

Stay sharp

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Abstract: Meat cutters' work is physically demanding and is performed mainly with the hand held tool of a knife. The aim of this paper is to report experiences of how researchers together with three companies of different size and character developed and carried out an education program in maintaining knife sharpness for meat cutters. It describes the process of developing an educational program suited for the business and discusses the outcome.

Keywords. Adult education, knife sharpness, meat cutting industry

1. Introduction

Meat cutters' work is physically demanding, being physically strenuous (Arvidsson et al., 2012; Nordander et al., 2013) from high velocities in wrists (Hansson et al., 2009) and upper extremities (Hansson et al., 2010) and requiring high oxygen uptake capacity (Christensen et al., 2000). Meat cutters also are exposed to high risks of musculoskeletal disorders (MDS) as carpal tunnel syndrome (CTS) (Gorsche et al., 1999). A large portion of the workload can be traced to the cutting task. The force needed to do this work is directly proportional to the sharpness of the knife's cutting edge (McGorry et al., 2003). A sharp knife is thus the most important tool in a meat cutter's working situation. Maintaining sharpness during the whole work cycle is therefore crucial for meat cutter's musculoskeletal health (Claudon & Marsot, 2006).

In a previous study we found that the differences in maintaining sharpness mainly refer to the knife user, not the specific knife brand (Bergstrand, 2011). This means that there is a set of skills needed for creating and maintaining a sufficiently sharp knife; sharpening the knife, avoid damaging the edge, and repairing a damaged edge by steeling or polishing. Another crucial skill is to determine when a knife is dull and in need of attention or if it is time to discard and re-sharpen it. These skills are traditionally not taught in the Swedish meat industry today (Karlton, 2008). However, education efforts regarding knife sharpening and steeling educational programs have taken place in Canada (Antle et al., 2011; Vézina & Chatigny, 1996). To improve the meat cutters' situation in Sweden, a project (SKARP) started with the goal to develop an education program of maintaining sharpness of knives and important ergonomic aspects of work technique.

An education has to consider both the content of the education and the context in which the education takes place (Ellstrom, 1996). Those conditions consist of structural, cultural and technical aspects that can have a positive or negative influence on the learning process, both on an individual and an organizational level (Ellström, 2004). Ideally, an education for adults will stimulate the individuals' personal interest and motivate and engage them in the education by involving them in the creation and practice of the same

(Knowles, 1980). At the same time the education need to challenge their knowledge (Larsson, 1996) whilst making sure that the work place allows for adjustments needed. Support from management linked with the education is therefore important (Ellström, 2004).

To inspire the individual, the contents of the education for adults' benefits from focusing on the individuals own experiences and day-to-day activities (Knowles, 1980). If the individual finds the content of the education meaningful he is more likely to learn (Jarvis, 2010; Knowles et al., 2011). Combining theory with practice also helps the learning process (Ellstrom, 1996).

The aim of this paper is to report experiences of how researchers together with three companies of different size and character developed and carried out an education in maintaining knife sharpness for meat cutters.

2. Methods and participants

The research reported here was performed as an interactive multiple case study where the research process included the development of the education program and its more detailed content in terms of written material used, equipment used and organizing of the educational activities. For the evaluation of the program and its effects reported here, four types of data collection methods were used: observations, interviews, questionnaires and collection of knife sharpness values achieved in the different plants.

These data were analyzed mainly by identification and description of aspects of the program as well as results. Pattern matching and descriptive statistics were also used to convey the findings.

Three plants participated in the study. They were chosen to represent one large, one medium sized and one small meat cutting department. The participating meat cutters differed in working experience from about half a year to several decades of work. Their previous formal education level was generally low. Most had learned their sharpening and knife maintaining skills from co-workers without extensive support from the companies.

3. Development and educational process

3.1 Development process

The research group, well acquainted with the meat cutting industry, developed a basis for the education program built on the existence of a knife sharpness analyzer (Anago KST 200e). This made it possible to achieve a reliable sharpness value for each knife, allowing for sharpness comparison between freshly sharpened and used knife. A laser goniometer for analysis of the edge angle and a small microscope for analyzing the status of the cutting edge were other devices available, all introduced to the industry by the researchers.

The involved researchers produced initially theoretical-practical instructions on knives and some overviews of devices available for sharpening and steeling and a presentation of ergonomically advantageous working techniques. Moreover, the written material included a Canadian instruction in steeling (Vézina et al., 2008) in English and instructions for the sharpness analyzer. In addition to this, a video related to the steeling instruction as well as a small number of links to informative videos in steeling and sharpening available on YouTube were included. Finally the instructions included a suggested structure for the education, comprising four meetings of about one hour each in small groups, involving a large amount of practical training during the meetings. The program was planned in an interactive process together with representatives from

participating meat cutting companies, the meat cutters' trade union and the food industry.

The approach was anchored in the steering committee and had two key points:

1. To conduct the education in small groups.
2. An approach of “train-the-trainer”, i.e. that the research group discussed and conveyed the material to the local instructors, who then had the task to actually convey it to the meat cutters in a way that suited the local context, themselves and the production best.

The written material, the education structure suggestion and the test equipment were introduced to a development group at the Large plant, including first line manager, knife officer, personnel officer, worker safety representative and 2-4 meat cutters (intended trainers). Detailed discussions were held and the group was asked to think about and develop a structure adapted to their own organizational circumstances. Two meetings with this group were held. During these meetings the meat cutters believed the material too technical and detailed but appropriate as base knowledge for the instructors.

3.2 Education process

The views of this group were communicated to the Medium plant which was the site where the education first was brought into practice. The education was led by the first line supervisor and an instructor, mainly working with vocational training at the company. In this plant the original idea of four meetings was abandoned since it was considered to decrease the production capacity too much. One group meeting in small groups and a final meeting with all participating meat cutters were held. In addition, each individual could test their knives with the help of the instructor. The power of the individual discussions (trainer & meat cutter) during testing the knife was discovered here although somewhat loosely organized. The motivation among the meat cutters was shifting and quite a few did not participate at all.

Next company to run the education was the Large plant. They had several internal meetings without researcher involvement to develop their own approach and the result was to adopt the individual meeting as the education solution. One of the large advantages was the very limited influence on the daily production flow. The organizing here was however more structured and included testing, discussion and practice in polishing. One meat cutter turned out to be the main trainer and did the main portion of the training together with the worker safety representative.

The final company to run the education was the Small plant. The individual approach to the education was suggested from researchers and the company with its limited resources accepted this approach. The first line supervisor was worried about the interest, industrial relations problems had made the climate in the company distrustful, and very few of the meat cutters did accept to participate in the beginning. When, however, the content of the effort became clear more meat cutters than expected did participate with great interest. The company had a lean coordinator who did most of the training in cooperation with the first line supervisor.

3.3 General characteristics

In all companies the education was preceded of two meetings with researchers at the plants for information and discussion about the written material and training the trainer on how to use the sharpness analyzer and the other instruments. Moreover, during the process of education, each plant had one support visit as well as telephone contacts. The meetings were characterized by an informal atmosphere and a joint dialogue.

Some characteristics of the plants are displayed in table 1.

Table 1. Some characteristics of the participating plants

Company info	Medium plant	Large plant	Small plant
Meat cutters employed #	30 (1 shift)	100 (2 shifts)	20 (1 shift)
Meat	Pork	Beef	Beef
Knife sharpening	Individual sharpening	External sharpening company	Individual sharpening
Registered participants #	11	74	11
Education session	Knife measurements varying individually, 2 group meetings of total 2 h/individual	45 – 60 min/individual	45 – 60 min/individual

4. Results

The education effort was considered a success and was met with positive response at all plants. All plants asked for a follow-up education within a year to repeat the instruction and the training and to do new measures.

Since the Large plant used an external firm for sharpening knives, each re-sharpened knife represented a direct cost. The plant reported a significant decrease in knife consumption after the training, representing a much higher value than the cost of the training sessions.

The introduction of the sharpness analyzer meant that a technical and objective feedback system was made available for knife sharpness. Previously knife sharpness, being really important for work load and quality of work, was only learnt by subjective evaluation as scraping the edge to your nail or something similar. All employees at the companies, management as well as meat cutters, did emphasize that this was crucial for the training. With the sharpness analyzer you got a value to compare with your previous knife or a colleague and see whether you made progress in keeping your knife sharp. The analyzer thus made learning in a true sense experiential and evoked genuine interest and engagement in the education program.

Regardless of company size the individual concept was preferred, being easiest to apply with the least disturbances of the production flow although being slightly more costly since the trainer had to spend an hour with every meat cutter. The individual concept also seemed to maximize learning, making the training session truly individual and allowing meat cutters, even experienced ones, to admit their problems regarding keeping the knives sharp without risk of losing status in the group.

The individual concept also made it easier for trainers, not having to stand in front of a group lecturing or leading discussions. They could check the understanding and adapt the training session to the individual meat cutter's personal needs, abilities and requirements.

The education program added knowledge to the meat cutter they were not aware of lacking; it was unconsciously demand-driven. The content was also considered relevant and useful by the participants. This made it interesting, which triggered motivation to participate.

When interviewing the meat cutters, they did not think they had been part of an

education or a training session; rather they spoke about it as “that knife thing”, indicating the informal characteristic of the education. They still report having learned from the session even though they did not consider it to be an education.

The other technical devices and the written information were not used or considered of such importance as the sharpness analyzer. The written information was highly appreciated by the trainers involved and the other technical devices were used by the trainers to extend their knowledge. At the Small plant both the written information and especially the laser goniometer (measures edge angle) were used for getting feedback on the sharpening skill since the company used manual grinders.

The high importance of polishing, not found in literature, was learnt by the companies as well as by the researchers. Often a dull knife could gain more from being re-polished than re-sharpened.

5. Discussion and conclusions

The fact that the researchers’ initial education suggestion was abandoned almost immediately is to be considered a success and not a setback. This made for a truly compatible model of education consisting of adaptations to both company and individual needs developed by the participating companies themselves. This model consisting of an informal meeting between instructor and meat cutter focuses on the knife and not the cutter’s personal competence. Testing the knife and discussing the sharpness value makes the meat cutter reflect on his most important tool and how to best use it to maintain the benefits from a high level of sharpness. Because of the sharpness analyzer, knife sharpness is no longer a subjective, indefinable sensation, but a number in black and white. This direct feedback opens up a new world of learning both by practicing and measuring the skills of sharpening, steeling and polishing but also from discussions about tricks and best practices among colleagues.

The fact that the meat cutters referred to the education in knife sharpness as ”That knife thing” is interesting. The program used here was informal and more of an eye-opener, not threatening to their professional pride and didn’t question their professional skill. The educational design meant that each meat cutter could learn at his own pace and didn’t have to share results with his colleagues if he didn’t want to. Important factors like relevant and inspirational content were met and motivation among participants spread automatically among the workers.

The research project introduced three vital ingredients to accomplish this. Firstly, the sharpness analyzer and other devices constituted the core of the experiential aspect and this is what inspired and motivated the meat cutters to participate. Secondly, the private discussion about the knife provided excellent opportunity for both the plant (via instructor) and meat cutter to learn from each other. Implicit knowledge suddenly became explicit and spread informally between meat cutters. Thirdly, a theoretical understanding of ergonomics, work techniques and the importance of knife sharpness as a health factor became more of a reality in the companies.

The effect of all this goes two ways, both towards individual skills but also towards organizational insights and economic benefits. Both the companies and the participating meat cutters express very positive feedback. The fact that the meat cutters also report changes in the way they both use and think about their knife and working technique is a testament of the effect of the education. The challenge now is to see to that the changes last, something the companies are aware of. The positive experiences from the project are also vital for motivating future educations.

All and all, the companies and researchers together found a way to form an education

model that maximizes individual learning whilst not interfering with the companies' daily workflow. The results so far show that the education resulted in sharper knives for the meat cutters and reduced costs for knife consumption for the companies.

References

- Antle, D. M., MacKinnon, S. N., Molgaard, J., Vézina, N., Parent, R., Bornstein, S., et al. (2011). Understanding knowledge transfer in an ergonomics intervention at a poultry processing plant. [10.3233/WOR-2011-1138]. *Work: A Journal of Prevention, Assessment and Rehabilitation*, 38(4), 347-357.
- Arvidsson, I., Balogh, I., Hansson, G.-A., Ohlsson, K., Åkesson, I., & Nordander, C. (2012). Rationalization in meat cutting - consequences on physical workload. *Appl Ergon*, 43, 1026 - 1032.
- Bergstrand, M. (2011). *Styckares arbetsmiljö: En studie om knivskärpa, olika knivstålskvaliteter, arbetsätt, samt fysisk ansträngning*. KTH, Ergonomics. (in Swedish)
- Christensen, H., Søgaard, K., Pilegaard, M., & Olsen, H. B. (2000). The importance of the work/rest pattern as a risk factor in repetitive monotonous work. *International Journal of Industrial Ergonomics*, 25(4), 367-373.
- Claudon, L., & Marsot, J. (2006). Effect of knife sharpness on upper limb biomechanical stresses - a laboratory study. *International Journal of Industrial Ergonomics*, 36(3), 239-246.
- Ellström, P. E. (1996). Rutin och reflektion. Förutsättningar och hinder för lärande i dagligt arbete. In B. Gustavsson, S. Larsson & P.-E. Ellström (Eds.), *Livslångt lärande*. Lund: Studentlitteratur. (in Swedish)
- Ellström, P.-E. (2004). Reproduktivt och utvecklingsinriktat lärande. In P.-E. Ellström & G. Hultman (Eds.), *Lärande och förändring i organisationer. Om pedagogik i arbetslivet* (pp. 17-40). Lund: Studentlitteratur. (in Swedish)
- Gorsche, R. G., Wiley, J. P., Renger, R. F., Brant, R. F., Gemer, T. Y., & Sasyniuk, T. M. (1999). Prevalence and incidence of carpal tunnel syndrome in a meat packing plant. *Occupational and Environmental Medicine*, 56(6), 417-422.
- Hansson, G.-Å., Balogh, I., Ohlsson, K., Granqvist, L., Nordander, C., Arvidsson, I., et al. (2009). Physical workload in various types of work: Part I. Wrist and forearm. [doi: DOI: 10.1016/j.ergon.2008.04.003]. *International Journal of Industrial Ergonomics*, 39(1), 221-233.
- Hansson, G.-Å., Balogh, I., Ohlsson, K., Granqvist, L., Nordander, C., Arvidsson, I., et al. (2010). Physical workload in various types of work: Part II. Neck, shoulder and upper arm. [doi: DOI: 10.1016/j.ergon.2009.11.002]. *International Journal of Industrial Ergonomics*, 40(3), 267-281.
- Jarvis, P. (2010). *Adult education and lifelong learning : theory and practice*. London: Routledge.
- Karlton, J. (2008). *En beskrivning av styckningsarbete och dess förutsättningar i Sverige 2008* (No. Research report 2008:3). Jönköping: Avd för Industriell organisation och produktion. (in Swedish)
- Knowles, M. S. (1980). *The modern practice of adult education: from pedagogy to andragogy*. New York: Cambridge.
- Knowles, M. S., Holton, E., & Swanson, R. A. (2011). *The adult learner the definitive classic in adult education and human resource development*. Amsterdam: Elsevier.
- Larsson, S. (1996). Vardagslärande och vuxenutbildning. In B. Gustavsson, S. Larsson & P.-E. Ellström (Eds.), *Livslångt lärande*. Lund: Studentlitteratur. (in Swedish)
- McGorry, R. W., Dowd, P. C., & Dempsey, P. G. (2003). Cutting moments and grip forces in meat cutting operations and the effect of knife sharpness. *Applied Ergonomics*, 34(4), 375-382.
- Nordander, C., Ohlsson, K., Åkesson, I., Arvidsson, I., Balogh, I., Hansson, G.-Å., et al. (2013). Exposure-response relationships in work-related musculoskeletal disorders in elbows and hands – A synthesis of group-level data on exposure and response obtained using uniform methods of data collection. [doi: 10.1016/j.apergo.2012.07.009]. *Applied Ergonomics*, 44(2), 241-253.
- Vézina, N., & Chatigny, C. (1996). Training in factories: A case study of knife-sharpening. *Safety Science*, 23(2-3), 195.
- Vézina, N., Lajoie, A., & Prévost, J. (2008). *Training in knife steeling*. Montréal: Université du Québec à Montréal.