On the role of industry contact on the motivation and professional development of engineering students

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Abstract— **This full research paper aims to investigate the nature of industry-related activities engineering students encounter at a Swedish university, as well as the impact these activities have on their motivation to study engineering. Over the last decade, many studies have been conducted concerning university-industry engagement which chart the landscape of activities, educational approaches, and challenges that students face when involved in industry-related activities. Despite the existing close collaboration between Swedish engineering universities and industry, it seems that not only the feedback from the industry to universities is missing, but also students' perceptions of their industry experience and their needs are not taken adequately into consideration by the other two actors. As a consequence, there is a gap among the above three actors preventing the advancement of engineering education in terms of industrial interventions. Furthermore, there is a lack of research about students' perceptions of university-industry engagement activities. This study adopts a qualitative and exploratory research perspective, intending to gain a deep understanding of students' perceptions of industry-related activities which were integrated into their education. Semi-structured interviews were conducted with nine master's students studying on five-year long engineering programmes in a large research-intensive Swedish university. An inductive thematic analysis was employed, and social cognitive theory was considered as an interpretive tool through which to explore student motivation. The interviews indicated that the students participated actively in various industry-related activities, such as guest lectures, field-trips, internships, summer schools, and masters' theses in collaboration with industry partners which give context to the findings which highlight how industry-related activities can either positively or negatively affect students' motivation for studying and learning in engineering education.**

Keywords — Learning in engineering education, Industry involvement, Industry-related activities, Student motivation.

I. Introduction

The prolonged gap between higher level engineering education and industry has been acknowledged in previous research. On one hand, studies have shown [1]–[4] that although engineering schools are sending students out to industry as part of their educational experience, reforming and developing curricula are often perceived not to be conducted in a way that is most appropriate to meet industry needs. As a consequence of this, the feedback interconnection between industry and engineering schools is often reported to be missing. In addition, masters' students in engineering education seem to be more knowledgeable about research than practice [1], further strengthening the view that industry relevance may not always be the major focus in master's level engineering education. On the other hand, industry collaboration seems to be of great importance as Drysdale and McBeath [5] found that university students who do not participate in industry-related activities during their studies have lower academic achievement, it is more likely that they will use shallow learning methods, and that they are more extrinsically motivated compared to students who have attended some industry-related activity and gained work experience. The more liberal perspective emphasizes that universities make change to accommodate business needs, municipal organisations, the government, and the community at local district and national level, based on the belief that engineering schools should belong to university "open-system" [6]. Even though the gap between engineering education and industry expectations is widely acknowledged, few studies have focused on the students' perspectives and their experiences of industry-related activities during their studies. There is also a lack of knowledge about how students' perceptions affect their motivation for studying and learning in engineering. Without this knowledge, there is a risk that the gap between engineering education and industry will grow and limit the advancement of engineering education in terms of industrial interventions. It has also been found [7] that when students' are allowed to participate in learning settings and university decisions it can help them to develop a mastery orientation. In addition, allowing them autonomy and control of this part of their education can support their development of independence, leadership skills, and responsibility. It can also have vital effects on student motivation and learning, and further their development of self-regulatory abilities. This study investigates students' experiences and perceptions of industry-related activities in engineering education. Its aim is to address the gap in knowledge concerning what influences student motivation in order to understand how to foster participation, collaboration, and choice in extracurricular and co-curricular industry-related activities through more strategic and impactful industry interventions.

II. Background

A. Motivation

High motivation and engagement in learning have significant impact on decreased dropout rates and increased levels of student achievement as well as to professional success [8]–[10]. However, there are a variety of factors that influence students' motivation and level of engagement in their learning which universities and teachers often either ignore or have diminutive control over [11]. One approach which can be taken to increasing student motivation is the integration of industry experience into their education. While such activities can fail to adequately interest and engage all students, research has shown that this problematic situation can be overturned [12]–[14].

According to Bandura, social cognitive theory explains that: "psychosocial functioning in terms of triadic reciprocal causation. In this transactional view of self and society, personal factors in the form of cognitive, affective, and biological events, behavioral patterns, and environmental events all operate as interacting determinants that influence each other bidirectionally" [15: 265-266]. Within social cognitive theory [16], individual learning, the acquisition of knowledge, self-regulated competency, and development are investigated through a social context in which stakeholders and teachers become significant actors as social models. Moreover, learning is conceptualised as a cognitive and active process, involving self-efficacy, learning methods, and motivation [17]–[19]. Social cognitive theory is characterised as a powerful theoretical framework in research due to its explanatory capacity in attempts to understand human development, its practicality, and its applicability to learning. Finally, these constructs are narrowly interlinked and inspected as essential elements for successful work performance and academic achievement [20], [21].

There are different definitions and disagreements about the accurate nature of motivation. Pintrich and Schunk define motivation as:

> The process whereby goal-directed activity is instigated and sustained… As a process, we do not observe

> motivation directly but rather we infer it from such behaviours as choice of tasks, effort, persistence, and verbalisations… Motivation involves goals that provide impetus for and direction to action. Cognitive views of motivation are united in their emphasis on the importance of goals. Goals may not be well formulated and may change with experience, but the point is that individuals have something in mind that they are trying to attain (or avoid)… Motivation requires activity-physical or mental, such as effort, persistence and cognitive actions as planning, making decisions, solving problems, and assessing process [22: 4-5].

Another definition of student motivation comes from Bomia, Beluzo, Demeester, Elander, Johnson and Sheldon that refers to "a student's willingness, need, desire and compulsion to participate in, and be successful in, the learning process" [23: 1]. It also can be argued that more often student motivation is divided into two categories. The first, extrinsic motivation, describes that a student can be characterised as extrinsically motivated when they engage in the learning process "purely for the sake of attaining a reward or for avoiding some punishment" [13]. The second, intrinsic motivation, describes that a student can be characterised as intrinsically motivated when they are motivated from within, actively engaging themselves in learning out of concern, curiosity, or pleasure, as well as to achieve their own personal and intellectual goals. Commenting on students who are intrinsically motivated, Dev argues they "will not need any type of reward or incentive to initiate or complete a task. This type of student is more likely to complete the chosen task and be excited by the challenging nature of an activity" [13: 13]. Ryan and Deci [24] highlight the basic distinction of motivation through questioning if behaviours are really autonomous and self-sufficient or controlled. For instance, whether people feel free in their actions or feel as if they are being forced to act in some way. In other words, the focus of action, or the insight of where the control for someone's behaviour resides, can have significant unwelcome consequence upon attributions and behaviours [25].

Many studies demonstrate that intrinsic motivation is strongly related to successful students' academic achievements [26]–[29], whilst other studies have shown that the use of extrinsic motivators to encourage students in learning process can both negatively affect student motivation and lower academic achievement [11], [13]. Furthermore, students who are intrinsically motivated are more likely to continue studying long after external motivators have ceared to exert influence, and are more likely to be lifelong learners [30].

B. Industry-related activities

University–industry collaboration is an essential component in the successful preparation of engineering students for their professional efforts. This collaborative relationship empowers students to engage in up-to-date industry practices, learn more about their discipline, and develop skills to be more effective students and future engineers [31]. It is well known that universities incorporate a variety of teaching methods and learning strategies, because certain knowledge, skills and values align with different teaching methodologies. According to Graham, Tripp, Seawright, and Joeckel (2007), learning techniques which allow students' active participation in the educational process have a positive effect on their academic achievement [32].

Trowler [33] discusses student engagement as the process of students' participation in in-classroom activities or/and out-of-classroom learning activities such as industry-related activities. For this study, industry-related activities are defined as student's active participation in various university-industry activities, such as completing a masters' thesis in collaboration with a company, a guest lecture from a person directly involved in industry, an industry field trip, an internship, attendance at summer schools, or industry-focused courses with, for example, industry associated problem-solving activities that are conducted as a part of the curriculum. With regards to internships and cooperative experiences with industry, previous studies [34]–[37] have shown that students who experienced a real workplace environment and culture gained motivation to learn, developed their interpersonal skills and communication, gained work experience, and also gained valuable real-world problem-solving experiences while discussing and observing industry's employees. Several studies [38]–[40] have described positive student learning outcomes from industry field trips, such as students observing a production process environment, engaging in workplace culture, developing manufacturing competencies, acquiring multidisciplinary skills, seeing daily routines of the employees and managers, and learning about new technologies. With respect to guest lectures, students listen to the guest speaker during a lecture and afterwards they can share their work experiences and patents, engage in teamwork and problem solving, and learn about communication, self-management, enterprise and initiative [41]–[43]. It has also been argued that students who participate in industry-related activities can develop problem-solving skills, analytical skills, collaborative abilities, build communication skills, and become more motivated to learn through the use of case studies [44], [45].

III. Purpose and Research Questions

The purpose of this study is to explore the nature of industry-related activities that students encounter within engineering education at a Swedish university. The study also seeks to understand what impact these activities have on students' motivation when studying engineering. Based on this objective, following research questions are posed:

1. For context, what industry-related activities did the sample of engineering students engage with during their studies?
2. How did the students perceive these industry-related activities to affect their motivation to study and learning?

The results of this study can contribute an insight into students' perceptions of their motivation for studying and learning in higher level engineering education.

IV. Methodology

This study sought to investigate students' perceptions of university-industry engagement activities. Due to the nature of the research questions, an explorative, qualitative strategy was employed. In addition, the purpose of this research was to understand and gain knowledge about students' experiences and hence an inductive approach was applied. Reiter argues that exploratory research can "produce valid and insightful findings in the social sciences, if conducted in a transparent and self-reflexive way. It can also profit from

applying dialectical thinking" [46: 129]. In this study, semi-structured interviews were conducted to obtain direct answers from students about their beliefs and insights concerning industry-related activities which they experienced as part of their formal education in order to gain an understanding of their perceptions on how these influenced their motivation to continue studying.

The protocol for the semi-structured interviews included questions and sub-questions divided into thematic categories so that the research questions were covered [47]. According to Bryman "what is crucial is that the questioning allows interviewers to glean research participants' perspectives on their social world and that there is flexibility in the conduct of the interviews" [47: 469]. Due to the characteristics of a qualitative research study [47], [48], purposive sampling was used. In this technique, a sample is purposefully selected that is satisfactory to specific needs of the research [48: 115].

This is a pilot study including nine masters' students who were studying on five-year long engineering programmes at a large research-intensive Swedish university. In Sweden, a Master's program consists of a two-year program, the final two years of the five-year programme, containing both courses and a Master's research project within the final semester. All of the interviewed students met the criteria of having encountered industry-related activities during their study time. The selected students were studying either on the first or the second year of their master's studies. In addition, all the selected students had participated in several industry-related activities since these we included into their master's programmes. Open-ended questions were used during the interviews to allow for flexibility, with interviews lasting approximately 45 minutes. All students were interviewed in English. All interviews were recorded and transcribed immediately and verbatim to check the saturation of the data. All students voluntarily participated in this study.

V. Data analysis

An inductive analysis was conducted on the transcribed data using NVivo software. Emerging and compatible themes were identified mainly related to the research questions. According to Braun and Clarke, inductive thematic analysis aims to "generate an analysis from the bottom (the data) up; analysis is not shaped by existing theory (but analysis is always shaped to some extent by the researcher's standpoint, disciplinary knowledge and epistemology)" [49: 175]. Furthermore, Willig claims that "while experience is always the product of interpretation, and, therefore, constructed (and flexible)… it is nevertheless 'real' to the person who is having the experience" [50: 13].

More specifically, the thematic analysis was conducted in the following stages: a) transcription of the data, b) reading and familiarization of the transcribed data while creating initial notes on pieces of potential interest, c) coding by creating "nodes" across the entire dataset, by coding papers individually and then reviewing once all initial nodes were created, d) nodes were incorporated into themes, and a thematic map was created to aid in visualising and understanding the relationships and links between them, and e) defining and naming themes reflecting the data [49], [51].

VI. Results

The inductive thematic analysis process that was applied to the transcripts derived several key concepts. These concepts are considered to be crucial in determining the students' understandings. The concepts have been divided into two main categories, or themes, defined as "encouraging elements of industry-related activities", and "discouraging elements of industry-related activities". Thus, the key concepts are considered sub-themes of each of these two categories. The category "**encouraging elements of industry-related activities**" has sub themes of:

- *'future working expectations'*
- *'real problem-solving'*
- *'inspirational role model'*
- *'practice oriented knowledge'*

The category "**discouraging elements of industry-related activities**" has sub-themes of:

- *'lack of collaboration'*
- *'marketization of higher education'*
- *'lack of relevance to students' interest areas'*
- *'lack of connection between students and company's R & D'*

A. Industry-related activities

Based on the analysis of the data, the industry-related activities which the students had engaged with were: a) guest-lectures, b) internships, c) master's thesis in industry, d) summer school, e) field-trips, and f) job-student fairs. Below, the findings demonstrate how the students perceived these industry-related activities to affect their motivation to study and their learning.

It is important to highlight that there are prospects of the students' narratives that overlap across these two categories. However, this should be seen as an interpretation of understandings and attitudes in general, which are not isolated perceptions but which are interrelated to each other.

B. Encouraging elements of industry-related activities

This category describes different aspects of the participants' experiences of industry-related activities which positively affect the students' motivation to study and their learning in engineering education. The positive impact of these industry-related activities on students' motivation is discussed sequentially through generated key concepts, and quotes from the transcripts are presented to illustrate the analytical claims.

1) Future working expectations

Students explained it was a positive experience when they were able to figure out the demands of the companies, which motivated them to clarify the field that they would like to specialise in in the future, to gain better understanding of their studies, feel more confident, get significant work experience (more practical-oriented) during their studies, and place themselves professionally in the future. Internships were argued by the students to have one or several of those effects.

The internship was very helpful to figure out what the expectations from the company are, what they need from you. I did not have any previous work experience from the industry, so I learnt a lot of things about the working environment in a company, it helped me to clarify the field that I would like to specialize in, because I was confused during my studies in electricity.

Student 3

However, after doing the internship I realized I don't care if programming gives me better opportunities in the future, I want to do design. So, it helped me take the right decision, and this could be reflected in my focus in the next semester at KTH.

Student 5

This internship was a revelation to me in what we were studying and how it applies to the industry. In a sense it was putting all the pieces together from my first and second semester giving me a better perspective on what I was actually studying and where I want to focus my efforts. I think it was the best part of my studies as of yet.

Student 5

2) Real problem-solving

Students stated that it was great to meet the industry and participate actively to real problem solving. More specifically, during summer school the students engaged with different industry-related activities, met people from companies, there were guest-lectures on the campus, meetings, discussions, and reflection activities between students and business-oriented people in a holistic way.

I took a project from start to finish, started from scratch with the conception of an idea to some actual deliverables, and presented it in front of a business jury with investors, so this whole procedure and some tight time constraints was extremely helpful and I enhance my skills in problem solving, conceptualizing, working with other people/collaboration.

Student 5

The organizers were 2 or 3 people from industry, they visited us, gave talks and lectures, and in evenings they were even helping us with our assignments. Of course, they could not help so much, but they could give us 2 or 3 hours a day to ask them stuff and we could always contact them afterwards to ask anything. It was a very nice experience.

Student 4

Furthermore, the students participated in various field trips or study trips where they visited different companies or businesses that cooperated with the university. The students who had been on field trips considered that there was a close relationship between their study visit and their education since they had to engage with real problem-solving activities within the companies and write a report as an assignment for their university courses. It seemed that these activities can increase students' motivation to learn.

We also had a very practical course called material for accounting, there we had a case from a company called xxx (paper company), we actually got to visit them and after that analyze their material and energy flow within the company/industry and understand how it can be improved. The whole course was group work on this, how to improve the material and energy flows at xxx. And that is pretty much all in terms of industry related activities that I had.

Student 3

For the "powerplant", we had an interview with the person in charge and we went on a little trip to see all the components and how they were working. We got to ask this guy everything related to cleaner production and how it works, so that we could write the paper on it.

Student 7

3) Inspirational role model

Students believed that these industry-related activities inspired them to be successful engineers in their future careers, motivated them to continue study engineering and complete their studies at the university, and inspired them to explore the production process in the industries. More specifically, inspirational guest lectures, internships, and field trips could contribute to the above individual role model.

Having industries integrated from the first year already in some courses could be very interesting as it inspires students about what actually happens in the industries…Role models, is a good idea. People like Mark Zuckerberg or Elon Musk, that are super inspiring changing the world with engineering solutions. I feel like role models are the first motivation, particularly for kids to get into engineering world.

Student 3

They were inspirational visits. It was cool to actually see what is happening in the process and the production…Then we went to their office and talked to people that worked with different things. It was not watching the process, it was more going to the office and getting inspired by what they were doing and meet a lot of people.

Student 8

4) Practice oriented knowledge

Students thought it was beneficial to be exposed to more practice-oriented knowledge than the normal theoretical knowledge which they could get through the courses at the university. They stated that industry related-activities such as internships and summer schools were examples of activities that give these types of experiences. In addition, the obtained practice-oriented knowledge can affect positively to students' motivation to learn.

I would say although we learn more theory at the university, practical knowledge is more appreciated in the industry…So I got some practical knowledge through summer school.

Student 5

I think that you need very specific knowledge in the processes that you want to work with. But maybe more the knowledge about how to solve problems and where to find information. I don't think that I will remember specific information that much from the courses only, in my case. I will more have a feeling of how to solve problems. I don't think that theory will help that much in practical ways, at least in my case. The internship was a great experience that get a lot of practical knowledge.

Student 8

C. Discouraging elements of industry-related activities

This category describes different aspects of the participants' experiences of industry-related activities which decreased their motivation towards engineering education. The negative impact of these industry-related activities on students' motivation is also discussed sequentially through

generated sub-themes, and data extracts presented to illustrate the analytic claims.

1) Lack of collaboration

Students argued that there is a lack of collaboration and communication between their supervisors at the university, themselves, and student's advisor at the company, where they are doing their master's theses for approximately six months. Furthermore, because of this lack of collaboration, the student interviews indicated that their motivation to pursue further studies at higher level decreased, and when they expressed dissatisfaction with company staff, they said they would be less likely choose these companies to work for in the future.

> *In general, I have to say that there were differences in terms of setting the goals of my thesis between the people from [university] and from the company. Furthermore, there was a lack of communication between me and one of my supervisors from [university]. He was missing for a long period while in the USA. So, it was very difficult to meet all together or discuss issues all together for the progress of my thesis.*
>
> *Student 1*

> *I did, I asked from the coordinator of [xxx] in Stockholm, and he was very polite and offered to meet me at his office, but the only support he provided was a pep talk or motivational speech. "Be passionate" and stuff like that, but he didn't provide any more help. He also contacted the coordinator of my masters, this guy who was a big head, and they didn't even reply to my emails. These were professors at [university]. No help from them.*
>
> *Student 5*

2) Marketization of higher education

Students expressed a negative attitude towards being exposed to companies' advertisements, staff commercialisation, sponsorships, and industry's marketing profiles during their engagement with industry through guest lectures, master's thesis projects, field trips, and internships. This exogenous privatization of higher education appears to negatively impact students' motivation to study and their learning as they do not like this relationship with industry and disagree with this kind of advertisement when collaborating with people at these companies.

> *In my other course some companies came just to present themselves, as guest lecturers. But I do not come to a 2 hours class to receive a marketing talk from a company…Yes, most companies play the game. For example, when I was at the student union, and there were companies paying for events, some were just advertising themselves…*
>
> *Student 3*

> *The company that we meet should not only be trying to make itself look good in front of the students, but it has to be a more open approach. We are there to learn, not only to be recruited. We can also criticize their work, which can also help them, because we can come with new ideas…Because the industries have more power, as in money. And maybe that's where you could have the biggest change. But at the same time also kind of questioning the morale of industries more.*
>
> *Student 6*

3) Lack of relevance to students' interest areas

Students claim that there is a lack of activities' relevance to their studies and discipline's courses. Some of the guest lectures, career affairs, and field trips they have experienced are not related direct to the courses at the university, which seem to make students motivated to attend these lectures and field trips, as they feel bored or/and these activities are not interesting to students. It can be argued that this phenomenon can affect negatively to students' motivation to learn.

> *There are the career fairs, like [xxx], where you mingle with companies…I mean, the lunch lectures that the students arrange are not that specialized. It is more about the companies' offerings. But guest lectures are more specific, for example, you can use our electrochemistry topic to develop a new thing in batteries, and so on. However, guest lectures also would maybe not be as much marketing for the companies as these are now, but you see what you can actually do with your learnings.*
>
> *Student 8*

> *I think some of them were boring, now that I remember. Some visits in companies where people talk- for example we visited a company called [xxx] both in Spain and Sweden and they gave a super boring presentation. And I think that it is a challenge for them to put people to talk who are interesting and energized.*
>
> *Student 4*

4) Lack of connection between students and company's R & D

Student's also expressed the missed opportunities to engage with the people who work in research and development (R & D) at the companies where they were doing their master theses, internships, or/and field trips. They highlighted that it is vital for their studies to have connections to people within R & D especially for their master thesis.

It was argued that the contact people at companies may not be able to provide useful information or share knowledge that could help students' research and studies. It is therefore argued that the lack of connection between students and R & D negatively effects their motivation to continue studying.

> *For someone to want to do a PhD, he/she would have to be interested in R&D, so research and development. So, if you reach the R&D part of the company, then students would be intrigued to learn more about research, and maybe figure out that they want to work in research and not just any conventional job. So, focus on R&D departments, they must do that, it is very important, but they never do at least in my case. I can't speak for everyone…In big companies, the R&D department, normally students don't get to meet those people. They meet people that can 'talk', so they are marketing people/executives or the company's representatives in the outside world.*
>
> *Student 5*

> *I remember that it was in the middle of my thesis that I was stuck and the model could not work and nobody could help me, neither the company nor KTH professors. There was a big 'gap' amongst me, KTH and the company. The third one that I have to say is the people from the company were not so willing to provide me the data to use in my thesis. They had to face the issue probably with the confidentiality, and the information from the markets. They have a lot of data but they are unpublished and it causes many problems to the students who are doing a research in the company.*

Student 1

VII. Discussion

The results described above highlight some important findings regarding students' perspectives on what is "encouraging" and "discouraging" about industry-related activities towards their motivation for studying and on their learning in Sweden. It is interesting to note that the findings on encouraging elements in this study can be confirmed by previous research, whereas it is more difficult to find reports from previous studies on the discouraging elements.

The present study adds additional credibility to findings about individual learning, which is conceptualised as a cognitive and active process involving motivation, in which stakeholders and teachers become vital actors as social models [16]–[19]. From the findings, the provision of inspirational role models was one of the encouraging aspects of industry-related activities, such as inspirational guest lectures, internships, and field trips. This appeared to motivate students to continue studying engineering and inspired them to explore the production process in the industries.

Furthermore, the results demonstrate that through "encouraging" industry-related activities, such as summer schools and guest-lectures, students can be engaged by real problem-solving, making decisions, and planning for future goals [41]–[45]. In that case, the use of extrinsic motivators can positively impact students learning [5], [11], [13] and increase their persistence when trying to understand key concepts [22].

In line with previous studies, the findings show that through "encouraging" industry-related activities, students gain more practice oriented knowledge than theoretical, interpersonal and communication skills are trained and their motivation to learn is increased [34]–[37]. Moreover, the results demonstrate that students can better understand their future working expectations through these "encouraging" industry-related activities, since they can observe the daily routines of the employees and managers as well as the workplace culture [38], [40].

However, it is worth discussing the facts revealed in the thematic analysis in the "discouraging" industry-related activities category. On one hand, the results confirm that there is often a lack of collaboration among the three actors (university-students-industry), since the students claimed that during these industry-related activities, such as master theses, the feedback interconnection from the industry to engineering schools and vice versa was missing [1]. As a consequence, in this study, this "discouraging" fact made the research process difficult and it did not foster students' motivation to continue learning and studying at higher level. In addition, the results of this study indicate the existence of industry-related activities are sometimes perceived by students not to be relevant.

From the thematic analysis above, two concepts have been revealed that has not been extensively studied before; the marketization of higher education and the criticality of the connection to company's R & D departments.

It can be argued that Swedish education illustrates almost all the features of internal, marketization or 'hidden' privatization that have been observed in many other countries all around the world [52], [53]. Marketization of higher education is a global phenomenon [54], [55] based on neo-liberalist ideology. Many education researchers have analysed the ways neo-liberalism influences education policies and practices. Neo-liberal marketization presumes a commodification of education and training provision. Regarding student's motivation, Beaty, Gibbs, and Morgan [56] suggest that universities need to focus on students intrinsic motivation to increase the chance of an emerging interest and love of the subject-matter or discipline. They argue that a student's orientation and motivation is both influenced by the university environment and the method taken to learn and study. Moreover, that universities should offer space and time for reinvention and reflection, and fascinate students who endeavour to be challenged and changed as humans. However, marketization undermines and weakens this above role:

> for vocational institutions particularly, it can be all too easily eradicated. Where there is an explicit focus to satisfy a desire for job-related skills, efforts to address other concerns may be dismissed by both the institution and the students. Indeed, some students consider theory to be pointless. The possibility of understanding a subject 'for its own sake' is lost [57: 281].

From the above it seems that when industry-related activities take place in a way that emphasises the promotion of a company, this discourages students' motivation to study and learn, which is also found in this study.

Finally, from the findings of this study there is an apparent lack of a critical connection between research students and company's R & D departments. Students' desired cooperation and help from the company's research departments during their engagement with different industry-related activities, particular their master's theses, and not getting this experience clearly had a negative impact on their motivation. More specifically, the students suggested that it would be great motivation for them to learn more and engage more with the research process if there was direct connection with the people who working in the R & D. This is seen as something important that it should be taken into consideration by both university and industry in the future when designing these types of activities.

VIII. Limitations and Suggestions for Future Research

The context of study is constrained to a research-intensive university in Sweden. As a consequence, this could be considered as a small-scale study. For this reason, the production of generalizations is not the scope of this research. Instead, this study provides an insight of students' perceptions of industry-related activities in terms of the impact they can have on their motivation to study and on their learning.

However, future investigations are necessary to validate the conclusions that can be drawn from this study. Pertinent research questions for future work can be derived from the categories and key concepts generated from this study to investigate, in a deeper and more holistic way, the impact of industry-related activities on students' motivation for studying and learning in engineering education.

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