

Learning through Industrial exposure

Group 5, Rohit Yadav and Simon Alinder

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1 Abstract

We wanted to investigate the benefits of and attitudes towards internships and projects within an industrial setting at Lund university's faculty of science. We intended to do this with a survey aimed at students who had done internships and interviews with staff. We had to change our target to engineering students at LTH due to almost no science students having done internships, and ended up using existing course evaluations. We found that most students think their internships were useful for the development of both their professional and general skills and that this was the primary goal of the university. We also found that a significant motivating factor for the student is that they are more likely to quickly get a job they want after their studies, which is also a benefit for the companies.

2 Aim and Goal

Experiential learning through contact with industry is implemented in many forms of education, usually as internships or project work. These internships or projects are not new especially in more vocational subjects such as medicine, law, and engineering (for examples, see <https://mycareer.lu.se/projects>). These industrial exposures are beyond classroom learning, contributing to the student's holistic development by familiarizing them with current market trends, future scenarios, and the new technology being applied, increasing employability, and helping with work-related learning (Knouse and Fontenot [2008]). Through this report, we want to investigate the impressions of internship and industry project work effectiveness among physics students and involved faculty staff. More specifically, we want to know how important students and staff think this exposure to the industry is and what impact it has on the students that go through it in terms of their development and future plans. Thus the purpose of this report is to review some literature/theories on the relation between internship and the learning of the university students especially focusing on the generic skill developments, and we will try to gauge student opinion with a limited survey of the Lund university students and faculty opinion through semi-structured interview.

3 Background

Throughout this report, we are going to be using the term "internship" to mean a period of study that takes place in a setting external to the university, like a private company. This may not be directly analogous to work practice (*praktik* in Swedish) and may also take the form of thesis work done externally or a course that involves learning at an external organization.

Due to rapid changes in technology and increased societal demand, the jobs market is always emphasizing work-related experiences alongside university or theoretical knowledge. For this reason, competitive markets want to hire a highly skilled future workforce, considering it as a win-win-win opportunities for all the stakeholders in the education system like students, employers, and institutions ([Callanan and Benzing, 2004]). These work-related environments offer students

an additional active learning environment than traditional classrooms. Through thinking, acting, and making decisions in realistic conditions, students can accelerate their professional growth. International universities and governments are focusing in to provide students with an opportunity to not only transform lecture knowledge into practical use but also to develop generic skills. Work-related exposure exists in the form of joint internships or projects between university and industry. However, there is neither a specific definition for internship nor does there exist a specific list for generic skills. In general, an internship is viewed as a short-term period where the student gains experience in a specific field of interest in either industry or a research institute. Generic skills mainly include communication, leadership, teamwork, problem-solving, critical thinking, work ethics, etc ([Rodzalan and Saat, 2012]). Alongside generic skills, internships (mainly industrial) also help employees to get insight into business culture and make networks since nowadays employee exchange has become more open and accessible. To further minimize the gap between theoretical learning and practical exposure, many universities started incorporating credit-based internships courses in their academic curricula based on the rationale that learning can not only be based on classroom pedagogies but should also come from hands-on experience acquired in a real working environment. The internship also helps financially to all 3 above-mentioned stakeholders i.e., students, employers, and educators. The stipend is an amount offered by the company as financial support to interns, although the stipend is usually very low it could be the first step for a student to become financially independent. Hiring skilled interns reduces the cost to the employer during permanent hiring of interns of recruitment cost and training cost. Internship programs also deepen the collaboration between academic institutes and companies which results in smoother technology transfer.

According to Coco [2000], the key intention of an internship is to safeguard the transition of students from academic life to the workplace. Chen et al. [2011], mentioned that internships can reinforce technical competencies, enhance analytical skills, and most importantly, foster an awareness of the constant need for adaptability and creativity in a changing world. Interestingly, some studies exist on the contribution of internship programs to students' learning, career prospects, and engineering skills. These studies on industrial experience showed positive outcomes.

Some universities include an internship as a part of the curriculum of their Bachelor's and Master's programs. The internship usually takes place in the third semester of a two-year program or in the fifth semester of a three-year program. The program coordinators can often help students with contacts and tips about how to find an internship, but in most cases, it is the student's responsibility to find their internship position. In programs where an internship is not included as a part of the curriculum, it may still be possible for students to choose an internship as an elective course.

At the Lund University physics department, there are two courses for internships offered, FYSB06¹ at bachelor's level and FYSP01² at master's level. These courses have goals listed in their documentation. These goals, that the students shall fulfill, are, for FYSB06

- To be prepared for professional work in the physics sphere,
- To have gotten relevant experience for professional work in a relevant occupational area,
- To have gotten an opportunity to critically evaluate the working situation of physicists.

And for FYSP01 they are

- To describe an occupational area within physics,
- To evaluate different work steps,
- To perform practical tasks at the workplace,
- To collaborate with other people working at the workplace,

¹<https://kursplaner.lu.se/pdf/kurs/sv/FYSB06>

²<https://kursplaner.lu.se/pdf/kurs/sv/FYSP01>

- To keep deadlines and report their tasks,
- To report on their work orally and in writing,
- To evaluate and develop their own contribution and participation in the work at a workplace within the field of physics,
- To reflect on their own role in the workplace and the need for personal development to function better in a workplace.

Both courses state the need for acquiring practical experience of work and the need for evaluating one's own efforts. FYSP01 also requires the students to acquire some generic skills like teamwork, ability to communicate, and ability to manage their work and keep deadlines. These goals are well in line with the benefits of internships claimed above.

4 Design

To understand students' learning outcomes from internships, we aimed to collect data through a questionnaire survey and interviews with the university staff.

1. The questionnaire survey was designed based on the provided guide (Harrison [2007]) and was planned to be sent to students who have experience of internship within an industrial setting. The focus of the survey was to find the student's views on internships in general, their influence on their education or career, and how internships helped them develop different generic skills. Using a questionnaire to collect data has its pros and cons. It is a quick and efficient way to gather a large set of coherent data, although it can also be a problem since a fixed set of questions does not provide flexibility for participants to answer differently, and sometimes the set of options for the question might not cover the whole picture. Also, targeting our survey at students who have completed an internship means we will not hear from students who, for whatever reason, have not done one. This means we are lacking a control group. Another potential issue is that the number of respondents may be too low to draw solid conclusions about the general attitudes of students.
2. Another method we used was interviewing a few responsible faculty members of Lund University who facilitate the internship for students, such as study directors or similar. The interview was constructed based on a semi-structured format according to the provided guide (Newcomer et al. [2015]). The interview was constructed to understand the role and evaluation process of the university such as what the university perceives as the benefits of internships, how or if students are encouraged to take on such work, and how it is decided which companies are invited.

However, when talking to physics department staff we discovered that only 3 students in the last 5 years have taken the course that lets them do an internship. This means that we have to change our target group. The Faculty of Engineering, LTH, offers more opportunities to their students to get exposed to an industrial setting. Their Students' evaluations of placement/internship courses show a total of 126 students were involved in the placement/internship program in period 2020/2021, 140 in period 2019/2020, and 28 in 2018/2019 ³. Since this group had already answered these questions in their course evaluations, we chose to use them instead ⁴. The course evaluation covers almost all of our questions and further contains data from previous years. Thus it was obvious for us to restrict our interviews to staff at LTH to match the survey, and also due to time restrictions, we limited our report to only one interview. The pros and cons of the new approach are slightly different. We have more data than we otherwise would, and the data is collected with a slightly different purpose in mind even though our questionnaire and the course

³<https://www.ceq.lth.se/praktikkurs/rapporter/>

⁴<https://www.ceq.lth.se/praktikkurs/rapporter/rapport/?lasar=202021&rapptyp=LTH&rapp=LTH&lang=en>

evaluation questions both are concerned with the quality of education. This means that not all the answers are useful to us, but since all the data already exists, this is not a downside we can affect.

Both we and the course responsible are interested in the effectiveness and applicability to future careers of the course, so we can use parts of the course evaluation to answer our questions. One section of the evaluation concerns the experience of the student during their internship, which contains questions regarding both specific professional skills and generic skills. Examples are

"In what way has your understanding of skills that are required in professional life developed?" and

"I had a chance to deal with work-related problems and situations." for professional skills and

"I had the opportunity to collaborate with active professionals within my profession." and

"In what way has your understanding of how different professions work together in processes or projects developed?" for generic skills. We also seek information on how applicable students think the experience of an internship is for their studies and future career, which is captured in the questions

"The experiences from my placement/internship will be useful in my continued studies within the programme." and

"My duties during my placement/internship were relevant to my specialisation."

5 Assessment and evaluation

The physics department communicates that it values generic skills somewhat by including some of them as goals in the course guides for the courses involving work in an industrial setting. These courses are open to all students at the department and have no special requirements for enrollment other than having completed a certain number of credits in physics, but they are rarely taken with only 3 students enrolling in the last 5 years. Obviously, this means that internships and the kind of practical experience they provide are not prioritized for science students.

This very low attendance prevents us from getting sufficient data by surveying the physics students for their opinions on how effective their internships were. The reason for the low involvement of internship programs in the faculty of science could be because the science faculty promotes internships in research teams at Bachelor's and master's levels instead. STREAM (STudent REseArch Mobility) is one such program aiming to facilitate research exchange opportunities for current students at institutions within LERU (the League of European Research Universities). A framework to do academic research together is created through the STREAM program. The faculty of science also supports students to acquire funding for the research internship. Students in the science faculty do not have a lot of options for internships within an industrial setting so they opt for funded and more structured research internship plans like STREAM.

From the Faculty of Engineering, LTH, the interviewed person was Associate Professor Carina Fasth (Program Director Technical Physics, LTH, Lund University). The interview was carried out virtually with both group members present. According to Prof. Fasth, the main factor that motivates students to do internships with companies is to create contacts and secure their first job. A quick and secure transition from education to employment is very easy to imagine as attractive for students. She further believes that the course examiners are looking for generic skill development in the students alongside subject knowledge while evaluating students' work. Here our main focus will be on skills other than subject knowledge. According to LTH program syllabi,⁵ the student shall demonstrate:

1. **Critical thinking and problem-solving skills:** Ability to systematically integrate knowl-

⁵<https://www.student.lth.se/english/masters-students/programme-syllabi/>

edge, perform critical analysis, and deal with complex issues even with limited information, highlighting critical thinking and problem-solving skills.

2. **Work ethic and creativity:** Ability to formulate tasks creatively and autonomously, undertake advanced tasks within the predetermined time frame, and ability to evaluate own work.
3. **Communication skills:** Capacity in writing and speech to report clearly and discuss their arguments and conclusions to a different audience.
4. **Team work skills:** Demonstrate active participation in research and development work or autonomous employment in some other qualified capacity.

Further, we have analyzed the student's course evaluation survey. The survey further shows that most students find an internship on their own. According to question (Q) **2b** in the appendix, > 93% were dealing with work-related problems and situations. This shows that courses set in industrial settings supports students' involvement in real problems which could help them develop problem-solving skills. From Q. **2f**, 80% and from Q. **2g** 65% students think they got very much opportunity to collaborate with active professionals and work in the group respectively. These questions depict the opportunity to develop teamwork skills during this course. Almost all of the students believe that, to some extent, they developed professional skills during the period of this course (from Q. **3a**). The course also provides an opportunity to develop communication skills by asking them to present work as logbooks or internship reports or seminars. However, the students does not seems so happy about them doing this extra piece of work. (Q. **4a, 4b, 4c**) Overall all of the students who participated in the survey showed some level of satisfaction from the internship or the course as a whole. (Q. **6a, 6b**) We have analyzed surveys from the last 2 years i.e. 19/20 and 2020/21, and the results were very similar, which showed that there is no significant change in the nature of the project.

To conclude, we can see that internships are a good idea for students and that it prepares them for their future careers with both specific and generic skills. This is true for students in physics as well as those in engineering. It is natural for students to seek out the option that they believe will help them most to reach their goals while learning, which is why we see so few physics students doing internships in an industrial setting. Physics students tend to seek out academic environments when doing learning outside of the classroom, see STEAM mentioned above. It is likely that physics students would see similar benefits as engineering students when going on internships. They would be exposed to real-world requirements that would lead to the development of specific and generic skills. It feels obvious that physics students go for higher education but it is also true that limited academic positions will not able to fit in all the graduates. If at the end of education, students need to go for the industry then it is better to have similar experience and generic skills in advance, which will be beneficial for both industries as well as life in general. University engagement in promoting internships is also required. From the LTH survey, it was found that most of the students are satisfied with the industrial exposure. If the LTH students think the internship is useful for them, then the university should help more students in finding these positions and should also encourage it in other disciplines as well. This project is based on limited case studies and thus suggests a detailed follow-up study.

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6 Feedback

At the feedback meeting we received some comments. The most significant of these were:

1. Expand the project to include the benefits of research internships as well.
2. On a similar note; find references and discuss why scientists generally don't go on internships despite the benefits.
3. Find what motivates students to do internships.
4. More details about the data. How was the questions selected? How was the data handled? How was the interview prepared for and handled? How do our questions relate to our aims?
5. Describe how the stated benefits of internships are related to the learning goals.
6. Give recommendations (to students) about how they can benefit from doing internships.
7. We need to go over the text and improve the grammar in some areas.

We also received a document with extensive comments. Generally, the document add little that is not covered in the points above. Some confusion was expressed as a result of the incompleteness of the report. The other frequent comment was a request for clarification both in how things are presented and talked about and grammar and sentence structure.

There was one comment on the result that very few students in the faculty of science had taken internships and that this means that this activity is not prioritised by the faculty which was "they should have thought about that in the beginning". This is not a constructive comment, it is just saying that we are doing a bad job because we did not know the results of our investigation before starting it. Maybe this would have been obvious to someone who did undergraduate studies here but no one in this group has that background. I (Simon) find it quite upsetting that this is the kind of feedback we receive in a graduate course with a large emphasis on respect and good

treatment of other people.

Here is what we did with this feedback.

- We have included results in our report.
- We added an explanation of how our plans changed, and we kept the old results as a way of explaining this.
- Regarding points 1 and 2, we are not going to do that. Expanding the project into another area when we are already severely behind is entirely unfeasible. However, we do include a mention that research internships provide similar benefits to industrial internships.
- For point 3, we have some data from the interview and I don't think we are going to gather any more. We put what we have into the report and that will have to be good enough.
- We addressed point 4 by adding the missing info.
- Point 5 is hard to address completely, since there are very many different study plans with different learning goals. To fully address this point we would need to address all different variations in these study plans. Instead we pick some common points from several plans (found at <https://www.student.lth.se/english/masters-students/programme-syllabi/>) and use those for comparison.
- We decided against adding explicit advice for students as point 6 suggests. We did this because student counseling is slightly outside the scope of this project, and the benefits of internships are obvious from the the text.
- The text was gone through and we attempted to fix all grammar/language issues.

7 Process report

- The project plan was created together.
- The final design of the questionnaire was decided together in a meeting on 14/2.
- The interview guide was designed together on 14/2.
- Both group members contacted staff at their respective departments at the beginning of the project (14/2).
- Both group members have been working on this report,
 - Simon wrote the "Aims and Goals" section
 - Rohit wrote the "Background" section and Simon contributed
 - Simon wrote the "Design" section and Rohit contributed
 - Rohit write the "Assessment and evaluation" section and Simon contributed
- Both group members conducted an interview with Carina Fasth on 22/2.
- Both group members processes the survey data.
- Simon wrote the "Feedback" section.
- Both group members made extensive edits to the text.

8 Appendix

Interview guide with answers attached below.

Survey and results available at <https://www.ceq.lth.se/praktikkurs/rapporter/>.

Original survey made by us available at https://docs.google.com/forms/d/e/1FAIpQLSdknuoTTLg18KJ6_8CFrZsZ0hbL_1j1AgBymn7evXTurZFucQ/viewform?usp=sf_link

Questions for interviews with staff:

Interview with Associate Professor Carina Fasth.

“Internship” is not really the case, but a course, a thesis work project.

1. How do they decide on the companies they want to invite for recruitment?

The uni does not make any selection, the students find their own contacts. Sometimes via normal job sites. Any place is ok as long as an appropriate plan can be drawn up by the supervisors at the uni and at the company. There is always a specific purpose (the learning goals of the course, for example, PHYM01¹).

2. Are students encouraged to do projects with the industry? Why or why not?

Not really, but probably depend on where you are. More applied educations are more likely to do this. Carina thinks working externally is more complicated as the student is working without much educational oversight.

3. What are the perceived benefits to the students from doing this kind of work?

Students can use this as a way to make contacts and get their first job. This is less the case in more research-oriented programs. Very vocational programs have more use for this.

4. How are the students credited for their work?

Course credits for the course they did. Some get paid as well, but that is up to an agreement between the company and the student.

Do collaborations between industry and research groups increase the likelihood of students choosing to do their projects externally?

At some departments. Computer science, automatic control, math (machine learning and financial modeling).

¹ https://kurser.lth.se/kursplaner/21_22%20eng/PHYM01.pdf