Learning of quality improvement theory – experiences with reflective learning from a student perspective

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Abstract

Purpose – The purpose of this study is to investigate how professionals who are continuing their education rate a higher education quality management course with an emphasis on reflective learning and real problem-solving. The audited course consists of module-based teaching, while students work on an improvement project at their workplace between course sessions. This study has a twofold aim: to contribute to the design of quality improvement courses based on doing as we learn and to offer insight into the use of a final grading method that consist of a folder with reports from the intermediate work steps and a final report.

Design/methodology/approach – After completing the course, students received a survey with questions and statements about the course content, delivery and final grading methods. They answered these questions on a seven-point Likert scale and also answered open-ended questions.

Findings – It is clear that professional students value the interweaving of theory with real-life training, and they value module-based teaching in which theory is reviewed and applied to practical problems. Reflective learning was achieved through feedback from both teachers and fellow students on various interim reports. Students' employers benefit from the course, as students gain experience with quality improvement. The grading of a final report on the improvement project based on three sub-assignments was highly appreciated.

Practical implications – Developers in courses in quality improvement benefit from learning how this course is structured, assessed and how participants perceived its components.

Originality/value – The course design with modules and intermediate work steps, where the students apply theory in quality improvement to a real project at their workplace, is an original concept. The modules correspond to the plan, do, check and act (PDCA) methodology.

Keywords Higher education, Quality improvement, Folder examination, Lean education, Process-based training, Reflective learning

Paper type Research paper

1. Background to the need for a new type of quality improvement course

Today's literature on quality management (QM) teaching at higher levels, to a small extent, addresses how students in the industry understand and are able to use various quality improvement tools and methods based on lean thinking. There are many different publications on QM courses and teaching methods, but few that directly focus on students who are working professionals (Emiliani, 2004, 2015; Alves *et al.*, 2016; Kazancoglu and Ozkan-Ozen, 2019; Martínez Sanahuja, 2020). Professionals must cope with ongoing work demands while continuing their education. This means that the implementation of a course must be adapted to that situation – it cannot be a traditional university course with a few lectures per week and a final exam based on selected literature. To make it interesting for professionals to further their education, the course should be meaningful, not only to obtain university credits but also to learn methods and tools that benefit one's workplace. In this context, there is a need for course structures, compared to traditional university courses that capture the application of available quality improvement methods to actual business problems. To create such a learning environment, a QM course was developed at the University of South-East Norway (USN) based on module-based teaching with intermediate practical application of different quality tools. The target group for the course is employees working with quality and improvements. Prerequisites are general study competence (in the Norwegian educational system, or equivalent, possessing a final grade from upper secondary school with grades passed or exceeding 90% of the subjects) and two years of work experience. The course covers 15 ETCs based on the European credit system. The course consists of four sessions during two full days (modules). Between sessions, participants work on a quality/improvement project at their workplace. The course has been offered four times (2019, 2020 and 2021 × 2), and a fifth round is planned for the fall of 2022. There have been approximately 20 students in each course.

When designing this course, we took into consideration that participants (students) had to be able to continue to work their normal job while studying. The course was, therefore, module-based over one semester (4–5 months) with intermediate work steps, where the intention was for students to apply the theory from the course to an improvement project. The underlying idea was to "do as we learn" and use the PDCA concept as a consistent theme for the intermediate work. The course modules correspond to the plan, do, check and act (PDCA) methodology. One of the goals when designing the course was to create reflective learning to obtain a deeper understanding of how different quality tools can be used. There is scant research on concept-based education such as PDCA, the main tool of the course (Naeve *et al.*, 2008; Laverentz and Kumm, 2017).

The chosen form of "exam," with sub-submissions and feedback from teachers and fellow students, contributes to reflective learning, also inspired by lean methodology (Burden and Steghöfer, 2019). A challenge of this type of course is grading. The literature on grading this kind of module-based courses in this context is also relatively scant (Collins, 1989; Vallespin, 2021), and the grading system needed to be evaluated. The course concluded with students submitting a folder with reports from their intermediate work steps

and a final report where the students include an academic reflection on their improvement project. The course grade was based on the final report, and all sub-reports must be approved before submitting the final report.

Many European universities and colleges, for example, at NTNU (Norway), Chalmers (Sweden), DTU (Denmark) and Aachen (German), offer QM courses in lean and quality improvement. However, curricula from quality courses show that many of these courses are traditional, meaning that students learn more about tools and methods and less about improving processes and implementation.

Experience of successful quality improvements in organizations based on lean methods shows that participation and involvement of staff are key (Abu Bakar *et al.*, 2015; Lameijer *et al.*, 2017; Ljungblom and Lennerfors, 2021). Gaiardelli *et al.* (2019) argue that although lean popularity is rapidly growing, its implementation is far from problem free, and companies have trouble sustaining long-term success. Based on this understanding of lean, it is important to understand the extent to which the individual is affected by changes, both regarding the implementation of hard (defined as technical and analytical tools) and soft (defined as organizational relationships and behaviors) methods (Petrusch and Vaccaro, 2019; Singh and Bowden, 2021; Syrrist, 2021). Lean practices can achieve long-term excellence. Lasting effects of quality improvement work are not achieved through the application of various quality tools but through the individuals concerned actually seeing and understanding the improvements (Takeuchi *et al.*, 2008; Towill, 2007). Based on this awareness, the university-level course for professionals must include both hard tools and soft methods. In our USN-created course, students gradually learn about essential quality analytic methods, different lean tools, Six Sigma and quality management techniques, as well as implementation processes theory, while at the same time practicing this knowledge in a real project at their place of work.

A preliminary study on the evaluation of this course was presented at the *7th ELEC* conference in 2021 (Fauskanger and Hellberg, 2021). The focus was then on the content of the course and form of student assessment. The purpose was to gain insight into students' views on two completed courses and determine to what extent they anticipate being able to apply knowledge from the course at their workplace. Based on students' evaluation of the course, the idea was to develop the course further. The analysis showed no immediate need to adjust the course content or form of implementation (note that the student base was small), and no changes were made aside from a small scheduling change. Experiences with imparting knowledge and theory, however, developed over time as instructors gained experience. The study questionnaire indicated that most students have leading positions in public administration and health or work in the private sector.

1.1 Purpose of this research

The purpose of this study was to investigate how professional students valued module-based theoretical teaching interspersed with practical application of the theory to real business problems, where they receive feedback on work done by both fellow students and teachers. In addition, we aimed to investigate how students perceived the grading system with the grading of interim reports and a final report, instead of a traditional written exam. It was also of interest to learn whether the project the students worked on produced lasting effects in the companies.

2. Choice of quality improvement theory for the course

The course was titled "Management of quality enhancement and continuous improvement" with a focus on basic modern quality management tools and main elements of Total Quality

Management (TQM), ISO, Six Sigma and lean methodology for improvements (continuous improvements). Successful implementation of improvement projects requires strong involvement of people who work close to the operations in the organization. Therefore, the course also provided knowledge of staff commitment, change management and organizational development. The authors support the idea of lean approach based on continuous improvements where employee participation is core for success (Rolfsen, 2014). While there are many good managerial practices to support lean, there remain significant challenges related to cultural issues (Connor and Cormican, 2022). Important for successful improvement is employees' commitment and respect for people (Coetzee *et al.*, 2019; Ljungblom and Lennerfors, 2021) and how organizational culture affects changes (Coghlan and Brannick, 2003; Rhydderch *et al.*, 2004; By, 2005,; Alvesson and Sveningsson, 2015). Change of attitude and behavior is required to achieve quality improvement in business. Basic knowledge about realizing cultural and organizational changes in a quality context is also required. This is mainly based on Kurt Lewin's theories of groups and group dynamics/ways of change and links to systems theory and organizational culture theory (Lewin, as cited in Huarng and Mas-Tur, 2016; Hussein *et al.*, 2018).

Quality is a more complicated term than it may appear. It seems that every quality expert defines quality in a somewhat different way. Our view of the concept of quality is that it is characterized by diversity. Various perspectives can be taken when defining quality (such as customer's perspective and specification-based perspective). Garvin's (1988) five different perspectives on quality, transcendental, product-based, user-based, manufacturing-based, and value-based fit well with our understanding of the quality perspective.

A contemporary definition of quality derives from Juran's (2004) "fitness for intended use," meaning that quality is meeting or exceeding customer expectations. According to Deming (1986, 2000), the customer's definition of quality is the one that matters. Based on this reasoning, it is essential to understand the customer, the customer's needs and the environment in which the customer will use the product/service. In this context, tools such as the Kano model and Quality Function Deployment or House of Quality are included. The Kano model offers insight into how product attributes are perceived by customers (Kano *et al.*, 1984) and into how customer's needs can be met or surpassed (Oakland, 2000). House of Quality is a method to transform qualitative user demands into quantitative parameters (Akao, 1994).

The idea is to gradually teach students methods and tools used in TQM, Six Sigma and lean and how to use them in in-house projects. The PDCA methodology permeates the structure of the course and associated assignments. The PDCA cycle is also known as the Shewhart cycle and the Deming cycle (Johnson, 2016). Deming (2000) further developed the PDCA model, where "S" stands for study.

The course also provides insight into traditional quality management tools such as Ishikawa's seven basic tools of quality (Tague, 2005) and Failure Modes and Effects Analysis. Unlike the seven basic QC tools, which measure quality problems that already exist, the seven new QC tools make it possible for managers to plan wide-ranging and detailed TQC objectives throughout the entire organization. These tools, some borrowed from other disciplines and explicitly developed for quality management, include relations diagrams, affinity diagrams, systematic diagrams, matrix diagrams, matrix data analysis, process decision program charts and arrow diagrams (Mizuno, 1988). The syllabus also includes a briefing on statistical process control and Six Sigma as a quality management method (Hilton and Sohal, 2012).

In addition to quality tools and methods, the course provides insight into TQM as an overall concept and International Organization for Standardization (ISO) systematics. TQM

is essentially a management practice that focuses on meeting or exceeding customer expectations. A TQM-centric organization focuses on process measurements and controls to achieve continuous improvements in the business process. Thus, an integrated approach to improving productivity includes both qualitative and quantitative concepts.

Within quality improvements, Six Sigma focuses on reducing process variation and enhancing process control, whereas a part of the lean concept focusses on waste (non-value-added processes and procedures) and promotion of work standardization and flow (Arnheiter and Maleyeff, 2005). The distinction between Six Sigma and lean has blurred, with the term "Lean Six Sigma" being used more often. This is because process and quality improvement require aspects of both approaches to attain positive results. Lean Six Sigma is a fact-based, data-driven philosophy of improvement that values defect prevention over defect detection. It drives customer satisfaction and bottom-line results by reducing variation, waste and cycle time, while promoting the use of work standardization and flow, thereby creating a competitive advantage. It applies wherever variation and waste exist, and every employee should be involved (Abu Bakar *et al.*, 2015; Lameijer *et al.*, 2017).

O'Reilly *et al.* (2019) found that the introduction of a Lean Six Sigma approach rather than only relying on lean, together with the integral part of Six Sigma methodology DMAIC (Define, Measure, Analyze, Improve, and Control), resulted in the achievement of different improvements such as cycle time and cost reduction, customer or employee satisfaction and rework and error reduction.

With this integrated approach, there are parallels between TQM, Six Sigma and lean, although these concepts differ significantly in other areas. The philosophy behind continuous improvement based on lean tools is called Kaizen. It involves identifying benchmarks of excellent practices and instilling a sense of employee ownership of the process. Other lean tools include 5S, Seven Waste, suggestions for improvement, stand-up meeting, visualization, A3, Kanban, extended value stream mapping and Andon, Jidoka, Gemba walks.

The basis of the continuous improvement philosophy is the belief that virtually any aspect of an operation can be improved. The people most closely associated with an operation are in the best position to identify the changes that should be made toward improvement. Consequently, employee involvement plays a significant role in continuous improvement programs. Workplace cleanliness, visualization (panel meetings) and employee involvement (proposal activities) are essential components of continuous improvement. Involving all staff in lean operations creates participation and commitment.

What the lean concept contains and is based on is not entirely clear – there are many different views (Åhlström *et al.*, 2021) in the same way that TQM is more of a philosophy than a uniform method. In comparison, Six Sigma and ISO9000 seem to be more homogeneous concepts (Vanichchinchai, 2022).

When implementing TQM improvement philosophy, it is not only about the customer's perceived quality and how to manage quality with different tools and models; it is equally an improvement focused on the processes involved in creating the organization's products and services.

Deming's theory of profound knowledge (Braughton, 1999) is a management philosophy grounded in systems theory. Profound knowledge theory is based on the principle that each organization comprises a system of interrelated processes and people who make up the system's components (Braughton, 1999). We believe in Deming's idea that the parts of a system are interconnected and, therefore, central when implementing changes (Deming, 2000). To stabilize and streamline processes, it is in some cases necessary to create new processes (BPR) (Andersen, 2007).

The course included several different angles on quality improvement work, for example, the fact that accidents are often because of human error and poor construction. Therefore, techniques are included on how to reduce human errors and improve planning designs for reliability and redundancy.

3. Pedagogical approach to the implementation of the course

The course was developed for students who work full time, a session-based structure with four sessions (modules) of two days (9:00–16:00). Furthermore, in line with Bloom's taxonomy (Anderson and Krathwohl, 2001), participants practice what they learn.

Problem-based learning (PBL) and reflective learning is the pedagogical approach for the course. PBL is self-driven learning through problem-solving and peer collaboration (Pettersen, 2005). The method is used as a learning method when authentic problems have to be solved. PBL is a student-driven approach to learning where students use knowledge from lectures and actively seek relevant knowledge to solve problems. In PBL, the teacher acts as a facilitator more than a disseminator and offers students open-ended problems to solve. The method has been used in lean manufacturing teaching for graduate students (Tortorella and Cauchick-Miguel, 2018). In Tortorella and Caushick-Miguel's 2018 study, PBL was used as a method for students to acquire practical knowledge in lean. The lecturer went through the subject material in lectures, and students then worked on practical problems in a manufacturing company with a lecturer and an experienced lean manager as coaches. Experiential learning formats such as PBL are appropriate methods to teach lean, and the approach is more involved than traditional learning approaches (McDermott *et al.*, 2021).

Reflective learning is a form of learning, which research has shown to be effective with knowledge being retained longer (Perusso *et al.*, 2020; Tan, 2021). A parallel model for reflective learning is the well-known learning cycle of Kolb from 1984, which fits well with a group of students who have practical and current experience (Morris, 2020; Healey and Jenkins, 2000).

Bull and Whittle (2014) argue that project-based courses are better for facilitating reflection than lecture-based courses, as they give students the opportunity to work iteratively. Such courses often consider reflection as an implicit learning objective and do not explicitly address it in teaching activities. The triple learning cycle, adapted from Elmgren and Henriksson (2010, in Burden and Steghöfer, 2019), describes well how the learning model in this course has been structured. In reflective practice (reflection loops), both students' and teachers' learning are interconnected (Figure 1).

Baker (2021) further developed high-quality learning and theories on one's ability to reflect based on work from Coe *et al.* (2014) and Danielson (2007) and showed that this type of teaching is demanding for teachers but provides good learning outcomes for students.

The objective in this course was for students to work on a project in their workplace between sessions. The assignments handed out after each session, and the written
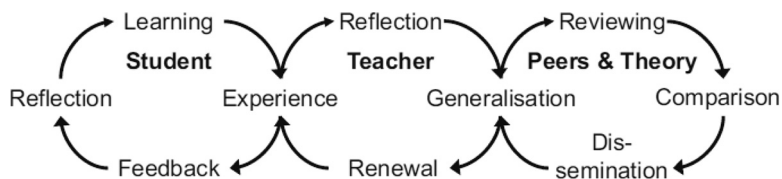
Source: Based on Burden and Steghöfer (2019)

assignment report were submitted before the next session with students receiving feedback during that next session. During sessions, students presented what they had done, and everyone had to present at some point during the course. Through feedback from teachers and fellow students on partial assignments, a form of reflective learning was created. Instead of staring blindly at their own solution, students had an opportunity to see the value in other solutions and learn from that. If a current student project required other tools and methods than those included in the course, then they were free to search and find them (with the help of fellow students and teachers).

Simonyte *et al.* (2022), who studied lean in higher education institutions, propose that practitioners implementing lean should identify barriers, plan their activities and consider success factors. Results of this study revealed that managers need to deal with the main barrier – the complexity of the community and its processes, and the tackling of such barriers is a similar experience for most organizations (Cudney *et al.*, 2011). Most research into lean thinking has been conducted within a manufacturing context, and it is sometimes presumed that lean is, therefore, only applicable to large volume industrial processes. Womack *et al.* (1990) claimed from the start, however, that the fundamental ideas of lean production are universal–applicable anywhere and by anyone. Lean thinking has been transferred from vehicle manufacturing to many other industries (Thirkell and Ashman, 2014, p. 4). As many have expressed, in some organizational contexts, it is required that certain lean expressions and methods are written in other words. In this course, we kept most of the original lean expressions, but students were free to adapt them to their project work.

3.1 Evaluation – three phases

The assignments are based on the PDCA methodology. Another important aspect is that participants learn from each other, and time was allocated for socializing and exchange.

There were three compulsory assignments, an oral presentation and a final report. The assignments were assessed as approved/not approved. All three assignments had to be approved before the student could submit the final report, which was graded A–F. The content of the submission assignments was, ideally, based on issues from the student's workplace, if possible, with companies' current improvement projects or process-oriented change tasks.

First submission: A presentation of the company's management system and the description of an improvement project that will be completed during the course.

Second submission: A written plan for the improvement project based on the PDCA methodology.

Third submission: A description of what has been done in the project. If the project has not started yet, then develop the implementation description further.

After each assignment, the student received feedback from the teacher, and in connection with presentations of assignments before the class, fellow students offer feedback and discussions arise. This creates a reflective learning experience.

Final report ("exam"): Based on the three assignments, the student wrote an analytical and reflective report with references to course literature.

4. Method of conducting the survey

The aim of the survey was to gain insight into how course participants (students) from the industry experienced the learning outcome with reflective learning in this newly created course in quality improvement based on lean, Six Sigma, TQM and other improvement methods. We aimed to obtain feedback on the way in which the course concluded, namely,

with a request to submit a final folder with reports from the intermediate work steps and a final report, which was the basis for the final grade; further, how the students experienced working with an actual improvement project in the company where they work, while they were in the process of completing the course; and, finally, whether the student project had, or will have, a (n) (lasting) effect on the company. In addition, we sought to learn whether course participants contributed more to improvement work in their organization after the course. In other words, we wanted to learn whether the course and its evaluation through applied improvement work was successful or not.

The course has been held four times (2020 and 2021), and upon completion, all students received a questionnaire about the course content, implementation and exam form. The surveys from the 2019, 2020, 2021 spring and 2021 autumn courses were in this case analyzed as one group. As the target group for our survey were students who had already completed the course and left the university, it was easy to contact them by e-mail with the questionnaire. There were 66 students from 2019 to 2021. As this student group is relatively small, we hoped that they all participate.

Questionnaires are a systematic method of obtaining data (Groves *et al.*, 2004). Questionnaire surveys are a structured form of standardized questioning: All respondents are asked the same questions in the same way (Ringdal, 2013). The chosen survey tool was "Nettskjema." Nettskjema is a tool for design and implementation of surveys and online data collection, made for the university and college sector, where respondents are anonymous. This online tool has been developed and operated by the University of Oslo in Norway.

As it was not initially a question of testing existing theories, the questions were not linked to a theoretical frame of reference but directly to areas of investigation.

The questionnaire was semi-structured, which is a combination of pre-coded, graded and open-ended questions. Pre-coded questions have several stated answer alternatives (Johannessen *et al.*, 2016). Some of our questions were designed so that it was possible to choose one or more answers in addition to free-text answers. Several questions were statements, where the respondents scaled the extent to which they agreed or disagreed with these statements. The questions were answered with a seven-point Likert scale. There were also open-ended questions with free text answers. Likert scales provide several possible answers to a statement or question that allow respondents to indicate their positive-to-negative strength of agreement or strength of feeling regarding the question or statement (McLeod, 2019). There are differing opinions among researchers as to whether a neutral middle category should be included. Some believe that such a category is an invitation to not really think through difficult questions (Jacobsen, 2005). On the other hand, others have good experiences with neutral survey response options (Johannessen *et al.*, 2016). The seven-point scale used in the study included neutral response questions.

The questions were divided into four parts. Part 1 covers the respondent's background. These questions were simple and neutral, which helps increase the respondent's motivation to complete the survey (Haraldsen, 1999). Parts 2–4 included questions related to four areas of interest. For brevity, the survey questions are not included in this article.

Once the questionnaires were completed, three people with relevant backgrounds from outside the study group reviewed the form and offered constructive feedback. This resulted in adjustments according to the scope and understanding of specific questions and word choices. The survey was intended to take about 10 min.

The link to the questionnaire was sent to all participants in each course after the course had been completed and the students had received their grades. The e-mail addresses provided by students during the course were used. In all, 66 students completed the four courses (2019, 2020 and 2 × 2021) and, thus, gained access to the questionnaire. For all

mailings of the questionnaire, there was a ten-day response deadline. However, it became necessary to extend the deadline for all course groups because the respond rate was low in the first ten days, and further encouragement for participation was called for. This reminder and extended response deadline led to more responses. In the end, there were 28 useable responses. This is a response rate of 42.4%, which is considered good (Nulty, 2008). As the answers were anonymous, we have not been able to carry out any deviation analysis of those who did not respond. The respondents spent between 4 and 18 min (average of 8 min and 44 s), in line with our goal.

4.1 Composition of the response group

Of those who responded, 21 were female and 7 male. In all, 6 respondents were aged 30–39 years, 13 were aged 40–49 years and 9 were aged 50–59 years. Five had high school qualifications, and five held a master or higher degree (Figure 2).

As shown in Figure 3, 8 respondents worked in the private sector; the other 20 in the public sector, of which 9 in the health sector. Nine worked in a position as top manager/ management team and seven as middle managers.
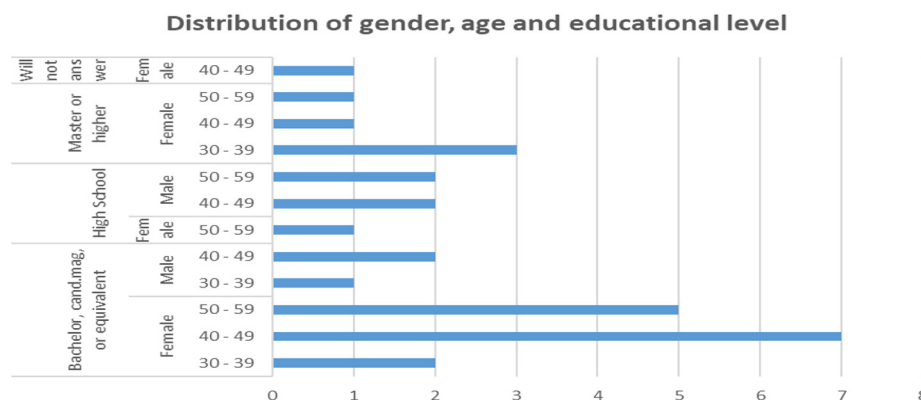

Figure 2.
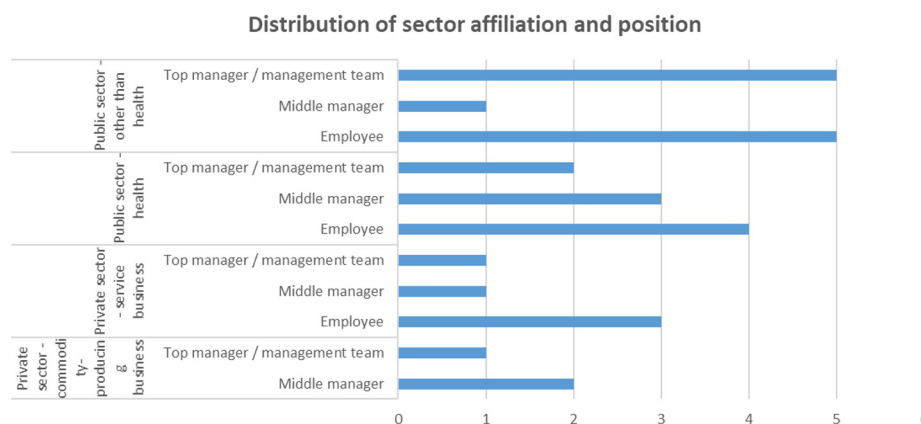Composition of the response group

Figure 3.
Composition of the response group

Of the respondents, 13 worked largely with quality-related tasks, another 13 worked to a lesser extent with quality and 2 did not work. In all, 8 worked for more than five years with quality-related work, and 15 worked 1–5 years with quality-related tasks (Figure 4).

5. Findings

Regarding the first area of interest, what the students thought about the course content, the course content met their expectations (Figure 5) and enabled students to complete an improvement project (methods, tools and skills) at their job (Figure 6). When asked whether the student can apply what they learned as soon as they returned to work, 26 out of 28 answered yes, 1 said no and 1 did not know. This indicates a relevant selection of principles and methods within quality management.

In the second area of interest, what the students thought about the module structure, the responses were a bit more fragmented. However, most considered that both the workload
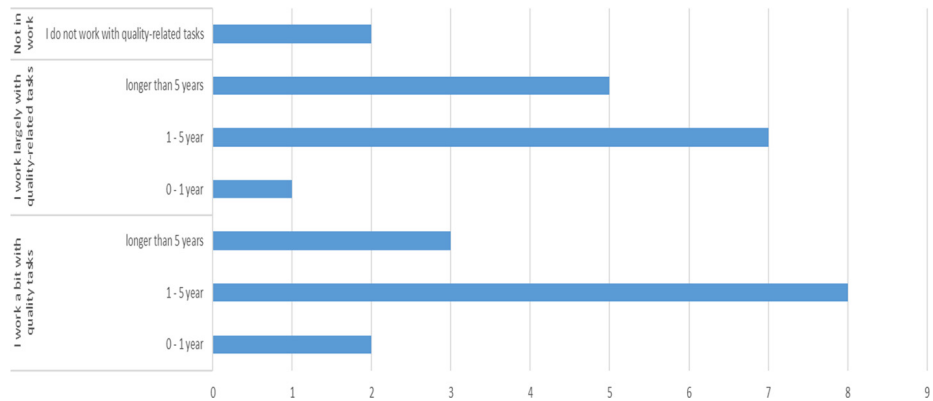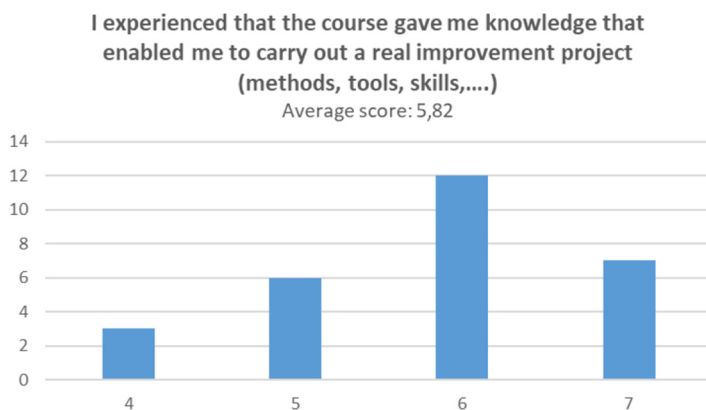

Figure 4.
The response group's experience of working with quality-related tasks
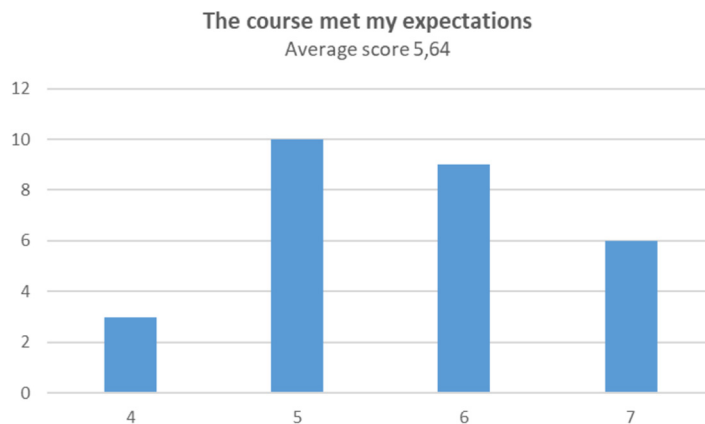
Figure 5.
How the course met the students' expectations

Note: 1 indicates strongly disagree and 7 indicates strongly agree

I experienced that the course gave me knowledge that
enabled me to carry out a real improvement project
(methods, tools, skills,....)
Average score: 5,82

Figure 6.
The extent to which
the course enabled
students to carry out
a real improvement
project (methods,
tools and skills)

Note: 1 indicates strongly disagree and 7 indicates strongly agree

and the time between sessions were good with an average of 4.9–4.7 on the seven-point scale (where value 1 indicates that the workload/time was too small/short and value 7 indicates that the workload/time was too large/long). In conversations with students, it was expressed that this form of module-based course enabled them to attend class, work and work on their project all at the same time. Getting away from work 4×2 days for studies was experienced as intellectually stimulating. The following student comment indicate that the model was appreciated: "A good model for implementation is to relate it to implementing an actual project in your own organization." The schedule for the teaching days was adapted for students who normally work, with dedicated breaks for participants to answer emails and take short phone calls. We interpreted this to mean that the current module structure works well for students who are working.

Regarding the third area of interest, what the students thought about the examination form, 24 of 28 students preferred an assessment form with work requirements (assignments) and a home exam (final report); for 2 students, it did not matter; and 2 students answered, "Difficult to answer - I have no basis for comparison." Of the 28 participants, 26 answered the form of assessment "suited me well" with a score of 5 or higher. A few students were not quite clear about how the three interim reports were included in the final report. As this form of examination was relatively new for most of the students, it is important that the criteria for grading are clear. This comment illustrates this:

> It would have been nice if we had been told on the first day of the course that the final exam would be based on the project we chose in the submission report. I didn't realize this until a while into the course. It is an advantage that you choose a project on which you can build your exam paper, that the project is not too large and complex

On the question whether the students would recommend the USN to continue with the assessment format, most of our students valued this form of evaluation (Figure 7). As a large percentage of respondents believed that the degree format should continue, it is assumed that this format suits professional students well.

Regarding the fourth area of interest, students' experiences with working with an improvement project in the workplace to apply acquired knowledge, 21 of 28 students had found it easy to identify a suitable project to work with at the workplace. Seven had found it difficult. It is problematic for this course if students do not have the opportunity to work on

an actual project. Of course, it is possible to participate in another student's project, but in practice, this is difficult because of logistics. On these occasions, students were able to solve the assignment more theoretically, but this was not ideal. For most students, the form of assessment contributed to improvement work in the company, which we interpret as a positive effect (Figure 8).

A comment from one of the students shows that the form of working with one project in parallel with the course was appreciated; "I think it was a great way to put theory and practice together in a gradual process."

It is interesting to know whether this type of student project applied in real life provided any lasting benefit to the company. Figure 9 shows that most students believe that the project they worked on has had a certain or significant lasting effect. This result indicates positive effects for both the individual and employer. Of the 28 students, 25 continued with other improvement tasks according to lean and PDCA thinking after completing the course.

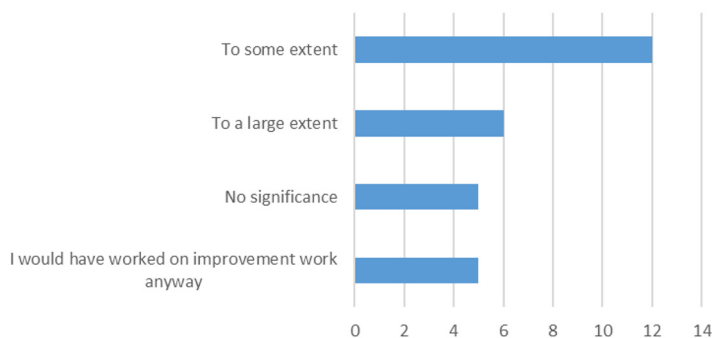**I would recommend USN to continue with the assessment form which involves three work requirements and one home exam**

Average score: 5,96

Figure 7.
The extent to which students would recommend continuing with the assessment form of three work requirements and a home exam

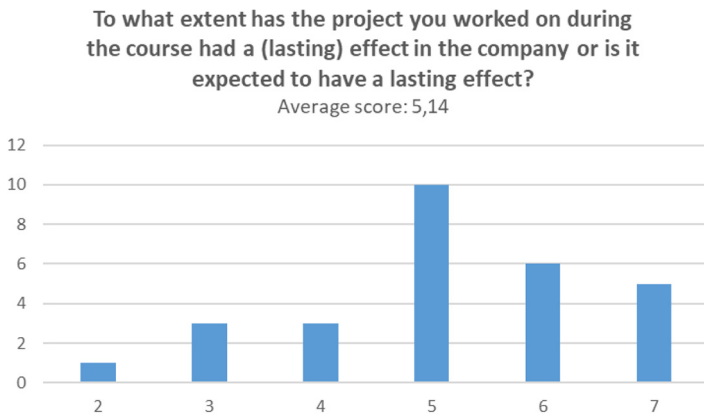**The form of assessment was instrumental in me getting started on improvement work in the company**
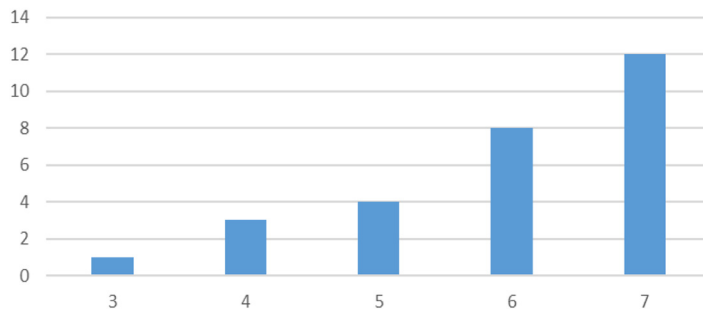
Figure 8.
To what extent students consider the form of assessment was instrumental in getting started on improvement work in the company

**To what extent has the project you worked on during
the course had a (lasting) effect in the company or is it
expected to have a lasting effect?**
Average score: 5,14

Note: One reflects a small effect and seven a large effect

Figure 9.
The extent to which
the project worked on
for this course had a
(n) (lasting) effect on
the company

It appears that more females than males started an improvement project in connection with the course. There does not seem to be any difference in this depending on the position (Figure 10).

Females without a leading position tend to believe that the improvement project they worked on during the course had a significant and lasting effect on their employer (Figure 11).

The basis for the answer is too limited to offer underlying explanations. Some comments that show how the students experienced the course and what the course contributed are as follows:

Did you start with an improvement work in the company while attending the course?
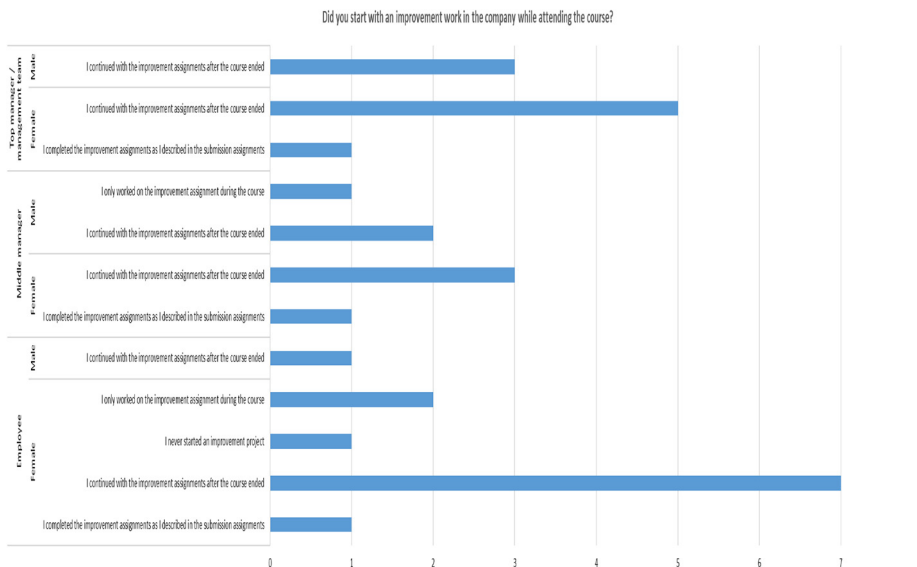
Figure 10.
Distribution of
answers according to
gender and position
on the question if you
started an
improvement project
in connection with the
course

To what extent has the project you worked on during the course had a (lasting) effect in the company or is it expected to have a lasting effect?
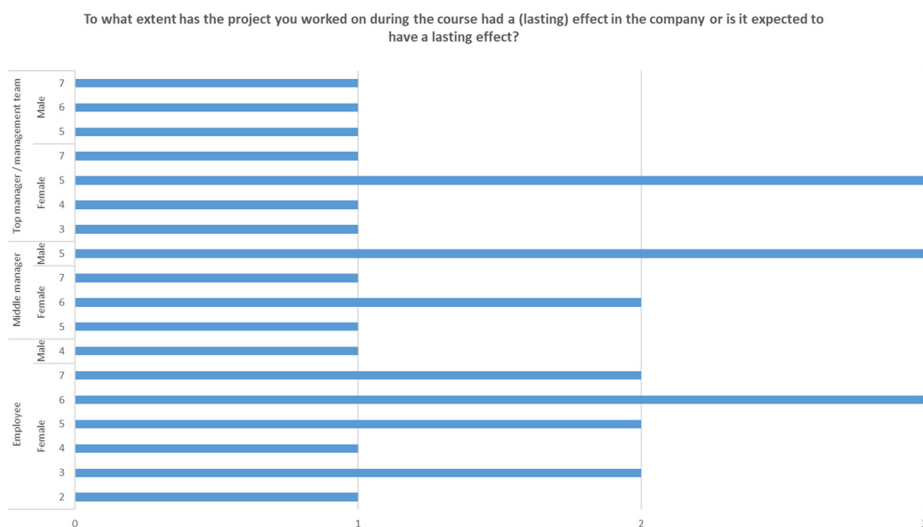
Note: One reflects a small effect and seven a large effect

- I became more aware and also got tools for how not only I should carry the load but involve others and get this way of working into our [company] culture.
- The course helped the improvement project that was planned. It became more concrete and contributed to employees and managers showing interest. Also contributed to facts being obtained, this created the basis for the work further. Facts and involvement contributed to the project continuing.
- I would have worked on the improvement tasks anyway, but maybe in a slightly different way. I gained new knowledge and competence in the course, which meant that I adjusted for example my approach.
- It was a great help to understand lean and PDCA, since I had to take it into my own context. It has been useful daily in my job. After the course, I was "operational" to begin with the improvement work and had clear to me the framework/structure for how I should approach it.

5.1 Reflections
The course content met students' expectations (Figure 5). Findings of this extended study (comprising four completed courses compared to the previous two completed courses and 28 responses compared to the previous 14 responses) show that the students consider the course content to meet their expectations (a slight increase from 5.4 to 5.6, where 1 indicates strongly disagree and 7 indicates strongly agree). In comparison to the first study (Fauskanger and Hellberg, 2021), students in this extended study expressed to a greater extent (increase from 5.6 to 5.8) that the course enabled them to carry out a real improvement project (methods, tools and skills). This result is interpreted as the course being adapted over time to students' needs. Formally, there have been no changes in the course content from the first to the fourth round other than schematic adaptations. On the other hand, the

emphasis on various elements of the course has probably been subconsciously adjusted. This means that course management and teachers have also learned (reflective learning). In comparison with Burden and Steghöfer's (2019) model, this matches well with Loops 2 and 3.

How the students experience the implementation of the course in module form is more fragmented. However, most considered that both the workload and the time between sessions were good. There was a large spread in the answers (from 3 to 7), where someone expressed that the workload could have been greater, while others thought it was a lot to study while doing their regular work simultaneously. However, several students expressed the importance of exchanging experiences with other participants both during the intensive teaching days and on social media in connection with their project. This is in line with Morris (2020) and Healey and Jenkins (2000) in the sense that reflective learning thrives in a group of students who have similar practical and current experience. This was also observed by Baker (2021), Coe *et al.* (2014) and Danielson (2007), namely, that talking with others, leading to greater understanding and learning, is very important. From the answers, one could interpret that the workload for the practical intermediate project was doable for students who are working.

Regarding how the students perceived the grading system with the grading of interim reports and a final report, instead of the traditional written exam, this suited the working students well, where 24 of 28 students preferred an assessment form with work requirements (assignments) and a home exam (final report). Many students commented that it was good to weave the theory from the lecture days into the actual project and to obtain feedback on progress in the interim reports. Our findings align with what Perusso *et al.* (2020) and Tan (2021) claimed. What can be added is that the time that runs between teaching sessions and is devoted to project work is a maturation process. Bull and Whittle (2014) support this iterative process in the sense that it provides a better learning outcome compared to traditional classroom teaching.

The information given to students on how the exam form works must be clear, as this form is new for most. The academic level is captured in the final report where students are expected to write an analytical and reflective report (motivate their choices and refer to the course literature).

Concerning whether the student project produced any lasting effect in the companies, Figure 9 shows that most students believe that the project they worked on has had a certain or significant lasting effect. An interesting observation is that women to a greater extent than men think that their improvement project had a significant and lasting effect on their employer. It is unclear from this investigation why this is the case. This result indicates positive effects for both the individual and employer. Of the 28 students, 25 continued with other improvement tasks according to lean and PDCA thinking after completed the course. This observation is backed by Pettersen (2005); problem-based learning (PBL) is self-driven learning through problem-solving. It is also supported by Tortorella and Cauchick-Miguel (2018) with the fact that lean requires practical understanding and participation from people involved.

In conclusion, this study shows that for professional students, problem-oriented teaching is motivating. This, coupled with reflective learning in the form of recurring feedback on interim reports from both teachers and fellow students, provides a high degree of learning of lean and quality improvement methods. The chosen form of grading, with sub-parts that would be approved before the final report is submitted, fits well with this concept. In Figure 12, this process with time for reflection and maturity between teaching sessions is visualized.
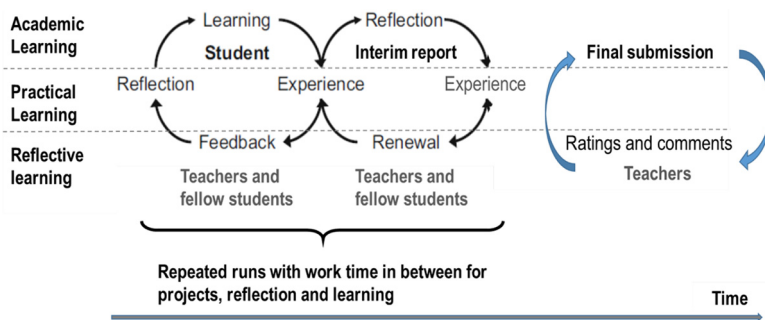
Figure 12.
Reflective learning
loops with time for
students to mature

Source: Inspired by Burden and Steghöfer (2019)

6. Conclusion

The purpose of this research was to investigate how professional students value module-based theoretical teaching interspersed with practical application of theory to real business problems, where they receive feedback on work done by both fellow students and teachers. In addition, we aimed to investigate how students perceived the grading system with the grading of interim reports and a final report, instead of the traditional written exam. It was also of interest to learn whether the projects the students worked on produced lasting effects in the companies.

The conducted survey clearly shows that the selection of methods, techniques and knowledge of implementation processes were useful for course participants. There may be methods and techniques unknown to us and, therefore, not used during the course, which could have enhanced the course. However, the chosen methods and techniques were useful. If certain projects that students were working on at their workplace required other tools and methods than those included in the course, then they were free to search and find them (with the help of fellow students and teachers). The reflective learning that occurred through talking to other fellow students on the course should not be underestimated.

A modular structure with full-day assembly and intermediate work on improvement projects in the workplace worked well for participants who work and study at the same time. The students appreciated the implementation form, which means that they could carry out their regular work in tandem with the course. In addition, the students appreciate gradually interweaving theory and practice.

The evaluation approach with three assignments and a grade-based final report with reflections and theoretical connections is an appreciated examination form, especially given the opportunities for feedback from peers and teachers and for engagement in reflective learning.

Applying knowledge to an improvement project in the workplace was valuable to our students. However, some participants were unable to gain access to projects in their workplace, which meant that they did theoretical assignments instead, which is not ideal. Most students answered that the project they worked on had a certain or significant lasting effect.

This research contributes to the theory of reflective learning, with new knowledge about professional students' need for an adapted study model with feedback from fellow students and teachers on project work. Students tend to be motivated by being able to apply and, thus, understand quality improvement methods on a real project at their own workplace.

Our research also contributes to increased knowledge about the folder examination form consisting of a number of interim reports and a final report as a basis for grading.

It is our hope that knowledge gained from this study can be used by others who want to develop courses with an interactive structure and examination form.

To gain more knowledge, a continued research focus should be on other universities and colleges that provide courses that include reflective learning and real projects. In such cases, it would be interesting to know how their students experience the course's implementation form and what quality improvement methods are taught in their courses.

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