# Effects of project-based learning in education-enterprise collaboration to learning experience and student engagement

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### Abstract

Studies of management can be built around multiple pedagogical principles, from lecture- and reading-based methods to case studies, project- and problem-based studies or even holistic development programmes performed in collaboration with corporate partners. In wider entities mixing some of the above methods is typical. This paper looks at the impact on learning experience of engaging live projects – performing research and development assignments for existing technology companies – as part of the one-semester specialization programme of high-tech management at JAMK University of Applied Sciences in Finland. In evaluation of the rationale of this pedagogical choice this paper utilizes the learnings of prior-art research as well as the guidance given by the legislation and the strategy of the institution. The results indicate that this pedagogical approach has the potential to deliver better learning outcomes compared to other traditional types of courses at JAMK offered by the same teachers.

Keywords: Interaction, problem-based learning, project-organized learning, project study, collaboration

# 1. Introduction

The ideas of project- and problem-based learning are not new. Kolmos (1996) traces the origin of these concepts back to early 1970s. Since new research and publications on the subject appear regularly, the method(s) seem both be well alive and not yet in the end of their life-cycle. Kolmos makes a point of project- vs. problem-based learning that is still valid – differentiation between the two is hard to make and label given to a relatively similar pedagogical solution depends mostly of the institution practicing it. In this paper the concept of project-based learning is adopted, as it is the term that is used in the context from where the unit of case analysis - an individual full-semester specialization programme, and more precisely its project module - is taking place.

The main idea of the project work is that it is emphasizes learning over teaching. Common to all types of project work is that the underlying problem needs to be analyzed and solved by means of different kind of learners (Kolmos, 1996). The role of the teacher is rather the one of a facilitator. Some differentiation between the problembased pedagogy and project-based one seems to be that the latter one allows participants to go for wider array of methodological choices and teacher's focus being more in the outcome, whereas the problem-based learning tends to put somewhat more teacher focus on process per se.

From educational point-of-view project-based studies are not the easy option despite their wide acceptance as a method. The challenges include risks both to learning and learning experience of the students as well as to the longer-term effects on the relationships to the project assignor company in case the planned results are not achieved. For example Jones and Clulow expressed in 2012 a statement deriving from a get-together of various stakeholders in the collaboration process that "Though industry-academic collaborations can be challenging, the benefits certainly outweigh the risks."

This research aims at contributing via a case study to the knowledge of the value of project-based learning and collaborative education-enterprise learning environment by answering the following research questions:

- 1. Can an environment that joins bachelor-level business students with high technology start-up entrepreneurs create collaborative learning?
- 2. Does teaching method including project-based learning have positive impact on achievement of learning goals and students' engagement to learning process compared to courses not having that element?

The context of this research is Finland, and more precisely the start-up segment of its economy. The entrepreneurs involved in the learning process of the study were all located in the city of Jyväskylä, whereas the students in the sample were both from Finland and abroad, thus representing multiple different cultural background and teaching and learning styles.

The rest of this paper is structured in the following way: Section 2 reviews the relevant literature bound to the phenomenon under study. Section 3 explains the methodology applied to answer the research questions. Section 4 presents the results of the case study and conclusions derived, and the paper ends in the closing Section 5 with a discussion of findings.

## 2. Literature review

The knowledge base for this paper is introduced in this section. The aim is to familiarize the reader first with the wider context of reasons for educational institutions and enterprises to engage into collaborative practices, then moving on to clear a sharper definition and defense based on literature to one form of those practices – project-based learning. In the last sub-section 2.3 the context of the case studied in this paper – high technology based start-ups and their specific managerial challenges - gets introduced.

# 2.1. Societal call for joint projects between education and enterprises

On the level of whole society it has been widely discussed and a general agreement has been achieved that collaboration between 1) the society setting demands as well as prevailing resources for education 2) industries who need skillful workers and up-to-date knowledge potentially achievable from different layers of academic research and education system 3) research and education institutions should all collaborate for creation of mutual benefit. For example the Finnish research consortium FINHERT (2003) coined the importance of this Triple-Helix (see Figure 1) as follows: "Moving towards the knowledge-based society, however, also means that boundaries between public and private, science and technology, university and industry are blurring as the distribution of research locations becomes a key factor of economic growth in a knowledge-based economy. Knowledge has become in growing extent a potential product that can be exploited on the market, which means the industrialization of the production of scientific knowledge". It is clear that the interaction between the players of the Triple-Helix vary in depth, length in time as well as the operational mode in which the interactions take place.



Figure 1: Triple Helix and activities within (FINHERT, 2003)

Societies, represented by governments have naturally various instruments in their use to promote and steer different entities to collaborate, one of the mechanisms being funding allocated to those who show evidence of capability to share with Triple-Helix partners. Societies' role can be interpreted to mostly that of an enabler that makes it possible to Universities-Firms interaction to take place. As Matlay and Mitra (2002) claim, the E-E model

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(Education-Enterprise) has been found to be consistent with the societal growth centric belief and thus suitable for economic regeneration of society. Societies have also taken in use legislative means in the attempt to ensure that the E-E model moves from planning to action. The Polytechnics Act 315/2003 was the prevailing legislation already at the phase of planning and first executions of the high-tech management programme in 2005. By reading the legislation one gets to a clear conclusion that E-E-cooperation is not an option in the given context but a default setting. The act (FINLEX, 2014) tells in its different sections that:

- Universities of Applied Sciences (UASs) shall provide higher education for professional jobs based on the requirements of working life and its development.
- Carry out applied research and development that serves their education, supports the world of work and regional development.
- In carrying its mission a UAS shall cooperate with business and industry and other sectors of the labor market.

In the field of education, quality assurance is also partly taken care by different accreditation schemes which use rigorous criteria in evaluating the outcomes of educational processes. One of them is IACBE, an Americanoriginated collaboratively developed sector-specific entity – as its full name "The International Assembly for Collegiate Business Education" says - focusing in quality in business education. IACBE (2014) has listed altogether 17 Characteristics of Quality in Business Education, some of which point directly towards real-life learning experiences in collaboration with enterprises. The criteria include (selections by the author):

- The academic business unit develops students, both personally and professionally, into well-educated, ethical, and competent business professional.
- The academic business unit encourages both internal and external cooperative relationships with other educational units and institutions that are consistent with its mission and broad-based goals.
- The academic business unit has meaningful and effective linkages between the classroom and practitioners in the business community, thereby contributing to the assurance of currency in and relevance of its business programs.
- The curricula in business programs ensure that students understand and are prepared to deal effectively with critical issues in a changing global business environment.

2.2. Potential added value of project-based methods to learning

As a summary to previous sections it can be stated that there is a wide acceptance that both society as a whole, educational institutions as well as companies have potential to gain from projects run jointly by academia and companies. To fully justify project-based learning a natural question is that of learning and learner.

Dale (1969) shows that higher student retention of subject matter can be achieved with higher engagement of the student, i.e. by "doing the real thing", indicating that project-based work has a role in improved learning experience. Dale's Cone of Experience still works as a motivator for teachers aiming for hands-on work and applied research projects, despite the fact that its accuracy has been under discussion.



Figure 2: The Cone of Experience ( adapted from Dale, 1969)

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Also the new technological advancements in learning and teaching have been seen as challengers to the hierarchical listing of the effectiveness of teaching modes. One way of looking at the new challenges and opportunities is that of "high tech – high touch". New means of learning enabled by technology can and are used to increase student engagement and thus improve learning results. This model (Figure 3) has also been used internally as a schematic model of learning solutions in the study programme of high tech management (HTM) at JAMK UAS that is the case in this paper. Quality in Business Education -project (QuBE) published in 2009 illustration of the synchronous vs. asynchronous human interaction and their effect on the level of student engagement. According to this, live projects create highest level of engagement (see Figure 3).



Figure 3: Model on High Tech/High Touch and engagement (QuBE, 2009)

As De Graaff and Kolmos (2003) underline, the basis of the project work lie in the subject-oriented nature of the process, where learning objectives related to subject matter exist that must be satisfied within an educational programme. Projects must have a clear skill- and knowledge-creative nature in the development of the learner, and the learning should be achieved from the project. The visualization by Kjaersdam and Enemark (1994) in their booklet "The Aalborg Experiment – project innovation in university education" puts well projects studies into dialogue with other modes and phases of learning and teaching (see Figure 4). This model has also been adapted to JAMK's HTM programme project-study module.



Figure 4: Principles of project-organized problem-solving (Kjærsdam and Enemark, 1994)

As mentioned above, the flux of scholarly writings on project- and problem-based learning is still high. New developments and measures of effectiveness are sought. As Sven Caspersen from Aalborg University states in the preface of the book on Aalborg PBL model (Kolmos et al., 2004), a proof of concept is that the graduates of this university that has applied PBL for a lengthy period are well-received by the labor market and that the model has been adopted by many other universities across the globe. The learning effects of project- and problem-based pedagogy have been assessed in various types of contexts.

An example of assessments was done by Pyykkönen and Kalliomaa (2013). In this assessment, a PBL application at the School of Business at JAMK UAS was analyzed in the course of international marketing. The PBL method was used at the international lecturing visits at JAMK's partner universities. Authors point out that student feedback was very recommendatory compared to the traditional pedagogy in place – and also the Finnish assignors ("problem-owners") looking for new markets and ways of market entry got value for their engagement in the process. Another assessment that happened in the same context as the course of scope in this paper was an international student group competition in business statistics course arranged jointly in 3 universities in Europe. In their analysis Akpinar, Del Campo and Eryarsoy (2014) conclude that collaboration among students that was forced by the setup of the learning method had a positive learning effect.

### 2.3. Specific management and learning challenges of high tech business

The previous sub-section introduced the general definitions and rationale of project- and problem-based learning. As the aim of this paper is to look more closely into implementation of live projects of one specialization course in collaboration with high technology based start-up enterprises, it is all natural to ask: Are there some specific characteristics in this business context that defend the role of project-based studies and/or set specific challenges to project-based learning?

Mohr et al. (2010) have summarized the main underlying forces that characterize markets of high technology products and services (see Figure 5). Despite the fact that the forces of Market Uncertainty, Technological Uncertainty and Competitive Volatility are present to certain extent in all industries, their presence in high technology business is such that they can transform the sources of success of individual companies and industries in a short time span. Fine (2008) has shown that the clock speed – a pace of profound changes in the value chain structures of industries and time-frame in which the value chain must operate on constant basis and react to environmental changes – has been increasing throughout industries. In addition there are sectors of industry like Information and Communication technologies, where the clock speed is of a higher level than the average of industries.



Figure 5: The forces characterising High tech markets (Mohr et al. 2010)

This pace of change sets a number of challenges to teaching and learning methods in the subject area of high technology management. Learning from the past, for example via case studies has limited applicability to present conditions.

Since the technology and knowledge-based growth companies are the main source of net job growth in most societies – opposed to most traditional established firms that are geared towards downsizing/streamlining their organizations –, the students' future workplaces are in firms and industries that are recently born or even to be born. This suggest that live projects – solving research and development projects assigned by enterprises – have also a meta-purpose form educator's point-of-view. In addition to offering networking opportunities and working-life based learnings to students, it offers the teacher or facilitator an opportunity to mirror the relevancy of the other theories and tools taught in other modes of learning.

The benefits of projects sourced from high technology firms seem to be quite obvious to learners and teachers, as well as to the educational institutions trying to fulfill the requirements set to them by governments and bodies of quality assurance in education (see sub-section 2.1.). What is there for the third party of the triple helix – the enterprises?

High technology firms naturally vary in size of their operations and organization. Typically the established firms have their own departments of research and development, business intelligence, marketing and sales, leading to less of a need to gain new information and knowledge via education-enterprise interaction. Quantity-wise there is however in high technology business a big undergrowth of small firms in the early trajectory of their existence and growth. These firms can be seen to be more likely welcoming to project-work in collaboration with students. Marmer et al. (2011) have in a relatively recent initiative of Start-Up Genome Project made an attempt to find the basic start-up technology companies. The research which was conducted in 2011 had already 650 companies in its database stressing some common nominators for start-up technology-based companies throughout the four first stages of company and business development: Discovery, Validation, Efficiency and Scaling. Two of these characteristics (selected by the author, for more comprehensive presentation see Figures 6 and 7) are the following.

- Non-mature start-up companies are extremely limited in terms of personnel resources (even in US where the database is collected from and where the Venture Capital industry is most developed). The available funding does not allow many recruitments into market research and/or buying specialized consultancy services
- The challenges and competitive advantages that are vital for success change in importance over the four stages of development path (see Figures 6 and 7).

1994 (1994)	Avg. Months Working	Avg. Funding Raised	Avg. Number of Employees	Avg. % User Growth in last month	Top Competitive Advantages	Top Challenges
1. Discovery	7	\$227,000	1	6%	IP Technology	Customer Acquisition Over capacity
2. Validation	11	\$800,000	4	21%	Partners Insider Info	Customer Acquisition Product Market Fit Problem Solution Fit
3. Efficiency	17	\$900,000	4	29%	Traction IP Insider Info	Customer Acquisition Team building Fundraising
4. Scale	25	\$3,000,000	17	43%	IP Traction Technology	Customer Acquisition Team Building

# Overview of Results:

Figure 6: The stages of new venture development and related resources (Marmer et al., 2011)



filter: only consistent startups that raised money



Thus the start-up technology companies can gain in relative terms more knowledge from student-enterprise interaction in relation to the knowledge accumulated by firm's internal resources. Also the projects tend to be more challenging and questions more open-ended, leaving room to students' own initiatives and methods of getting into results. This can be well understood by following the thoughts of some of the most quoted writers on start-up business development. Eric Ries (2011) defines start-up as "an organization dedicated to creating something new in terms of extreme uncertainty". This definition itself proposes that the uncertainty can even change the project assignment in the timeframe in which a student-enterprise collaboration takes place, typically 3-5 months. This type of redirection of the project aim and "moving goals" give student a very realistic view of life in the business environment their assignors are operating.

Steve Blank is the founding father of the Customer Development philosophy, which has been followed in development of the Lean Launch Pad entrepreneurial training methodology. In Blank's thinking (see Figure 8) the core knowledge for company development is the identification of the potential customers, their true needs and as a result, finding of a problem-solution fit to them.



Figure 8: The phases of company development in Lean Launch Pad model (Blank, 2007)

Since high technology business is very much global, these customer discoveries in many cases have to be found in multiple geographical markets. Therefore international student groups with skills in multiple languages, knowledge of cultures and with skills of modern data search methods, can assist non-mature technology firms with their output.

## 2.4. Start-up business context for project-based learning - entrepreneurial approach to projects

The most fertile ground for live projects in high technology business may be growth oriented start-up firms which are in an evolving stage and short of own resources. The collaborative learning in dialogue with them leads students also to see some parts of the entrepreneurial growth process, as founding team members are likely to act as project assignors. In other words, jointly with problem-solution search that takes place in the project itself, meta-skills in entrepreneurship can potentially be achieved.

There has been throughout the beginning of the millennium a strong call for new methods and programs to foster entrepreneurship education, and in the economic downturn the role of entrepreneurship has even fortified. Wee (2004) proposed a model of transferring the existing lecture-tutorial based entrepreneurship education into problem-based learning environments. The statement by Wee is that "students are more likely to consider entrepreneurship if they are aware of and can manage the critical incidents faced by entrepreneurs competently and confidently". Recently, Maia and Claro (2014) summarize the findings of a study of an ample body of literature in entrepreneurship education by stating that "despite the lack of supporting theory and methodologies, entrepreneurship theory suggests that exposure to enacting experiences is a way to improve entrepreneurial behaviors. These enacting experiences are said to be quasi real-world experiences, in which students work on real problems and real solutions, with short-term deliverables that require rapid iteration. By close collaboration with companies, well-designed and facilitated project work process, the "quasi" part of definition can be in the best case abandoned. In the paper of Duening et al. (2007) where diverse educators from across Arizona State University's (ASU) campus discuss the entrepreneurship education from various angles, F. Miguel Valenti (from the School of Theatre and Film at ASU) states that: "Students should depart their university-based entrepreneurial training with, at the very least, a more flexible method of analyzing problems and opportunities than that with which they likely matriculated. They should develop a basic understanding of how successful entrepreneurs have reacted to the business and social realities they have faced." How this can be achieved is discussed later in the paper. According to Prasad Boradkar from School of Design the following three mechanisms should be used to deliver knowledge related to entrepreneurship.

- 1. Lectures and readings to introduce students to the fundamental concepts of entrepreneurship.
- 2. Project based education where they can apply the concepts learned.
- 3. Internships and mentorships where they can engage with entrepreneurs and corporate leaders, and observe as well as learn from the practitioners.

All of these elements have been built into the curriculum of the course in this paper, implementation of which is explained in Section 3, and results achieved are analyzed in Section 4.

# 3. Research design and methodology

This research used case study as its research method. More tightly put, a single-case study was the methodological choice. Case study-approach was chosen due to the nature of the research questions and access to relevant data. Eriksson and Kovalainen (2008) state case study approach is used when we want to study intensively a single organization or smaller unit of it and recognize factors involved in its behavior. In this paper the unit of analysis is a specific course inside a curriculum of a university degree programme, and more precisely the project-based and collaborative methods of learning in the course. Comparative multiple case study was not applied even though multiple cases are suggested to increase the methodological rigor of the study through "strengthening the precision, the validity and stability of the findings," (Miles and Huberman, 1994).

Due to the rather individual nature of the unit of analysis, well-suited cases that would possess enough of similarities in the context were not found (for example many of technology management courses and programs are looking high technology company management from engineering angle, and/or they are taught first at Master's level). According to Yin (2002) an intensive single case study is a defendable option when it aims at understanding a single case from within by providing extensive description. Since the author of this paper has been involved in the implementation and planning of the unit of case analysis – the course of HTM at JAMK UAS, the position of research in this case study requires consideration. At the same time when it allows as close understanding of the case and analysis from within, it could lead to biased interpretation. Gillham (2005) points out that a case study researcher must maintain neutrality and professionalism even in cases where the evidence and findings do not support all assumptions held by the researcher. Also these findings need to be researched and presented. To eliminate the potentially biased view, the data (see sub-section 3.1) was not collected via author's observation but from JAMK UAS's feedback databases.

According to Hair et al. (2006) the research design can be of three types: exploratory, descriptive or causal nature. Since clear research questions were formulated and relevant theory base for the research collected before engaging the case analysis, this paper is least leaning on the exploratory design, despite the fact that the case in question has not been subjected to a rigorous research before. The research design utilized is mostly of descriptive

nature. The nature of the case is described, and its outcomes as assessed by the stakeholders are presented. A step towards causality is taken by trying to create insights on what contributing factors may have influenced the results.

#### 3.1. Data collection

Measuring the value of project-based studies can be done on many different levels and form multiple angles. These can include the measures of education-entrepreneurship collaboration merely based on quantity of projects performed, learning effectiveness and learning satisfaction as experienced by students, effect in which the learning accumulated in projects transform the other parts of curriculum, and effects on student's employability.

Radharamanan et al. (2011) listed some constituents to make the base for evaluating the Entrepreneurship Engineering Education in Mercer University. These included factors such as student enrollment, number of entrepreneurship courses, number of entrepreneurial design projects in the program, exit interviews from seniors graduating from the entrepreneurship program, faculty teams to advise and evaluate the entrepreneurial senior design projects, and entrepreneurs to serve as advisors/mentors to student project design teams as well as judges for entrepreneurial senior design and business plan competitions.

Focusing on the numbers of students involved or projects preformed per course are considered to be not good indicators of quality as the HTM course taught at JAMK is a specialization option, which is not an obligatory part of any study track. Besides, the number of projects sought to be performed is related to the number of students choosing the course each year in order to maintain good project-team sizes. Number of projects is an indicator of existing collaboration with the business community. The firms have connections to the university so they can find students to meet their project needs, and university has contacts and credibility in liaison with companies in its search for project assignors. The number of projects done per course has varied from 6 to 11 projects, and the number of students involved in the project-based learning has varied from 23 to 50+.

For this paper the primary data was collected from 2 assessment mechanisms available for the case in question. The indicators used in this analysis for the value of project-based learning experience are the following.

- 1. JAMK general feedback database: student's numerical feedback collected at the end of each semester with focus on grades given by students to overall impression of the course, the suitability of teaching methods and students own activity to reach their learning goals (engagement).
- 2. Pre-and post programme surveys of the new type of project work established as part of the course in 2014: 8-week intensive LaunchPad Supercoach® Entrepreneurial Training (SET) (later in this paper referred as Launpad SET) programme. Students of HTM served in the role of assistant coaches to start-up teams in this project.

# 3.2. Presentation of the case

Since 2005, the International Business-programme of JAMK UAS has had in its curriculum a 3rd/4th year specialization course in HTM. This was a one-semester intensive course that has hosted both degree students of the host institution as well as exchange students from JAMK's partner universities. The specialization course was developed based on the dialogue in 2002-2003 with the surrounding business community of needs for future capabilities to foster job growth and economic wealth creation. The course has from the beginning been divided into 4 courses (high tech industry dynamics, high tech marketing, high tech strategies, managing change and innovation in high tech business). These were taught as one-month intensive course modules in a lecture/master class mode including however more case studies and industrial guest speakers then average in the rest of the School of Business and in the international business programme.

Parallel to this every student needs to take part of the fifth module: Analysis and implementation of a high tech project, where students work intensively for a full semester in an assignment addressed and monitored by firms operating in the field of high tech business. Most of the enterprises were in a start-up of even pre-start stage, so the context for project studies has been of entrepreneurial nature. The project-study module at JAMK HTM consists of three kinds of stakeholders. Since the demands set for the project are coming from enterprises and they have the best knowledge of the existing knowledge, they typically are involved in the project guidance. One shall remember that the high tech business uncertainties can also cause project targets and time frame to change during the process. Enterprises often collaborate with the teacher/expert tutor of the university in the project definition, and get interim and status reports to comment during the process.

Jones et al. (2014) stress the importance of project management in order to reach the learning targets as well as meet the substance goals set for the project as follows: "Poorly executed project management may be inconsequential during the academic period of a project or design, but will likely manifest itself at pivotal periods in the project lifecycle. Practicing good project management at the onset will help articulate team visions and goals, establish clear expectations, and ensure the technology, business, and risks are well understood". The project managers and process facilitators from both enterprise as well as academia act in multiple roles and practices related to the learning experience. Lutz et al. (2014) identify the following roles depending on the engagement levels of those non-student participants in the process:

- *Coaching*: multiple ways in which educators direct and guide students' project work.
- *Pushing for explanation*: verbal guidance strategy in order to encourage students to ground their decisions in empirical evidence, demand a clear chain of reasoning, and identify gaps in their knowledge that still need to be filled.
- Protection: not only from project failures, but from failures to learn the kinds of skills, behaviors, and attitudes that can transfer beyond the immediate course project to upcoming endeavors in the field.
- *Rapport*: to create a setting where students feel comfortable approaching mentors to ask for direction.
- Acceptance and confirmation: to provide encouragement as students face the inevitable setbacks and direction changes that accompany the process.
- *Role-modeling*: to help students envision the practices they are learning in action via their mentors' own practices and to help develop the mentors' credibility based on past experiences of both success and failure.

The last point brought up by Lutz et al. (2014) is important for the relevancy of the professional practice of the teacher tutor. Every new project with its recipe for success and setbacks experienced and hopefully solved serves as a foundation for new projects to come. Main actors in the projects are the following.

- 1. *Project assignor*: Typically a manager in a high technology firm or a member of the founding team of a start-up or pre-start-up phase team.
- 2. *Students*: as learners, carrying out the project task assigned by the company. The size of a project team has varied from 2 to 6 people of various nationalities, depending on the size of the task and for example the market areas that the project team needs to cover.
- 3. *Teacher tutor*: a JAMK lecturer or substance area expert assisting in the process of performing the project and managing the process.

# 4. Results

The faculty involved in delivering the teaching and learning assistance are the members of the permanent faculty of international business programme, teaching typically 3-4 other courses besides their duties in HTM course. Thus the teachers' skills, personalities and teaching methods are not likely to be a differentiator between HTM and other courses in the international business programme. What sets HTM apart from the rest of the offering, is the intensity of the company interaction that materializes in the form of the assigned projects. By comparing the student feedback grades for courses we can see if intensive project work seems to have effect on the experienced learning and student engagement.

To further improve the connection to working-life reality and collaborative learning with enterprises, it was decided by the programme management to integrate to the Spring 2014 implementation of the HTM course a previously separate intensive 8-week entrepreneurial coaching programme, developed by Sharon C. Ballard and Jonathan Levie at EnableVentures Inc., USA, and implemented into 100+ universities in US and abroad. The original target group of the coaching programme are the first-time science and technology-based entrepreneurs – i.e. tech start-up teams. In JAMK's model of implementing the process,  $3^{rd}$  and  $4^{th}$  year students can join the programme as "assistant coaches", joining the forces with founding team members of start-ups. Thus in 2014 HTM students had 2 separate education-enterprise collaboration projects to work on:

- 1. A research assignment project
- 2. The intensive collaborative entrepreneurial coaching programme

There was inevitably an increase in the student workload, since the two projects run simultaneously and the teaching of the 4 other modules coincided in time with these projects. Impact of such additional workload to the learning experience and student engagement can be assessed by looking at student feedback grades for 2013 and 2014.

The intensive 8-week Launchpad SET programme consists of 4 intensive full-day seminars where the structure of the whole course and main tools to be utilized in the process are introduced, and students are assigned to the entrepreneurial teams where their interests and skills match the needs of the start-up teams. Following the intensive days there are weekly coaching sessions facilitated by certified instructors of the coaching programme, where a holistic plan for new tech business development is created via seven separate themes for each session, with exercises to which the start-up teams and students collaborate to answer. The structure of the programme can be seen in Figure 9.





There were pre-and post-programme surveys done, in which both students and start-up entrepreneurs give their views on:

1. The criticality of different expertise areas for a development of the start-up

2. The level of expertise they feel they possess

By comparing the pre- and post-course survey results we can compare the change in the view of demands for start-up success – a focus shift, and learning achievements in the sense of experienced growth of expertise. If the students' (20 in number in pre-course survey and 17 in post-survey) and start-up team members' (7 and 11 in preand post-surveys) views are moving in the same direction, then it can be stated that collaborative learning has taken place. The results are summarized in Tables 1 and 2.

The first question was posed in the Pre-course survey as: "What do you believe are generally speaking the most important capability areas for start-up companies?", and in post-course survey the question was modified to be: "List how important the following capability areas – the seven themes that consisted the first seven weeks of the 8-week program, the remaining one being the final presentation to investor panel - are for further development success of the business case you worked on". The business case means naturally the start-up firm, so both entrepreneurs and the student coaches that had worked actively on the case for the 8 week period were looking at the same cases.

The results (summarized in Table 1) show that there is slightly smaller difference in views of the students vs. team members from start-ups (average difference in  $\Delta$ -value across 7 capability areas decreasing from 0,35 to 0,29), indicating that their views get closer to each other as a result of a joint process. Interestingly, however, the changes in numerical values given to individual capabilities were in some cases going in opposite directions. At the start of the program the start-up team members put a very high value to IPR and technology management, and that value dropped notably by the end of the process, whereas in students' view the value remained constant. This may be explained by the different backgrounds of the two cohorts; the start-up team members were mostly – and just as the planned set-up for the course is – first-time science and technology-based (in majority of cases in field of ICT) entrepreneurs. So their business idea and stage of business plan was at the start technology-heavy.

The surprising phenomenon of average numerical values falling in case of start-up team members, opposed to the increase in values in student cohort. The development in students' grading seems to be explained by the increase of assessed importance in two capability areas: IPR and Technology management & Financial Planning. The previous one is quite obvious, since typical business studies in bachelor's level contain very little IPR management studies. The second capability area rising in importance in students' views is more surprising, since the students have taken various courses in financial accounting and management prior to the process. The explaining factor may be that for the first time in their learning path the financial look at the companies is done from and for venture capital investor's point of view. The overall decrease in importance assessed by the start-up

team members would need deeper – perhaps qualitative study to find a root-cause for the phenomenon. At this point, it can be said speculatively, that overall growth in expertise (see Table 2) in the capability areas increases the self-confidence in those substance matters, and then the "importance" and "importance to learn more for our case" get subconsciously mixed in the mind of the survey respondents.

**Table 1.** Importance of different capability areas for start-up development - pre- and post-programme evaluations (scale 1 = not important at all  $\leq > 5 =$  extremely important).

	Pre-Programme Survey				Post-Programme Survey			
CAPABILITY AREA	Start-up team	Students	Difference	Δ	Start-up team	Students	Difference	Δ
Strategic Planning	4,71	4,45	0,26	0,26	4,45	4,35	0,1	0,1
IPR and tech management	4,14	4,00	0,14	0,14	3,45	4,00	0,1	0,55
Marketing and Sales	4,86	4,50	0,36	0,36	4,64	4,47	0,17	0,17
Competition and alliance knowledge	4,29	4,10	0,19	0,19	3,64	4,29	0,65	0,65
Operations, management and staffing	4,29	3,90	0,39	0,39	4,00	3,76	0,24	0.24
Financial Planning	4,43	4,15	0,28	0,28	4,09	4,35	0,26	0,26
Presentation Skills	4,71	3,90	0,81	0,81	4,18	4,06	0,12	0,12
Average	4,49	4,14	0,35	0,35	4,06	4,18	0,12	0,29

The second question was set as "Rate your skills in different capability areas" – that was asked at the start of the course as well as after the course. Following conclusions can be drawn from the results (summarized in Table 2).

1. Important steps of capability development can be achieved in the relatively joint time-span of 8 weeks.

2. The capabilities of students and start-up entrepreneurs can be developed simultaneously in a collaborative learning process.

- 3. Depending on the educational and experience background of students vs. start-up entrepreneurs, the steps taken in (self-assessed) capability development can be of different magnitude for example, in the areas of IPR and technology management & financial planning.
- 4. However, despite the different magnitudes of development steps taken the student and entrepreneur cohorts' views of their possessed capabilities moved closer to each other on average (decrease in the average of the  $\Delta$ -value between the two cohorts).

Pre-Programme Survey		e Survey	]		Post-Program	nme Survey	]	
CAPABILITY AREA	Start-up team	Students	Difference	Δ	Start-up team	Students	Difference	Δ
Strategic Planning	3,29	2,84	0,45	0,45	3,73	43,47	0,26	0,26
IPR and tech management	2,71	1,80	0.91	0.91	3,64	3,24	0,40	0,40
Marketing and Sales	2,43	3,15	0,72	0,72	4,00	3,78	0,22	0,22
Competition and alliance knowledge	2,71	2,45	0,26	0,26	3,82	3,53	0,29	0,29
Operations, management and staffing	3,14	3,05	0,09	0,09	3,55	3,53	0,02	0,02
Financial Planning	2,70	3,00	0,30	0,30	3,64	3,18	0,46	0,46
Presentation Skills	3,50	3,92	0,21	0,21	3,55	3,82	0,27	0,27
Average	2,92	2,78	0,14	0,43	3,70	3,50	0,20	0,27

Table 2. Assessed personal skill levels of participants – pre- and post-programme evaluations.

In addition to the analysis on the feedback to specific intensive LaunchPad SET programme, the student feedback to HTM specialization course was compared to the overall feedback to courses arranged by the same degree programme, taught in same premises and by same teachers as HTM. The biggest single differentiating factor was the mode of working, and there the differentiator is the high-intensity project work, as other modes of teaching like case studies, guest lecturing, workshops etc. are commonplace throughout the curriculum. The hypothesis was that intensive work with real-life companies is both supporting the learning as well as work. Demands from a project assignor act as a motivator, leading to higher student engagement and more active work towards the learning goals.

The data (see Tables 3 to 5) was extracted from JAMK's internal ASIO IT-system, where the feedback (from 1 to 4) given by students is done at the end of each semester anonymously, response rates move typically between 50-70 %. The assessments by the students were analyzed for 3 different questions in JAMK's feedback system:

- 1- Overall feedback grade for the course (an average of answers to 7 sub-questions)
- 2- Q4: The Teaching methods used supported well my learning
- 3- Q6: I worked myself actively to reach the learning goals.

Assessments given to HTM course were compared to the feedback for all IB programme's courses from 2011 to 2014 in Table 3. In Tables 4 and 5 the comparable course sample was made of 6 randomly selected year 2014 courses from JAMK International Business-curriculum. To avoid a personal bias, the choice of the representative course sample was not done by the author of this paper, who is a stakeholder in HTM and LaunchPad SET as course/programme coordinator.

A special topic of interest was to see if the inclusion of the LaunchPad SET programme within HTM has an effect (i.e. 2014 evaluations vs. previous years) on overall course feedback as well as feedback on teaching methods and student's own engagement. The findings (see Tables 3-5) give indications that allow the following statements.

- A specialization programme having intensive students-company relationship are in general terms assessed to be better than a random sample of other courses in the same programme (see Table 3).
- Intensive students-company relationship seems to be a factor positively assessed in the quality of teaching (see Table 4), more precisely a method assisting better learning.
- The holistic and intensive collaborative learning environment with real-life start-up entrepreneurs made a notable increase in all 3 factors assessed overall quality of the programme, support of methods to learning and student's own participation (see Table 5).

Table 5. Overall student feedback 1111	The vs. die whole in programme.						
	2011	2012	2013	2014			
HTM programme	3,60	3,50	3,38	3,76			
Comparable sample	3,00	3,20	3,10	3,20			

Table 3. Overall student feedback - HTM vs. the whole IB programme

Table 4. Feedback to Q4: "Teaching methods used supported well my learning".

	2011	2012	2013	2014
HTM programme	3,70	3,50	3,50	3,80
Comparable sample	3,10	3,30	3,10	2,90

Table 5. Feedback to Q6: "I worked myself actively to reach the learning goals".

	2011	2012	2013	2014
HTM programme	3,60	3,40	3,30	3,70
Comparable sample	3,10	3,20	3,10	3,20

As a summary it can be stated that both research questions can be answered in the light of the case research results. The results, however, would gain more reliability if comparable cases were identified and thus multiplecase-study method was applied. Based on the results it can be assumed that collaborative education-enterprise learning environments can be created in high technology business context in such a way that it allows collaborative (different stakeholders learning same things even though assessed gain in knowledge varies) and mutual (learning from each other) learning. Also the inclusion of live projects where students are engaged with real-life companies in solving the assigned project tasks, acts as an enhancer in achievement of learning results and student engagement towards their own learning goals.

## 5. Discussion

This research with its results adds to the earlier research on value of project-based learning, strengthening the views that adding real-life business connections and tasks derived from them has positive impact on students' learning results and active engagement to the learning process. Creating collaborative education-enterprise practices seems to work also in the high technology business context, at least with firms at their start-up phase. Both members of entrepreneurial teams as well as the students can learn jointly and from each other.

There are also learning achievements applicable to business development by the practitioners. One effect that seems plausible but was not studied in this paper is the deeper impact to the educational institution and its actors. Working in cooperation with (newborn) companies can be assumed to improve and keep up the professionalism and networks of teachers, having an effect that goes beyond limits of one course or program. This effect would require a specific study. Can the choice of investing into collaboration with high-tech companies be justified, or is any project-based learning with all kinds of companies beneficial? Kauffman foundation (2013) research has shown that in US new and young firms are responsible for net job creation, not small businesses in general. The same pattern can be found in most developed economies, Finland included.

As the expert of confederation of Finnish industries Jari Huovinen (2013) stated, the number of growth companies (using the criteria of OECD and Eurostat: a growth company is a company that employs at the start of follow-up period min. 10 people and grows personnel min. 20% annually for 3 consecutive years) is growing relatively more than the total number of companies in Finland. Despite the fact their sales revenue only represents about 3% of the total sales of Finnish industries, their impact is larger than that, since "growth companies are important in fostering positive attitude towards entrepreneurship and activity. Young generation also has a lot of interest towards start-up entrepreneurship". Long-term effect on entrepreneurs, students and society of the educational course that was the case analyzed in this paper, can be fully assessed over the years by following the growth and success of the firms involved and trajectory of students as experts or entrepreneurship if they are aware of and can manage the critical incidents faced by entrepreneurs competently and confidently". Can exposure to real-life entrepreneurial work lead to students ' own future as entrepreneurs?

This research hopefully gives ideas for educators on how to arrange collaboration with companies and the value that can be derived thereof. The findings of this research cannot be directly be generalized to studies in different contexts and across subject matters, though many mechanisms described in this paper may prevail also in wider scale.

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