



**Creativity, Invention, Innovation and Entrepreneurship, connected in theory separated in practice: - Can we strengthen engineering education by understanding the overlaps and the differences between the four concepts in an educational context**

**Thomassen, M. L.; Løje, Hanne; Basaiawmoit, R. V.**

*Published in:*  
Proceedings of the 46th SEFI Annual Conference 2018

*Publication date:*  
2018

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Thomassen, M. L., Løje, H., & Basaiawmoit, R. V. (2018). Creativity, Invention, Innovation and Entrepreneurship, connected in theory separated in practice: - Can we strengthen engineering education by understanding the overlaps and the differences between the four concepts in an educational context. In R. Clark, P. M. Hussmann, H-M. Järvinen, M. Murphy, & M. E. Vigild (Eds.), Proceedings of the 46th SEFI Annual Conference 2018 (pp. 462-478). European Society for Engineering Education (SEFI).

---

**General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

**Creativity, Invention, Innovation and Entrepreneurship, connected in theory  
separated in practice**

- **Can we strengthen engineering education by understanding the overlaps and the differences between the four concepts in an educational context**

**M. L. Thomassen**

Associate Professor  
VIA UC  
Horsens, Denmark  
E-mail: [melt@via.dk](mailto:melt@via.dk)

**H. Løje**

Senior Innovation Officer  
Technical University of Denmark  
Ballerup, Denmark  
E-mail: [halo@dtu.dk](mailto:halo@dtu.dk)

**R. V. Basaiawmoit**

Head of SciTech Innovation and Entrepreneurship  
Aarhus University  
Aarhus, Denmark  
E-mail: [rvb@au.dk](mailto:rvb@au.dk)

Conference Key Areas:

Teaching Creativity & Innovation

Keywords: Invention, Creativity, Innovation, Entrepreneurship, Engineering Education

**1. Introduction**

During the past two decades innovation and entrepreneurship have been dedicated much attention both politically and in an educational context across multiple disciplines including engineering. Skills and competences developed within these fields are believed to be essential for continued social and economic prosperity, which is why many governments support innovation and entrepreneurship promoting activities i.e. education. But are we getting the most out of the attention and resources dedicated for this in an engineering education context? Though seemingly connected and linked with creativity, innovation education and entrepreneurship education are most commonly separated in practice and research. Furthermore, technical inventions are essential in all engineering educations, but not always put in the context of innovation or entrepreneurship education, though this is important in order to understand how

inventions can create value for the society and not just explore and challenge technical boundaries. So are we, as educational institutes providing our students with the best possible education within these fields?

The scope of this study is to get a better understanding of the four concepts, creativity, invention, innovation and entrepreneurship, in theory and in the practice of engineering education. With this purpose our research question is;

*How are the concepts of creativity, invention, innovation and entrepreneurship defined in theory and in the practice of engineering education in Denmark?*

Therefore, this study outlines, compares and contrasts theoretical definitions of the terms; creativity, invention, innovation and entrepreneurship, based on a literature review. Furthermore empirical data was collected from Engineering Programs at five higher educational institutes in Denmark and at a workshop at the Exploring Teaching for Active Learning in Engineering Education 2017 conference (ETALEE 2017) to study how the terms are used in practice in Danish engineering education.

## **2. Method**

A literature review was done where we applied a keyword search in SCOPUS using “Defining” and then the four concepts. The purpose was to find the 5 most cited publications and compare and contrast their definition of the concepts. Proponents of creativity, consider “creativity” and the study of it as a unique and independent discipline and thus it made sense to do a separate literature search on the concepts. However, in practice it is most commonly not taught separately in engineering education but implicit or explicit a part of invention, innovation and entrepreneurship education and for this reason it was excluded in the questionnaire. (However, in hindsight it would also have made sense to ask practitioners to define this seemingly founding concept).

To collect empirical data about definitions of “Invention”, “Innovation” and “Entrepreneurship” a survey was conducted in winter 2016/spring 2017. A questionnaire was made and sent to researcher and educators within the fields of invention, innovation and entrepreneurship in engineering education. The participants were associated with one of the following universities: The University of Southern Denmark, VIA University College, Technical University of Denmark, Aarhus University, Aalborg University. The participant was asked to write their definition of the three terms. Furthermore, they were asked to add name, profession and working place. Totally 24 recipients/participants answered the survey.

At the conference Exploring Teaching for Active Learning in Engineering Education 2017 (ETALEE) held in May 2017, the authors hosted a hands-on session about the topic and during the hands-on session, similar data was collected as in above.

## **3. Definitions in theory**

We have done a literature search in Scopus with the terms “*Defining creativity*”, “*Defining Invention*”, “*Defining Innovation*” and “*Defining Entrepreneurship*” in the heading, key words and/or abstract. The 5 most cited publications relevant within the context of education (broadly defined) were then reviewed with the intent of gaining

an understanding of how each of these is defined in theory. The review yielded the following results for each of the chosen concepts under sections 3.1-3.4:

### **3.1 Creativity**

The scopus research showed that finding a unanimous definition of creativity based on theoretical literature is not possible. Some authors have actually looked at this problem from an educational psychological angle (Plucker, Beghetto, & Dow, 2004). They argue that the problem with defining creativity is harmful to the field of research because without a solid definition the field will lack direction, be object for damaging mythologies and general misunderstanding. This will generally undermine creativity as a field of research and have a negative impact on the development of educational practices. In their study they compare and contrast explicit definitions of creativity based on the inclusion or exclusion of the following descriptive parameters – Unique; Artistic; Psychometric; Usefulness; Stakeholder-defined; Accessible; Divergent thinking; Problem solving.

A large variety of combinations of the descriptive parameters becomes apparent across the definition examples. Then Plucker, Beghetto and Dow suggests the following definition of creativity: *“Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context.”* (Plucker et al., 2004)

In this broad definition, creativity is the result of interaction between aptitude, process and environment outlining three important components if the creation process. Moreover, there is a requirement for a perceptible product that needs to be defined as useful and novel according to the social context it is created with in. This means that creativity needs to be manifested and is not confined to a cognitive function. Furthermore, the novelty and usefulness cannot be objectively defined, but must be evaluated based on context.

Rob Pope (2005) wrote a book about creativity, studying the concept through different lenses. First looking at defining creativity historically, then creating definitions theoretically and finally looking at different creative practices. Using different lenses and situating creativity in different contexts results in multiple definitions of the concept. But initially Pope provisionally define creativity as: *“...the capacity to make, do or become something fresh and valuable with respect to others as well as ourselves.”* (Pope, 2005)

With this definition, Pope defines creativity as a capacity and elaborates on the potential out-put of creativity as something you make, do or become, still requiring novelty and usefulness. An example of a very narrow and context specific definition of creativity is offered by Shai, Reich and Rubin (2009) in relation to Computer Aided Design. They define creativity as: *“...a capability that enables the creation of systems that are patentable”* (Shai, Reich, & Rubin, 2009).

In this definition, creativity is defined as a capacity but with a specific purpose, to design a system, and there is a specific requirement for novelty, which is defined by patentability.

With these examples it is established that the definition of creativity is highly context dependent. Broad and general definitions of the concept exist, but they draw on

different descriptive parameters and the more context specific we work with creativity the more specific the requirements for creativity becomes.

In relation to engineering education, Fodor and Carver (200) offers the following definition: "...students' proposed solutions to an engineering problem ... novelty combined with appropriateness, value or usefulness" (Fodor & Carver, 2000)

Drawing on the descriptive parameters; uniqueness, usefulness, problem solving and stakeholder defined.

### **3.2 Invention**

Interestingly, the search term "Defining Invention", unlike the other three topics, gave no results. Thus, the search term was broken down into "Invention" AND "Definition". Even here the search yielded 744 results of which only 80 were in the domain of Business literature. The term-use was very discipline-dependent and most articles that were listed related to the legal aspects and especially the patenting literature. Indeed when searching for "invention" alone one would get thousands of papers but very few have actually gone on to defining invention. Only one paper stood out as the one that has attempted to define Invention and Innovation and this paper is by Roberts E, B, first published in 1988 and then reprinted by Research, Technology and Management in 2007. It is interesting to highlight that Roberts already coupled the concept of Creativity with that of an inventor when he stated: "*Prior to our start, academics had concentrated largely on two themes: historical romanticism about the lives and activities of great "creative inventors," like Edison and Bell, and psychological research into the "creativity process."* While those writings made interesting reading, in my judgment neither track contributed much useable knowledge for managers of technical organizations"(Roberts, 2007). In saying so, Roberts claimed that industry did not set a lot of focus on "creativity" as a process and neither did they do it for "invention" – not systematically at least. Furthermore, he set out to tease apart (maybe one of the only few who have attempted this) the concepts of Invention and Innovation. In a section dedicated entirely to the two, he states:

*"Roundtable discussions at the 1970 annual IRI spring meeting provide a useful starting point for this review-a set of definitions of the invention and innovation process: Innovation is composed of two parts: (1) the generation of an idea or invention, and (2) the conversion of that invention into a business or other useful application . . . Using the generally accepted (broad) definition of innovation-all of the stages from the technical invention to final commercialization-the technical contribution does not have a dominant position (3).*

*The invention process covers all efforts aimed at creating new ideas and getting them to work. The exploitation process includes all stages of commercial development, application and transfer, including the focusing of ideas or inventions toward specific objectives, evaluating those objectives, downstream transfer of research and/or development results, and the eventual broad-based utilization, dissemination and diffusion of the technology-based outcomes" (Roberts, 2007).*

With these definitions invention is viewed as an important part of innovation, but inventions can stand alone without innovation if the invention is not put to use or

commercialized. Moreover, the invention is described as being the product of a process.

### **3.3 Innovation**

The scopus search on “defining innovation” yielded 30 hits. The most cited publication was on defining innovation networks (Corsaro et al, 2012) . Then a number of publications focused on the definition of innovation in a specific contexts i.e. in surgery ((Rogers et al, 2014) and energy sector (Lee and Lee, 2013). More specifically looking at defining innovation in general Baregheh, Rowley and Sambrook (2009) presents these following definitions based on their literature review.

*“Innovation is the generation, acceptance and implementation of new ideas, processes, products or services”* T. Thompson’s (1965, p. 2). In their definition West and Anderson (1996) include that innovations must benefit someone; *“Innovation can be defined as the effective application of processes and products new to the organization and designed to benefit it and its stakeholders”*.

Kimberly (1981, p. 108) broadens the term by not only focusing on the product but also include innovation as a process or attribute.

The degree of newness is central in some definitions of innovation. An innovation does not need to be new to the world, but being new to the people involved qualify according to Van du Ven et al (1986). Innovation is also associated with change. Damanpour (1996) provides the following definition of innovation *“Innovation is conceived as a means of changing an organization, either as a response to changes in the external environment or as a pre-emptive action to influence the environment”*. The change does not have to be radical in order to qualify as innovation, incremental innovation also provide newness and change.

Depending on context innovation can be very narrow defined i.e. patent based. But many definitions are more comprehensive one of which is: *“Innovation as the creation of new knowledge and ideas to facilitate new business outcomes, aimed at improving internal business processes and structures and to create market driven products and services.”* Plessis (2007, p. 21)

Based on our review, it is obvious that some definitions of innovation is very close to some definitions of creativity. One might argue that innovation is a creative process, making it difficult to clearly distinguish the two concepts.

### **3.4 Entrepreneurship**

Even the search for *“Defining Entrepreneurship”* had limited results though much more than “Invention”. Of the 13 hits, most papers tended to try and “define” and thereby justify the existence of Entrepreneurship as a field of research and of value in education. One of the most cited papers here was that of Rocha, H, O (2004) where he states that *“Entrepreneurship is defined as the creation of new organizations”* (Rocha, 2004) within a macro-economic perspective of the relevance and impact of clusters. Most papers that tend to define Entrepreneurship tend to do so as Rocha. However, Kobia and Sikalieh (2010) also highlight the problem of “defining Entrepreneurship” and their entire paper is based on the struggle of researchers in trying to define Entrepreneurship which is succinctly captured in this

statement – “...the findings of the literature review showed that none of the approaches used to define entrepreneurship gives a comprehensive picture of entrepreneurship. There is a lack of a common definition of entrepreneurship.” (Kobia & Sikalieh, 2010).

Kao, R.W.Y's definition of Entrepreneurship as: “*Entrepreneurship is the process of doing something new and something different for the purpose of creating wealth for the individual and adding value to society*” (Kao, 1993) can be seen as the precursor to many such similar definitions. One definition that most scholars also cite is that “*Entrepreneurship can be defined as the process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, psychic, and social risks, and receiving the resulting rewards of monetary and personal satisfaction and independence*” (Hisrich, Peters, & Shepherd, 2004). For others, Entrepreneurship is “*solely about Innovation and entering a new venture*” (Fooladi & Kayhani, 2003), with the premise that an entrepreneur has to be innovative if he/she should be successful in entrepreneurship. However, studies have shown that most entrepreneurs – loosely defined as anyone who starts a business – often (>80%) build their businesses on someone else's idea and not their own (Bhide, 2000). While there exist multiple perspectives on the definition of Entrepreneurship, the current consensus is that it is the ability to spot/create an opportunity and then exploit that opportunity to create value for multiple stakeholders including oneself (Shane & Venkataraman, 2000).

### **3.5 sum up of definitions in theory**

After researching the definitions of creativity, invention, innovation and entrepreneurship in theory it is apparent that the definitions vary from broad general applicable definitions to very specific context dependent ones. We can conclude that there are similarities but also differences in the definition of the four concepts. However we see that creativity is an important element and part of the definitions for the three other concept

## **4. Definitions in practice**

To gain more insight into how these concepts are defined in danish engineering education, empirical data was collected twice to better understand how the terms invention, innovation and entrepreneurship is understood and used in practice. Defining creativity was left out of the empirical data collection because it is embedded in innovation, invention and entrepreneurship education but rarely taught as a stand alone topic in engineering.

First a survey was constructed asking 24 educators, from 5 different engineering educational institutes, to define the three concepts. Then at the 2017 ETALEE conference in Denmark, three focus groups were constructed consisting of 4-5 members each. The members were engineering educators who signed up for participating in a session about active learning in invention, innovation and entrepreneurship. The purpose with the session was again to construct definitions of the three concepts, but this time based on group discussions.

In the following results from our survey and focus groups are presented.

#### 4.1 Empirical data from surveys

Based on the data from the 24 respondents of the survey, the following practical definitions were found (See appendix 1 for survey result).

**Invention:** It is the act of “creating” something (Idea, product, technology, process, system, meaning, solution) for the “first” time, an invention is something new – i.e. no known prior exists beforehand. The new creation can potentially have a social or economic impact, and it might not be a “completed/finished” creations but something which can be further developed.

Figure 1: Visualisation of definitions of invention



Some respondents argue that the invention should be applicable to someone or something, demanding a sort of value creation for someone. While others define the newness through patentability, an invention is thereby expected to have a degree of “uniqueness” and “unexpectedness”.

**Innovation:** It is the act of “renewing” or “changing” what has already been invented to something new. It can relate to an idea, product, service, technology or process. Innovation can be defined on a spectre from incremental innovation to radical innovation. Generally, incremental innovation is as improving what is already known, where radical innovation is the creation of something new, which disrupts status quo. It was largely accepted that an innovation should be possible to implement and/or commercialize to give value to someone- i.e. customers, society and companies.

Figur 2: Visualisation of definitions of innovation

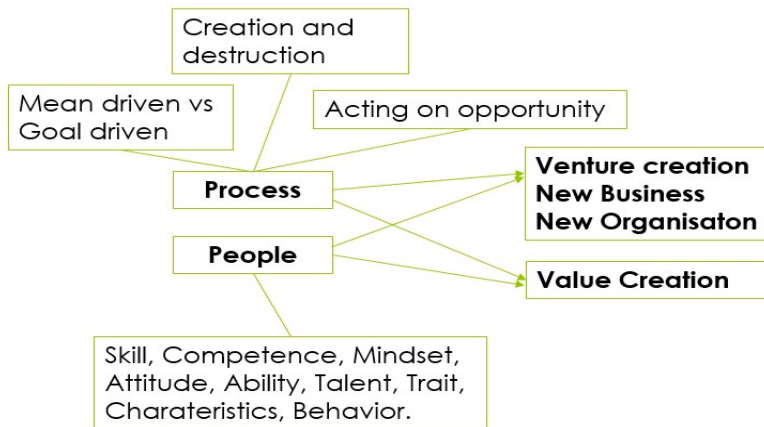


**Entrepreneurship:** It was not as linear defined as invention and innovation. The focus was either on the process of entrepreneurship or the people. The process was described as means-driven (Sarasvathy, 2001) or the acting on opportunity or as a creation and destruction process. All with the result of either building a venture/business/organisation or with the broader term value creation as end result.



In addition, it was seen as opportunities for getting on the market with innovation or inventions.

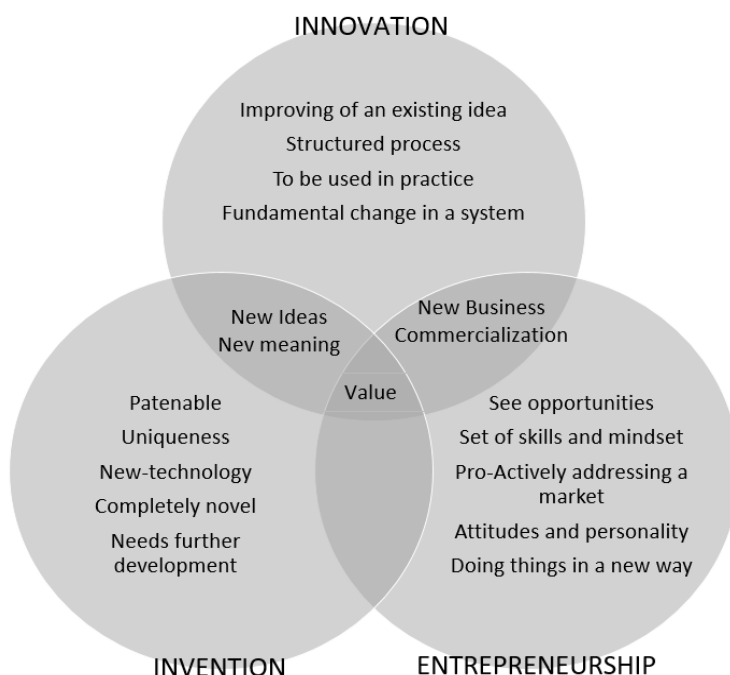
Figure 3: Visualisation of definitions of Entrepreneurship



The same spectre of outcomes was described in the definitions focusing on the people, but rather than emphasizing the process leading to this outcome, the people focused definitions highlighted individual's; Skills, competences, mindset, attitudes, abilities, talents, trait, characteristics and/or behaviour.

In the above the definitions of the three concepts are presented separately. But when comparing the definitions of invention, innovation and entrepreneurship it is found that they are mutually overlapping and presented in figure 4. The figure illustrate what the three concepts share and what is only associated with one or with two of the concepts.

Figure 4: Diagram of unique and overlapping definitions of invention, innovation and entrepreneurship, in engineering education based on a survey



All three concepts have in common to create value/impact - creativity. Innovation and invention share new ideas and to give new meaning, while innovation and entrepreneurship share new business and commercialization. In our survey no sharing only between invention and entrepreneurship was found.

#### 4.2 Empirical data from focus groups

At the 2017 ETALEE conference data was collected from 3 focus groups during our workshop on active learning in engineering education. The purpose of the focus groups was to gain more insight into the definitions of invention, innovation and entrepreneurship in an engineering educational practice. The three groups were asked to discuss and write down the definitions of the three concepts while observed by a member of the research team. In the table (table 1) below the results of these discussions are showed.

*Table 1: Definitions of invention, Innovation and Entrepreneurship from the three groups.*

	<b>Invention</b>	<b>Innovation</b>	<b>Entrepreneurship</b>
<b>Gr. 1</b>	<ul style="list-style-type: none"> <li>- A thing no one had thought about before</li> <li>- Invention=innovation</li> <li>- To invent and develop (creation)</li> <li>-A new product or service</li> </ul>	<ul style="list-style-type: none"> <li>- Make a new product or service and make a sale (Commercialization)</li> <li>- Something that also have a commercial side (market analysis)</li> <li>- Development of a new solution</li> <li>-Similar to invention, but less a thing- Abstract</li> </ul>	<ul style="list-style-type: none"> <li>- The need to make a product or service a business</li> <li>- to do it in practice</li> <li>- Business, mindset</li> <li>-leads to a business case</li> </ul>
<b>Gr. 2</b>	<ul style="list-style-type: none"> <li>- New creation</li> <li>- To invent something new</li> <li>- New produce, service or idea</li> </ul>	<ul style="list-style-type: none"> <li>- Value creation, novelty</li> <li>- Combining existing things in new ways that create value</li> <li>-Bring inventions to use</li> <li>- Clever solutions</li> <li>- Utility</li> </ul>	<ul style="list-style-type: none"> <li>- Making money on inventions</li> <li>-Practical start-up</li> <li>- Creating value with ideas</li> <li>- Not necessarily innovation</li> <li>- From Scratch</li> </ul>
<b>Gr. 3</b>	<ul style="list-style-type: none"> <li>- Idea</li> <li>- Invention covers that you as a student invent something new to you...maybe also to others</li> <li>- Scientifically valuable new idea...Creativity</li> </ul>	<ul style="list-style-type: none"> <li>- Methodology/ physical product</li> <li>- Combine theory with practical stuff into new products</li> <li>- the process of creating new things/ideas without existing knowledge</li> <li>- Methodology to bridge the idea into end product</li> </ul>	<ul style="list-style-type: none"> <li>- Outcome/product</li> <li>- The process of putting your inventions into production and making it a live in production</li> <li>-Converting ideas into sustainable and marketable products</li> <li>- Put ideas on the market</li> </ul>

The results from the focus groups align with the results from the survey. In relation to invention and innovation there is a focus on creation and novelty, while in relation to entrepreneurship exploitation of a business opportunity is prevalent.

“Creativity, *Invention*, *Innovation* and *Entrepreneurship*” as independent concepts with certain degrees of overlap.

## **5. Discussion**

Our literature review shows that there is no unanimous definition of neither creativity, invention, innovation or entrepreneurship. All definitions were context dependent some wide and other very specific. This finding was supported by our empirical data. So are we building a tower of babel that prevents us from improving education within these fields, when we are using the same terms but not agreeing on their definition or using different terms but in reality talking about overlapping concepts? Deciding on *one* definition of each concept is likely impossible, but could we strengthen engineering education and maybe education in general if we explicitly define the concepts in our theoretical studies and practice? Would this better enable us to pool empirical data, debate, compare and contrast research for the benefit of all research fields? In practices innovation and entrepreneurship research and education are most often separated and invention is not always put in the context of innovation or entrepreneurship. But maybe an educational innovation in all fields can come from sharing best practices?

## **6. Conclusion and future implications**

With this contribution we have researched, how the concepts of creativity, invention, innovation and entrepreneurship are defined in theory and in the practice of engineering education in Denmark. We found that creativity, innovation and entrepreneurship lack a unanimous definition and not much research is dedicated to defining invention. Plucker, Beghetto, & Dow (2004) argue that the problem with defining creativity is harmful to the field of research because without a solid definition the field will lack direction, be object for damaging mythologies and general misunderstanding. This will generally undermine creativity as a field of research and have a negative impact on the development of educational practices. This is likely transferable to the other three concepts. It is clear that some educators use innovation and entrepreneurship interchangeably and it is not clear in educational processes where creativity, invention, innovation and entrepreneurship starts and ends. However, on one hand we have to consider that in education the practical use of these terms is very important. Using them interchangeably can lead to confusion for the students and also affect their motivations. Expectations and perspectives that the students come with into the classroom from the prevailing definitions of these have to thus be taken into account. On the other hand, due to the clear inter-connection between creativity, invention, innovation and entrepreneurship, it may be fruitful in educational development and research not to look at the concepts in isolation. Insight could possibly be gained by cross-conceptual work, solidifying each field. In the future, it is recommended that more work be done in this area and that a larger study conducted in which we can extend the preliminary findings of this paper.

## References

- Baregheh, Rowley and Sambrook(2009). Towards a definition of innovation. *Management Decision* Vol. 47 No. 8, 2009 pp. 1323-1339:
- Bhide, A. V. (2000). *The Origin and Evolution of New Businesses*. Oxford University Press, USA.
- Corsaro, D; Cantú, C; Tunisini,A. (2012), Actors' Heterogeneity in Innovation Networks, *Industrial Marketing Management*. Volume 41, Issue 5, July 2012, Pages 780-789
- Damanpour, F. (1991). Organizational Innovation: A Meta-Analysis Of Effects Of Determinants and Moderators. *Academy of Management Journal*, 34(3), 555–590. <https://doi.org/10.5465/256406>
- Fodor, E. M., & Carver, R. A. (2000). Achievement and Power Motives, Performance Feedback, and Creativity. *Journal of Research in Personality*, 34(4), 380–396. <https://doi.org/10.1006/jrpe.2000.2289>
- Fooladi, I., & Kayhani, N. (2003). Is Entrepreneurship Only About Entering A New Business. *The Journal of Entrepreneurial Finance*, 8(2), 1–11.
- Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2004). *Entrepreneurship* (6th ed). Boston, Mass. : McGraw-Hill/Irwin. Retrieved from <https://trove.nla.gov.au/version/35026418>
- Kao, R. W. Y. (1993). Defining Entrepreneurship: Past, Present and? *Creativity and Innovation Management*, 2(1), 69–70. <https://doi.org/10.1111/j.1467-8691.1993.tb00073.x>
- Kobia, M., & Sikalieh, D. (2010). Towards a search for the meaning of entrepreneurship. *Journal of European Industrial Training*, 34(2), 110–127. <https://doi.org/10.1108/03090591011023970>
- Lee,K And Lee,S. (2013). Patterns of technological innovation and evolution in the energy sector: A patent-based approach. *Energy Policy*. Volume 59, August 2013, Pages 415-432
- Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why Isn't Creativity More Important to Educational Psychologists? Potentials, Pitfalls, and Future Directions in Creativity Research. *Educational Psychologist*, 39(2), 83–96. [https://doi.org/10.1207/s15326985ep3902\\_1](https://doi.org/10.1207/s15326985ep3902_1)
- Pope, R. (2005). *Creativity: Theory, History, Practice*. Routledge.
- Roberts, E. B. (2007). Managing Invention and Innovation: Technological Innovation Can Alter the Competitive Status of Firms and Nations but Its Purposeful Management Is Complex, Involving the Effective Integration of People, Organizational Processes and Plans. *Research-Technology Management*, 50(1), 35.
- Rocha, H. O. (2004). Entrepreneurship and Development: The Role of Clusters. *Small Business Economics*, 23(5), 363–400. <https://doi.org/10.1007/s11187-004-3991-8>
- Rogers, W.A. ; Lotz, M., Hutchison, K., Pourmoslemi, A., and Evers, A.(2014) Identifying surgical innovation: A qualitative study of surgeons' views. *Annals of Surgery*. Volume 259, Issue 2, February 2014, Pages 273-278.
- Sarasvathy, S. D. (2001). Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *The Academy of Management Review*, 26(2), 243–263. <https://doi.org/10.2307/259121>
- Shai, O., Reich, Y., & Rubin, D. (2009). Creative Conceptual Design: Extending the Scope by Infused Design. *Comput. Aided Des.*, 41(3), 117–135. <https://doi.org/10.1016/j.cad.2007.11.004>
- Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, 25(1), 217–226. <https://doi.org/10.5465/amr.2000.2791611>

**Appendix 1 (Survey data):**

<b>Concept Actor</b>	<b>Invention</b>	<b>Innovation</b>	<b>Entrepreneurship</b>
Participant 1		-Something new that creates value -Doblin's 10 types of innovation.	
Participant 2	A process of creating a new meaning. A meaning could be a tangible product, intangible product (e.g. service), concept/idea, process/workflow/method.	-A process of creating new values from some existing meanings through implementing continuously the principles of "connecting the disconnected", whereas discovering the disconnected is achievable through intense observation into the key aspects including functionality, usability, technology, methodology, aesthetic and user's affection. The principle of "reflection in action" applied through the continuous loop of design-build-test is the key to innovation. Neither disruptive nor sustaining innovation concept is put into the above definition.	
Participant 3			-Behavior related to opportunities leading to value creation for others.
Participant 4			-The start of a business. As a starting point, a company that you want and are able to start.
Participant 5		-The ability to create innovation with a business aim or the ability to create renewal to promote the solution of tasks in both the public and private sectors.	

Participant 6		<p>-Innovation must be value creating, implementable and innovative.</p> <p>-Innovation is transforming creative ideas, mindset and processes into reality - be it products, businesses, workflows etc.</p>	
Participant 7	<p>-The development of a new technology, product or process.</p>	<p>-Creativity that creates value.</p> <p>Creating something new by development or/and adaption new ideas or concepts that gives value to customers, citizens, organizations, society</p> <ul style="list-style-type: none"> <li>- a process</li> <li>- a product</li> <li>- a market segment</li> <li>- a business model</li> <li>- a mindset</li> </ul>	<p>-Ability to search for and undertake new concepts/ideas/projects/technologies/mindsets to create new business</p> <ul style="list-style-type: none"> <li>-to drive the creation and destruction process.</li> <li>-to discover the unknown to make benefits for organization, business, customer, citizens.</li> </ul>
Participant 8	<p>-A complete new – never seen before way of doing something or technology – it can be in research or in development, services.</p>	<p>-A combination of know technologies or services or inventions where it is bringing values to the users/customers/citizens/companies.</p>	<p>-The way to see opportunities for getting on the market with the innovation or inventions.</p>

Participant 9	-Something completely new and unexpected, which has an application of some type. It may be patentable, but it is not a demand that it is patentable. It should not just be an incremental change building upon things known to the inventor, but should have a uniqueness and unexpectedness with respect to the environment that the inventor (student) is in and their level of experience and knowledge.	-An ability to create something new or a new value proposition that can have value. In the context of a student and education, this does not have to result in a prototype (but it can) or a finished 'thing', but should result in some kind of product demonstrating the potential of the innovation, for example a report addressing how the innovation can be realized in practice, relevant business models etc. An innovation does not have the same demand of unexpectedness that an invention has.	-An ability to take an invention or an innovation or some kind of value proposition and to actually realize it into a product that creates concrete value of some type (not necessarily monetary), both for the organization (or the entrepreneur themselves) the entrepreneur is in, as well as for the 'customer', stakeholder or end user of the 'product'. The word product is used in a broad sense and does not have to be a device. Entrepreneurship also encompasses intrapreneurship.
Participant 10	-A specific invention.	-A more or less structured process that leads to new products, businesses or services.	-A set of skills and methods that you can acquire and practice depending on talent.
Participant 11	-A game-changing solution for an existing (or assumed) problem.	-A game-changing solution for an existing (or assumed) problem.	-The process to bring any of the two concepts above to real life.
Participant 12	-The process of bringing something completely novel into the world.	-The art of improving an existing idea or technology.	-The process of building a business from an invention or innovation, i.e. commercializing it.
Participant 13	-A new and unique product, service, process etc. Something which can be patented.	-It's the process of generating and implementing ideas that create value for a group of users (therefore focus on users is also a big part of innovation process). - Innovation doesn't have to result in something "novel". It can be "something new to the world", but it can also be	-Entrepreneurship is much about the skills of the person(s) who turns ideas into reality and bring them to the markets where customers are willing to pay for them. They are starting and growing new business' or developing new business' in existing organizations.

		“new to a market” or “new to an organization” etc.	
Participant 14	Something invented as seen for the first time (often a technical feature, a product, a process not necessarily very useful or the use of the invention may be unclear (needs to be discovered).	Developing and implementing new, useful (value creating) solutions.	The actions, attitudes, mindset and personal proactive behavior the individual plays out while conducting or making innovation happen in spite of extreme uncertainty.
Participant 15	An idea or new technology.	Creating new business with an idea or new technology.	Starting a new business.
Participant 16	A new technology.	A new prioritizing, combination, and selection of perspectives that creates new value.	Goal oriented execution of a business through discovery, incubation, and acceleration.
Participant 18	<ul style="list-style-type: none"> <li>- Coming up with proposals for new solutions to known and unknown problems.</li> <li>- Typically relates to technical aspects in product development, e.g. new functionality or new construction principles. Maybe even eligible for a patent (it actually happens sometimes).</li> </ul>	<ul style="list-style-type: none"> <li>- commercial viable product or product-service (student projects are not an innovation, but they may be innovative)</li> <li>- newness criteria (multiple, see e.g. Doblin group 10 types of innovation)</li> <li>- design perspective: creating new meaning.</li> </ul>	<ul style="list-style-type: none"> <li>- pro-actively addressing a market need/opportunity and acting upon it.</li> <li>- attempting to bring a new product/service to market.</li> </ul>
Participant 19	Invention er ikke i mit ordforråd. Tænker blot det betyder opfindelse.	Innovation is to do something new that can be used in practice.	Entrepreneurship is the ability to create a new organization, most often business. Business formation is a little bit narrower.



Participant 20	An invention is the introduction of a new idea, often manifested in a new product, service, process or business model. For inventions, the market/implementation success is still unknown and thus inventions may lead to no implementation or commercialization.	An innovation entails a successful implementation or commercialization of a new product, service, process or business model.	A new venture creation or new value creation. The concept of entrepreneurship can often be tied to a "person" or a "process", where the former emphasizes traits and characteristics of the entrepreneur the latter describes the content and the activities which are a part of entrepreneurship.
Participant 21	An invention is an idea, a sketch or model for a new or improved device, product, process or system. Such inventions may often (not always) be patented but they do not necessarily lead to technical innovations. In fact, the majority do not.	An innovation in the economic sense is accomplished only with the first commercial transaction involving the new product, process, system or device, although the word is used also to describe the whole process.	Entrepreneurs are innovators: People who come up with ideas and embody those ideas in companies.
Participant 22	The creative production of an inventor.	The process of making an economic impact based on an original and useful idea.	The process of making an economic impact by means of a new venture creation.

Participants 23	This invention can be further developed into an actual product, but it is still not innovation.	You can talk about innovation as both a process and a "result". The result arises as a result of the process: When a new invention has been developed for a real product (service or other) that the intended recipient has addressed (I distinguish between customer and user, which is not necessarily the same) so that The product changes something (existing ways of doing things or introducing brand new possibilities). It can be shortened to Invention + commercialization + adoption = successful commercialization, which is the innovation performance that a business is looking for. However, innovation may also be non-commercial. If someone invents something new and useful, which changes something for example a good friend - but does not choose to commercialize the product ... yes, it is also innovation, but it does not end with innovation.	It is about building a business by developing and / or commercializing something new. It is associated with some personal characteristics - ie. You can be entrepreneur and thus able to identify, pursue and exploit new opportunities.
Participant 24	Is an idea, a sketch or model for a new or improved device, product, process or system. It has not yet entered into economic system, and most inventions never do so.	An 'innovation' is accomplished only with the first commercial transaction involving the new product, process, system or device. It is part of the economic system.	Entrepreneurship: An organizational structure aimed at bringing a product or service to the market.
Participant 25	The creation of a new idea / invent.	Do new things or do things that have already been done, in a new way, so it creates values.	Realize ideas by establishing a new organization.