From Theoretical to Practical Competence on Health and Safety

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Abstract

Purpose – The construction industry is considered worldwide to be a dangerous industry because of its high rate of fatal accidents and serious injuries. This study aims to find ways to improve this situation by focusing on how to improve competence on health and safety (H&S) among newly graduated construction engineers in Norway.

Design/Methodology/Approach – In Norway, the regional safety representatives (RSRs) are considered to be cornerstones in ensuring H&S in the construction industry. Information in this study was gathered by conducting semi-structured in-depth interviews with 15 RSRs.

Findings – The results show that RSRs believe that while construction engineers have sufficient *theoretical* competence on H&S; however, many seem to lack the *practical* competence needed to ensure and implement H&S measures. The informants underline the importance of work practice on construction sites as part of the education as key to improve H&S competence among graduates.

Research Limitations/Implications – Input on possible improvements is collected from only one group of stakeholders in the industry. Other stakeholders might have valuable input that should be considered before concluding what improvements in the education are most effective.

Practical Implications – The findings may help to decide upon and implement improvements in the education of construction engineers and, thus, contribute to a safer and healthier industry in the future.

Originality/Value – The stakeholder perspective of RSRs on education of construction engineers has not been considered in earlier research despite the fact that they represent vital competence on H&S in the construction industry. This study aims to fill some of this gap.

Keywords Civil engineer, Construction education, Construction industry, Health and safety (H&S), Regional safety representatives (RSRs), Theory and practice

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1. Introduction

Construction is a dangerous industry because of its high rate of fatal accidents and serious injuries (Teo *et al.*, 2005). Reducing the risks in this industry is a high priority of the public

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authorities and the social partners of trade unions and employers' organisations in Norway (Løken and Stokke, 2009).

Newly educated engineers quickly become managers that are required by law to ensure the health and safety (H&S) of employees (Løken and Stokke, 2009). Thus, the competence among construction engineers is critical to ensure H&S in the industry.

Earlier research have identified a lack of focus on H&S in the learning outcomes of educational programmes (Åsgård *et al.*, 2017), and a gap between employers' expectations and their evaluation of the H&S competence among newly educated construction engineers (Danielsen *et al.*, 2017). This study uses a stakeholder perspective to gain input from key actors in the industry – the regional safety representatives (RSRs) – to identify possible improvements in the engineering education that can contribute to a healthier and safer construction industry.

2. Theoretical background

2.1. Engineers as influencers on health and safety in construction

In Norway, there is a long tradition of engineers holding management positions in industrial and technical enterprises (Nygaard, 2014). In the construction industry, engineers are found as top managers, designers and planners in construction projects, project managers, construction site managers and managers of H&S. Leadership commitment to safety in all phases of construction projects, is identified as a major factor when it comes to H&S (Roberts *et al.*, 2012; Swuste *et al.*, 2012). Thus, engineers are key influencers of H&S in construction, and their theoretical and practical H&S competencies are important when trying to achieve a healthier and safer industry.

2.2. The practice–theory dimension in engineering education

How to balance practice and theory has been a major issue in Norwegian higher technical education. Theory is presently prioritised in Norway. However, the primacy of theory has not always been the case.

Industrialisation in Norway was predominantly based on technology transfer from the UK. In the 1870s three engineering colleges were established offering three-year programmes, while admission required two years of practical work (Brandt and Nordal, 2010). Hence, practice was as an important element in engineering education.

It became common for Norwegian engineers to develop their competence by travelling to Germany, as German technical *Hochschulen* offered four-year programmes at a higher scientific level. These programmes became the model when the Institute of technology (today NTNU) was established in 1912 (Brandt and Nordal, 2010). Admission required only one year of practical work, as well as secondary school. Thus, NTNU represented a move towards more theoretical education for Norwegian engineers.

The original technical colleges consequently reduced their degree programmes from three to two years. At the same time, new technical short courses were established. However, this system led to conflict. The NTNU candidates attempted to monopolise engineering positions, arguing that theoretical knowledge was most important, while the other candidates propagated practical experience (Nygaard, 2013).

After WW2, theory emerged as the key component in engineering education as the university colleges established three-year programmes and required secondary school for admission. During the 1960s, NTNU removed practice as a requirement for admission, while the university colleges reduced the requirement from two to one year. By the 1990s, practice as a requirement for admission to higher technical education had disappeared (Andreassen, 2006; Brandt and Nordal, 2010).

The strengthening of theory in education fits well with the process labelled as *academic drift* (Pratt and Burgess, 1974). In Norway, the academic drift rested on the idea that research caused innovation and economic growth. The tendency towards academic drift did, however, cause a reaction; several engineers claimed that practice constituted an essential part of engineers' training and knowledge base (Andreassen, 2006; Nygaard, 2013). Recently, the pendulum has turned; all educational institutions in Norway are debating the practice-theory balance. They are not alone in this quest, even though the perfect balance is still contested (Crawley *et al.*, 2014).

3. Methodology

The findings reported in this paper are part of a larger research project aimed at ensuring sufficient H&S competence among construction engineers in Norway. A literature search was conducted as descripted by Arksey and O'Malley (2007) to get an overview of earlier research. As the studied area has not been subject to much earlier research, semi-structured interviews with key stakeholders were considered a favourable method to gather the data needed. The stakeholders chosen for the purposes of the part of the study presented in this paper are the regional safety representatives (RSRs) in the construction industry.

3.1. The (regional) safety representatives as stakeholders on construction H&S

The safety representatives are regarded essential to ensure H&S in the Norwegian labour market (Løken and Stokke, 2009). According to the Norwegian Working Environment Act all enterprises should have a safety representative elected by and among their employees to ensure safety, health and welfare. However, enterprises that employ less than ten employees are not required to elect a safety representative. As a result, in 1981, the arrangement of having *regional* safety representatives (RSRs) in the construction industry was established.

The RSRs work within a specific geographical area across company boarders. They visit construction sites, inform workers and managers on issues concerning H&S and cooperate closely with the Labour Inspection Authority (RVOBygg&Anlegg). The RSRs have insight into the H&S challenges of the industry as they gain first-hand experience with various construction sites.

3.2. Semi-structured in-depth interviews

In the Norwegian construction industry, there are 29 RSRs in total. All were invited by e-mail to participate in the study, and 15 were interviewed. Semi-structured interviews provide the informants with the opportunity to talk more freely and give unanticipated answers. The study follows a discourse of empowerment by conducting symmetrical interviews where both interviewer and informant are viewed as participants in the production of meaning (Gubrium and Holstein, 2011).

12 interviews were conducted face to face, while two were done by telephone. One interview was organised as a group interview with two informants present, while 13 were one-on-one conversations between interviewer and one single informant. All interviews were performed according to the prescription for semi-structured interviews made by Blumberg *et al.* (2011), and were audio recorded, transcribed and analysed.

4. Results

H&S work requires both theoretical and practical competence. A major concern among the informants is what they perceive to be lack of practical skills among engineers. The informants believe that without the combination of theoretical and practical competence,

engineers risk making decisions that may look good on paper, but are not practical in real life. They also risk introducing new safety guidelines that lack legitimacy and encounter resistance among workers.

Some statements from the informants regarding the need for practical H&S competence are listed in Table 1.

The improvements in education of construction engineers suggested by the informants in this investigation mostly include some form of closer integration between education and the industry. Possible ways of achieving this will be discussed in the following section.

5. Discussion

A profession needs to be based upon scientific expertise and a professional body of knowledge acquired through higher education (Ressler, 2013). However, a profession cannot exist without its professional practice (Brante, 2011). The RSRs point to the academic drift in education of engineers as a major obstacle in improving H&S in construction. Even though some efforts have been made to strengthen the practice elements in education, the RSRs believe these efforts have not been sufficient to enable future engineers to help improving H&S. Without practical understanding of the work processes of a construction site, the RSRs believe it is difficult for the engineers to become competent practitioners of H&S work. They argue that a closer cooperation between industry and education is necessary to improve the practical H&S skills of construction engineers.

There are many possible ways to bridge the gap between practice and theory. Two main strategies seem to be evident: (1) bringing the industry into education and (2) bringing education into the industry. Some options will be discussed in the following.

One way of bringing the industry into education is to invite practitioners into the educational setting as guest lecturers. This (partly) established practice could be improved by making input from practitioners more systematic and frequent. For this option to be realistic there has to be an interest among the actors in the industry itself to contribute more to education. The expressed willingness to contribute as guest lecturers by many of the informants in this study indicates that this could be an interesting option to pursue.

Table 1. Statements of Regional Safety Representatives (Translated from Norwegian)

Informant	Statement
No. 1	It may be that some [engineers] are good, but they don't manage to get it [H&S] out into the organization
No. 2	You can learn a lot of strange things by reading, but to see it with your own eyes and learn it with your body, which is something different
No. 7	I am out meeting managers (. . .) and it is my impression that they lack a bit of practice when it comes to what they should look for [regarding H&S]
No. 8	They are college educated, and I say that they have learnt a lot, but they can't *do* anything
No. 9	They have never held a hammer, and then they work as construction managers
No. 11	Earlier they [engineering students] had to be out on construction sites before they were allowed to become engineers. I think that was a good rule. The best engineers I have worked with are professionals that have moved up the ladder because they had the background for it. (. . .) I can see that they have a totally different understanding and culture for it [H&S]
No. 12	It has something to do with knowledge and the attitude that you should protect everybody. Someone who has not worked with it [on a construction site] may not as easily see all the things that must be finished. So it has something to do with being on a construction site and knowing the construction site somewhat in practice

Hiring practitioners as lecturers is another possibility. An ongoing debate in Norway is the possible new title in academia of *practice professor* to attract professionals with substantial work experience into teaching and research positions. This would require a change in the recruitment policies of academia to allow practical experience to outweigh academic credentials when hiring for academic positions. How to ensure that the practice professors do not lose touch with the industry over time must also be considered. It is still uncertain whether the position as practice professor will indeed be realised, and if such positions will be able to attract competent practitioners.

A third option is to let the industry provide students with relevant assignments. This will let students move beyond the level of experimentation and give them experience with real-life cases. To ensure that both parties benefit from the cooperation, this approach will require a close collaboration between the industry and educational institutions to assure the quality and relevance of the assignments provided, and to make sure that the students are qualified to handle them.

Turning to the strategy of bringing education into the industry, visits to construction sites is one option already being practiced. There are, however, some challenges in organising such visits, especially when many students are involved. Another weakness is that a visit is short and can never give the same insight as doing the actual work, as many of the informants also emphasise.

Another alternative is to make practical work experience from construction sites mandatory in education of construction engineers. Today, some educational institutions offer work practice as elective subjects. However, work practice is currently not mandatory at the bachelor level, and the content of the work practice is often weakly specified.

One way to introduce practical work requirements into education would be to establish cooperation between educational institutions and the industry on summer jobs. Norwegian students often work during summer break; however, many of the jobs available are not relevant for their future professions. Summer job cooperation could prove to be a win–win for both industry and students. The contractors gain easy access to substitutes, while their regular employees are on vacation, and opportunity to assess potential future employees. The students gain relevant work experience, and develop a personal network in the industry valuable to their future employability. Such cooperation would involve the development of a framework of requirements on what kind of work practice meets the criteria of approval.

Developing an apprenticeship programme, or mandatory subjects that include industrial training, is another option. At the Shaqra Universtity in Saudi Arabia, they try to reduce the gap between theoretical knowledge and field experience through industrial training. 90 per cent of the participants consider this kind of industrial training crucial for engineers according to an evaluation of this programme (Alsayyari and Hafez, 2016). Such established programmes in other countries could constitute learning possibilities for education of construction engineers in Norway.

Introducing more practice into the education would, however, not go undebated, and can be done at the expense of theoretical knowledge. This could, according to Ressler (2013), erode the scientific base of the profession. However, a lot of other professions and semi-professions in Norway – such as physicians, nurses and teachers – require work practise as part of their education. Instead of regarding more practice as a potential threat to the professional status of engineers, it could be considered an opportunity to strengthen the profession.

A stronger emphasis on H&S in education could be an important expansion of the professional body of knowledge of construction engineers, and thus, the scientific expertise that a profession needs to be based upon. In addition, a profession needs not only expertise

but also a professional ideology to justify its societal position. However, the engineering profession has been accused of having a weak ethical foundation, where efficiency seems to be the only professional value of importance (Lohne *et al.*, 2017; Ressler, 2013). Hence, an increased professional commitment to H&S could not only strengthen the professional expertise of construction engineers, but also the ethical reputation and value base of the profession.

6. Conclusions

The aim of this research project has been to identify possible ways to improve H&S in the construction industry by focusing on the education of construction engineers. The study used a stakeholder perspective to gain input from the RSRs as key H&S actors in the industry. According to the informants, construction engineers need to move from predominantly theoretical to more practical H&S competence to contribute to a healthier and safer industry in the future.

Two main strategies for a closer integration of education and industry have been identified: (1) bringing the industry into education and (2) bringing education into the industry. Some options have been discussed in this paper, though more exist, and they all need to be developed further to be seriously considered. Nevertheless, bridging the gap between theoretical and practical H&S competence and a closer integration of education and industry can prove to be important to improve H&S in the industry and to strengthen the engineering profession.

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