miss one layer, which details how practical work and active learning activities are linking the assessment of course contents with the learning objectives. As an example of this, see the following matrix where i followed an adapted version of Millar's (2010) approach to highlight how these practical work and active learning activities are deployed to help students make the link between the domain of 'objects' and 'observables' (things we can see and handle) and the domain of ideas (concepts which we cannot observe directly).

Millar, R. (2010). Analysing practical science activities to assess and improve their effectiveness. The Association of Science Education. University of York. Link: Getting Practical

> Now my whole argument is that (long term question of my SKO research) incorporating entrepreneurial mind-set in the M-GEO education programme would contribute to the creation of industrial innovation and the establishment of a knowledge-based society, ameliorating thereby sustainable developments in targeted countries.

Oef, these are very ambitious statements: so, keep dreaming but start small. E.g. we hope our students will understand what other entrepreneurial business models exist in addition to the one they know, selling their hours in advisory or consultancy services *aka* 'hour factory'.

> 2- Is this course fit to M-GEO students?

I'm afraid students will not be convinced with the current broad scope that other entrepreneurial business models are worth considering, e.g. creating products/services, in addition to the one they know best (selling their hours in advisory or consultancy services *aka* 'hour factory').

3- Does the course content and design fit the long term objective

The LOs are horizontally scaling, i.e. each adds new aspects:

1. Present and apply entrepreneurship concepts and mechanisms;
2. Valorise geoinformation-based solutions: international, economical, environment and societal values;
3. Identify and develop business opportunities from geoinformation science;
4. Create and/or evaluate solutions fostering stakeholder-partnerships that overarches political and cultural differences;
5. Self-reflect on the learning process supported with evidence;
6. Present the outcomes in a simulated public hearing with an international character.

So, rather than broadening I'd suggest you vertically deepen the knowledge with each LO (only 1, 3 are partially overlapping, with most of the other LO you are adding new aspects/dimensions). But perhaps I do not fully comprehend your logic, so my apologies if this is this case. I can see your ambition, but isn't it too ambitous? Perhaps consider dropping this altogether:

Hence, the focus of this course lies on creating an entrepreneurial mind-set to (i) identify and developed business cases from geoinformation science that have economical, societal & environmental values , and (ii) create and evaluate transdisciplinary solutions fostering stakeholder-partnerships that overarches political and cultural differences.

Because a primary human motives are to avoid risk and seek confirmation of security, so how can one stepping out of this comfort zone (becoming an entrepreneur) even consider transdisciplinary solutions that overarches political and cultural differences?

Tyn

From: Venus, V. (ITC) <v.venus@utwente.nl>
Sent: dinsdag 5 februari 2019 11:59
To: Salama, S. (ITC) <s.salama@utwente.nl>
Subject: Re: feedback

Hi Suhyb,

Sure, will do. You have a template for the evaluation (with items to assess)?

12. Appendix D: Anonymous evaluation

Received on the 21st of January 2019

12.1. Introduction

The European Council for Small Business and Entrepreneurship (ECSB) is a research-driven, non-profit organization whose main objective is to advance the understanding of entrepreneurship and to improve the competitiveness of SMEs in Europe. The ECSB is an affiliation to the International Council for Small Business (ICSB). The ECSB conferences on Entrepreneurship Education (3E Conference) offers an exclusive and engaging opportunity for researchers, educators and politicians to debate and exchange their experiences of the major challenges and advances in enterprise education with a special and unique focus on Europe. Unlike more traditional academic events, the conference will focus on problems and questions rather than on ready-made solutions and presentations of research findings. There are no keynote speakers to tell us the way but we will pave it ourselves in a joint effort. For the 3E conference to be held in Gothenburg, Sweden on May, 2019, I submitted an abstract (section 11.2) which was peer-reviewed by the scientific committee of the 3E conference (section 11.2). The final outcome of this review was reject.

12.2. Abstract

12.2.1. Objective

Today we face a range of complex and wicked problems, from climate change to sustainable development of resources and the well-being of citizens and their environments. Geospatial education programmes are confronted with the challenge of graduating professionals that are capable of using geospatial science to address these eminent problems while contributing to economic and social gains.

The field of geospatial science can conceptually be divided following the 3P principle (Elkington 1997) into People, Planet and Profit. Therefore geospatial education programmes mainly focus on mapping and analysing people and earth's systems, with the profit component being mainly centred on generating environmental benefits. For example the education programme on Geoinformation Science and Earth Observation (M-GEO) of the University of Twente (The Netherlands) is directed towards capacity development of less-developed countries (LDCs). Ultimately geospatial educations, like M-GEO, should stimulate the creation of socio-economic profits to accelerate the sustainable development of targeted LDCs.

Ameliorating socio-economic revenues of LDCs through geospatial education could only be achieved through incorporating entrepreneurship into non-business education (Kuratko 2017, Bonnet et al., 2007, Smith et al., 2006). However, entrepreneurship is much broader than the creation of a new business venture (Kuratko and Morris 2018). It is also a mind-set – a way of thinking and acting. It is about imagining new ways to solve problems and create value (Neck and Greene 2011). In the context of changing paradigms in development corporation, giving a mayor role to the private sector in the aid to trade agenda, this entrepreneurial mind-set will help geospatial and engineering students (Lu et al., 2016; Mäkimurto-Koivumaa and Belt 2016) to promote a balance of economic, social and environmental outcomes benefiting multiple-stakeholders in a sustainable manner (Morris et al., 2013).

The main objective of this paper is to identify the characteristics of an optimal design for an entrepreneurial education for geospatial students with the potential of stimulating sustainable development and creating industrial and innovative capabilities.

12.2.2. Approach

Students enrolled in the M-GEO programme (Master and Postgraduate levels) at the ITC faculty of the University of Twente, The Netherlands, are the targeted group of this research. The employed approach hereafter follows a cyclic process iterating on four main phases: data collection and analysis, design and test course.

12.2.3. Results

In 2017 an elaborated survey was carried out to probe the consequence of having M-GEO diploma and how it shaped alumni's carrier. The survey was designed on a large scale using the framework of Salant and Dillman (1994), i.e. specification, coverage, sampling, response, and measurement and the techniques of Ross (2005). Ross method for conducting survey is appropriate for the purpose of this project as it was earlier used by ITC, and originally designed to monitor educational quality in Africa and southeast Asia, origin-countries of the majority of ITC alumni. However Ross approach was updated using the European standard for carrying out surveys (de Leeuw et al., 2008).

The survey was sent out to 2045 ITC's graduates with PhD, MSc, Master and PGD degrees in the years 2008 until 2017. 759 alumni from 89 different nationalities, 63% male and 37% female, responded to the survey. Few questions were on the content of additional courses that ITC should offer. With a response rate of 95% (710 response out of 759) 68% of the respondents indicated entrepreneurship as a "must to offer" course by ITC . More than 70% of survey's participants also indicated usefulness of providing online courses, this percentage became 90% for the group who choose of entrepreneurial skills. The presented survey contained many open ended questions, some of which were analysed in the course of this work. Although tools do exist to automatically analyse textual data (e.g. Yahya et al., 2013 Gomaa and Fahmy 2013, Chavan et al., 2014, Manning et al., 2014, Chaudhari and Govilkar 2015), the manual analysis of the textual data (i.e. reading) permitted the empathic understanding of students' needs, opinions, emotions and appraisals, as suggested by Pombo and Tschimmel (2005). Specific to this research one open ended question was analysed with 431 responses (10,508 words) which identified the main ingredients for the course design which include (Val et al., 2017; Karatko and Morris, 2018):

- Cognitive / behavioural skills: understand and apply entrepreneurship concepts of opportunity identification, assessing business ideas, project management, business development, and strategy growth.

- Non-cognitive / attitudinal skills: creativity, self-reliance, lateral thinking, and translating ideas into action.

12.2.4. Implications

Creating critical mass of entrepreneurial capabilities in less developed countries (LDCs) will form a bridge towards economic improvements and in a sustainable manner.

12.2.5. Originality

The inclusion of entrepreneurial skills into the M-GEO "geospatial" education program is expected to unleash new capabilities of the students providing them with a gateway to be:

- Lifelong learner and more self-confident in addressing wicked problem;

- Creative in nudging between disciplines to design environmentally sound and societal relevant solutions;

- Innovative in business start-ups;

- Employable and involved in creating a knowledge-based society. Value/Originality

12.3. Feedback

Dear Mhd. Suhyb Salama:

We are sorry to inform you that the following submission was not selected by the program committee to appear at 3E 2019:

Entrepreneurship in Geospatial Education: a Bridge Towards Sustainable Development

The selection process was very competitive. Due to time and space limitations, we could only choose a small number of the submitted papers to appear on the program. Nonetheless, we still hope you can attend the conference.

We have enclosed the reviewer comments for your perusal.

If you have any additional questions, please feel free to get in touch.

Best Regards,
3E 2019 Organisers

3E 2019

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=====================================================================
3E 2019 Reviews for Submission #4
=====================================================================

Title: Entrepreneurship in Geospatial Education: a Bridge Towards Sustainable
Development
Authors: Mhd. Suhyb Salama
=====================================================================
                           REVIEWER #1
=====================================================================


---------------------------------------------------------------------
Reviewer's Scores
---------------------------------------------------------------------
                Type of the submission: 2=Empirical paper
                       Novelty 1 (1-7): 3
                       Novelty 2 (1-7): 2
                       Importance (1-7): 5
                       Preference (1-7): 4
                   Best paper potential: 2=No
              Plenary session potential: 2=No

Detailed Comments
---------------------------------------------------------------------
This submission taps onto a niche topic of teaching entrepreneurship to
geospacial science students. It is interesting and relevant when it comes to
social and sustainable entrepreneurship research, creation of environmental
impact. The paper sets an aim to identify characteristics of an optimal
design for entrepreneurship education in the niche of goespacial science.
However, as a reader, i am not convinced that the current version of the
abstracts delivers on the promise. It seems that the general results are
stated in the Originality section, while the Results section could be better
focused by separating out methodological details in another respective
section. Methods and selection of students also raise questions. For example,
why the researchers used only certain fraction of the overall data; why it
was seemingly qualitative while the survey was quantitative; why 2017 and
2018 graduates -- what if students in these cohorts were different from
others? These are standar!
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d methodological questions. The main concern, however, rests with giving a
clear and novel answer to the question/aim of the research stated, and
developing other questions based on that. The latter part is completely
lacking.
Overall, the submission could be of interest to the conference delegates but
i recommend the authors to better focus the results and contribution.

--
3E 2019 - https://www.softconf.com/i/3E2019

13. Appendix E: Learning Outcomes of M-GEO

The Learning Outcomes of the Master's programme Geo-information Science and Earth Observation - as accredited with NVAO under Croho nr.: 75014 are:

13.1. Domain/ Academic field

1. Identify and understand principles, concepts, methods and techniques relevant for geo-information processing and earth observation
2. Analyze problems and cases from a (geo-)spatial perspective
3. Use and design models to simulate (or: study) processes in the system earth with a spatial component
4. Apply principles, concepts, methods and techniques in the context of system earth, the user and an application domain to solve scientific and practical problems
5. Independently design and carry out research in the domain according to acceptable scientific quality standards

13.2. Scientific

6. Analyse issues in an academic manner and formulate judgments based on this
7. Analyse scientific and practical domain problems in a systematic manner and develop scientifically valid solutions for these problems in a societal context
8. Communicate both orally and in writing on findings of research work to specialists and non-specialists
9. 9. Explore the temporal and social context of geo--information science and technology and be able to integrate these insights in one's scientific work

13.3. Internationalization

10. Operate professionally in a multi-cultural environment, and act adequately on cultural differences
11. Express him/herself adequately to colleagues of different nationalities

13.4. General

12. Critically reflect on his/her own and other's work
13. Study in a manner that is largely self-directed and autonomous