

## Embedded Literacy and Numeracy Project: Teaching engineering trade mathematics Action enquiry - Case study from the Department of Corrections



### Author:

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## ACTION ENQUIRY TOPIC AND RESEARCH QUESTION

- » Does using illustrations and drawings help the learner to demonstrate knowledge of how to transpose simple engineering formulas?

## TOPIC

The focus was an attempt to make learning engineering formulas easier to understand. Thus, illustrations and drawings were the intervention I investigated.

## CONTEXT

### Corrections

One of the Department of Corrections' goals is to reduce re-offending by 25% by the year 2017. A key strategy to support this goal is to put in place a prisoner training programme that, once completed, will provide the prisoners with a trade skill that will enable them to seek and secure employment on their release. Stable employment has been shown to reduce the likelihood of prisoners re-offending.

A training programme has been put into place for the training of prisoners to a Level 2 in mechanical engineering, and then to allow them to follow on with a Level 3 welding training programme, eventually going on to a Level 4 Certificate in Welding, making them a qualified tradesman. All these courses give the prisoners a recognised NZQA certificate.

## THIS ENQUIRY

The mathematics subject and engineering formulas are two of the most difficult and time consuming subjects to teach within the National Certificate in Mechanical Engineering at Level 2.

Mathematics and transposing of formulas are frequently used in completing various engineering projects and my thoughts were to use practical examples to teach the prisoners how to use and gain experience in this sometimes confusing subject area. As most

of the prisoners are unable to understand how to complete an engineering equation or an engineering formula, I needed to find a way of teaching this subject.

## METHOD

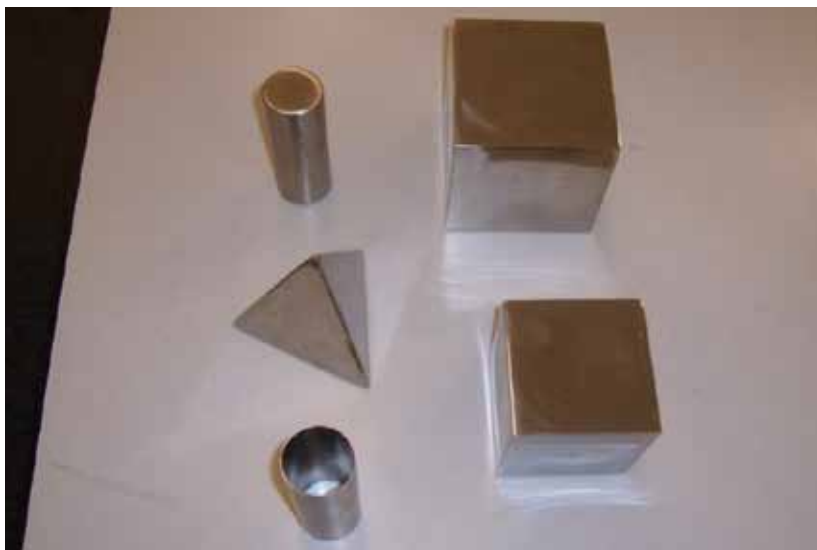
I used observation and informal discussions with the prisoners to find out what the learning was like with these diagrams and illustrations.

## FINDINGS

My first attempt was a dismal failure (although I did learn a lot from this failure on how to review my teaching methods). The illustrated cards and the symbol drawings used for the first time appeared to cause nothing but confusion amongst the learners resulting in it taking twice as long to teach the subject. The confusion appeared to be related to the prisoners not understanding the meaning of the cards or the symbols. When placing the cards into an engineering formula, the prisoners' calculations gave incorrect answers.

The next attempt was to use the action enquiry process in conjunction with some of the practical subjects that I teach, such as the technical drawing unit standards where the prisoners complete 25 technical drawings, and the machining unit standard that requires the prisoner to manufacture five engineering projects. This was a more successful approach to my teaching. Due to this practical approach to the subject, the prisoners understood what they needed to know. They could then construct a drawing and use the mathematical formulas to complete a dimensional check of their drawings.

During the teaching of the technical drawing, prisoners are taught how to construct various shapes such as squares, rectangles, triangles and circles. As part of the drawing construction process, prisoners must check the dimensions of the squares and the rectangles from corner-to-corner to check if the drawing is square and true. Using a simple engineering formula, the prisoners calculated actual corner-to-corner dimensions. This formula also applies for the construction drawings of triangles. With regards to the circle formula, this is used several times per day whilst the prisoners complete the machining unit standard as they use a simple engineering formula to obtain the cutting speed required for the manufacturing process to complete the five engineering projects.



*An example of three-dimensional objects.*



*An example of one of these cars.*

At the end of the project and my attempt to entrench the learning, the prisoners completed an engineering project using what they had learned. This engineering project was a weight driven car. At the start of the project the prisoners organised themselves into groups. The groups planned, designed and built the car. The prisoners created a written production schedule of how the project was built, containing all the relevant drawings required to complete the project. They also had to complete the relevant calculations needed to manufacture their cars. The only rules were that the car had to travel in a straight line for five metres. The goal is to provide an authentic reason for learning the formulas and entrench prisoners' literacy, language and numeracy skills. This task is very popular and tends to be a successful project amongst prisoners as the cars race against each other.

## WHAT WE LEARNED

I have found that, in keeping the engineering learning task as simple as possible, prisoners picked up the knowledge they needed to complete the various engineering projects. I therefore tried to break down the projects to their simplest form and then talk with the prisoners to see if they had an understanding of what calculations are required. This allowed me to track backwards to find where their calculations had gone haywire. From these calculations I was then able to teach the prisoners how to re-calculate the formulas to give the correct answers. Within a short space of time the prisoners who had gained an understanding of the mathematical process were teaching the other prisoners how to do the calculations correctly.

From this process I then proceeded to teach the prisoners how to work out the formulas to find the correct cutting speeds at which to operate the various engineering machines.

My second attempt at addressing the formula interpretation would appear to be working with the prisoners, as they can now actually see the formulas falling into place as they are completing their drawings. From here, the prisoners are completing their calculations and then checking their drawing to see if the corner-to-corner dimensions are correct.

## CONCLUSIONS

This action enquiry project taught me how to examine my practice quite closely and really notice what I was doing and how this affected my learners' progress. I would never have noticed these things otherwise. It also guided me in knowing how to adjust what I did to better suit what the prisoners needed to know.

## WHAT NOW

The next step is to look for practical projects as well as simple ideas that will keep the learning going and improving. This may include making the mathematics subject more interesting to prisoners, as well as reviewing prisoners' numeracy levels, and putting into place those mathematical building blocks missing from the prisoners' education up to this point. Metal fabrication and welding projects could be rich opportunities for developing lessons to improve prisoners' literacy and numeracy abilities.