

SHOULD ELECTRICAL APPRENTICE STUDY MORE MATHEMATICS

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Abstract

The Department Of Electrical Services Engineering, formerly known as the Installation Department Kevin St., train Electrical Apprentices to become qualified Electricians, has recently started to award Degrees in Electrical Services Engineering Which includes the built environment. These students come from CAO applicants and from phase 6 students who have passed through the school. It is a popular and well subscribed course. I am involved with teaching Phase 4 and 6. To progress to phase 6, phase 4 students must pass four examinations of which Electric Science is by all accounts the most difficult. Phase 4 science contains a significant quantity of mathematics and has the highest failure rate. To qualify as Electricians phase 6 also must pass four examinations and as in phase 4 the mathematics exam presents the biggest difficulty. It is with this in mind that I find the Departments decision to discontinue the mathematics class for phase 4 and 6 a backward step. Foreign and native companies operating in Ireland speak of the crying need to improve dramatically the Mathematical ability of our Engineers and Craftsmen. I set a Math test on 9th March 2010 for phase 4 and phase 6. The questions came from a past Leaving Certificate ordinary level paper, which most students said they sat. The test was quite easy, but the results were poor. Eighteen students handed back papers and overall 44% passed and 56% failed (Phase 6). The results were worse for phase 4 with a pass rate of 26% failure rate 74%. Later when I wrote the solutions on the board I was surprised to see them working in groups comparing notes. The survey completed, I can say that it is vital that the Math program be reinstated fully and not have it as an optional subject when classes have ended at five o'clock. After students have put in a long day. The idea that we train Electricians and they leave the DIT with only a rudimentary knowledge of mathematics is out of date in the 21st century. We lag behind greatly Engineers in the Orient and parts of Europe. This situation must be addressed quickly. Mathematics for Apprentices could be reintroduced as a core subject, or Web CT or virtually or as an Elective model. The students would be asked for feedback to establish that they can perform simple calculations, such as power inputs and outputs of motors etc.

Keywords: Apprentice Education, Mathematics Education, examination, mathematical standards

1 INTRODUCTION

The DIT has been training Electrical apprentices since the early 1960's. Formally the department was called The Installation Department and since early 2000, is called the Electrical Services Engineering Department. Under the new scheme apprentices go to DIT for block release of 11 weeks for Phase 4 & Phase 6. (Phase 4 are second year Apprentices and Phase 6 are final year Apprentices) Before that they are trained in FAS Centre's for Phase 2. At the end of Phase 4, the apprentices sit four examinations, namely Electrical Science, Electrical Craft Theory, Phase 4 Practical and an examination in the Electronics Lab. The student cannot progress to Phase 6 to complete their apprenticeship unless they have passed all four exams. Similarly, they cannot secure their Electricians Card unless they complete Phase 6.

1.1 Educational Background

On completion of Phase 6, the qualified electricians have the option of doing a Bachelor of Engineering Technology Degree (DT10) (Electrical Services Engineering), 3 years full time (Level 7). This Degree course is also available part-time (DT078), 3 nights per week, with fast entry to Stage 2 for Phase 6 students. There is advanced entry (into second year) into the full-time course for applicants (Electricians) with AutoCAD and ECDL.

I am mainly lecturing Phase 4 and Phase 6 apprentices. A proficiency in Mathematics is vital since two of the examinations they sit (Electrical Science and Electronics lab) tend to contain mathematical problems. The majority of the apprentices have sat the Irish Leaving Certificate (the final examination in the Irish secondary school system) or the Junior Certificate (an intermediate level examination usually sat at age 15-16).

Many of these students are very weak in basic mathematics. Phase 4 and Phase 6 need proficiency in many areas of basic Mathematics including an understanding of Pythagoras Theorem, the Sine, Cosine and Tangent of an angle, as well as formula manipulation. These basic tasks present enormous difficulty for many of these students. These same problems carry on in to the Engineering Courses In the past Apprentices studied Math as part of their training. They sat an exam at the end of their course, but the exam was optional. Some companies namely the Electricity Supply Board(ESB) and Coras Iompair Eireann(CIE) only hired Apprentices with Honours Mathematics at Leaving Certificate level and would seem to endorse what the Confederation of Irish Industry have said about the ability of our Graduates and Craft persons in Maths and Science, namely that we lag behind our counterparts in Europe and to a greater extent in the Orient. This means that our Graduates and Craft persons will not be as good and will continue to lag behind our competitors if the problem is not tackled immediately.

Mathematics is currently not taught at all in DIT Kevin St. due to lack of interest on the part of the students and lack of funding. Interestingly Mathematics is taught in other DIT Colleges to apprentices of other trades. The Math content for Electrical Apprentices is much greater than for other Trades such as Carpenters, Brick Layers Plumbers etc.

To this end, I find it puzzling that mathematics has been taken off both Phase 4 and Phase 6 curriculum. Even before that the situation was unsatisfactory in that there was mathematics on their timetables but the Maths exam was not mandatory, and this simply negated and undermined the course itself. Very few students sat the maths test at the end of their course in Kevin Street since it was not required as a subject to qualify as Electricians. This state of affairs maths course must be reinstated and the maths test must be made mandatory to qualify as an Electrician.

2 RESEARCH METHODOLOGY

2.1 International Comparison

2.1.1 Great Britain

Apprenticeship Framework

Years 1 to 3 (day release)

The apprentice will achieve the following:

- (a) A Technical Certificate
- (b) National Vocational Certificate (NVQ)
- (c) Key Skills: Communication
- (d) Information Technology
- (e) Problem Solving
- (f) Improving Learning & Performance

Year 4

- (a) A site based NVQ at Level 3
- (b) AM2 Practical Test

Course Requirements:

- (a) GCSE in Maths, English and Science

2.1.2 Australia

Length of time to serve: between 3 & 4 Years

School training before starting?

This involves a mixture of academic vocational education training and paid employment where school studies, training and work all fit together.

Additional Information: Proposed Actions

- (a) Develop and progressively implement a more seamless apprenticeship.
- (b) Re-entry deferral and support system.
- (c) All government infrastructure projects will aim to secure at least 10%
- (d) Of the total contract labour hours are taken by apprentices.
- (e) Government to strengthen their mentoring and support for out of work
- (f) Apprentices and those at risk of losing their apprenticeship.
- (g) Create a higher quality education and training experience for
- (h) Apprentices and employers to increase participation.

2.1.3 Canada (Similar to USA)

Differences exist between states and territories in training.

Length of time to serve:

Apprenticeship programs usually last 4 to 5 years. Apprentices have to pay €400 for some of the off-site training and get no pay during this time. Grants are available.

Licenses issued by each Territory. Must pass an exam and have experience working as a journeyman electrician.

School training before starting?

Yes. A number of public and private vocational-technical training schools offer safety and construction to become an apprentice is required before starting an apprenticeship.

Do you always need an employer?

Yes.

Specialty Electricians.

Construction/Maintenance (c/m) and low rise residential (L.R.R). Transfer as a journeyman from one type to another involves some retraining and on site work, including examination is required.

2.1.4 Germany

Differences exist in training between different federal states.

School training before starting? No.

Length of time: 4 years.

License required:

Yes. Issued by each territory. Must pass exam and have experience working as a journeyman electrician.

Master standard available.

Yes. Required to start a contracting business. Training consists of additional training in the theoretical aspects of the chosen field. Building Automation Technology. Telecommunications and I.T. Networks. Industrial Automation Technology. Audio Visual Equipment and Systems.

3 RESEARCH METHODOLOGY

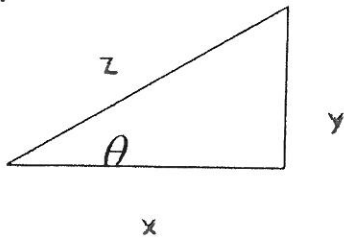
3.1 Diagnostic Test

To test the ability of the apprentice's ability in Mathematics, I set a simple test in Leaving Certificate (Ordinary Level) Mathematics. The test was conducted in early April 2010 and both Phase 4 and Phase 6 were given the same paper, since they all or very nearly all had sat the Leaving Certificate.

4 MATH TEST & TABLE OF RESULTS

ALL QUESTIONS TAKEN FROM PASS LEAVING CERTIFICATE PAPER.

Q1.



(a) Find Sine θ

(b) Find Cosine θ

(c) Show $\frac{\text{Sin } \theta}{\text{Cos } \theta} = \text{Tan } \theta$

Q2.

(i) $X + Y = 8$

$2X - 5Y = 12$

Solve for X and Y.

(b) If $y = x^4$

Find $\frac{dy}{dx}$.

Find x.

(c) $V = \sqrt{2\alpha s}$

Make "s" the subject of the formula.

Q3.

(a) A person's wage is increased by 8% to €118.80. What was his previous weekly wage?

(b) A circle and a square have the same perimeter. Which, if any, has the greater area?

Table 1

CANDIDATE	SBE 6A AND 6B		ALL SAT LEAVING OR JUNIOR CERTIFICATE
1	30%	FAIL	3 QUESTIONS GIVEN. SAME QUESTIONS GIVEN TO PHASE 4. MARKED OUT OF 100%.
2	45%	PASS	
3	13%	FAIL	
4	30%	FAIL	
5	36%	PASS	
6	0%	FAIL	
7	30%	FAIL	
8	10%	FAIL	
9	35%	PASS	

Table 2

CANDIDATE	SBE 6A AND 6B		
10	19%	FAIL	3 QUESTIONS GIVEN. SAME QUESTIONS GIVEN TO PHASE 4. MARKED OUT OF 100%.
11	30%	FAIL	18 CANDIDATES GAVE UP PAPERS.
12	16%	FAIL	3 CANDIDATES PASSED.
13	19%	FAIL	15 FAILED.
14	26%	FAIL	FAILURE RATE = 83.5%
15	23%	FAIL	PASS RATE = 16.5%
16	30%	FAIL	
17	20%	FAIL	
18	10%	FAIL	

Table 3

CANDIDATE	SBE 4A AND 4B		ALL SAT LEAVING OR JUNIOR CERTIFICATE
1	20%	FAIL	3 QUESTIONS GIVEN. MARKED OUT OF 100%. 40% PASS
2	36%	PASS	
3	20%	FAIL	
4	0%	FAIL	
5	23%	FAIL	
6	10%	FAIL	
7	30%	FAIL	
8	10%	FAIL	
9	10%	FAIL	
10	26%	FAIL	
11	15%	FAIL	
12	29%	FAIL	

Table 4

CANDIDATE	SBE 4A AND 4B		ALL SAT LEAVING OR JUNIOR CERTIFICATE
13	29%	FAIL	3 QUESTIONS GIVEN. MARKED OUT OF 100%. 40% PASS
14	8%	FAIL	19 CANDIDATES GAVE UP PAPERS
15	20%	FAIL	2 CANDIDATES PASSED
16	23%	FAIL	17 FAILED
17	50%	PASS	FAILURE RATE = 89.5%
18	13%	FAIL	PASS RATE = 10.5%
19	19%	FAIL	

5 RESULTS

As seen from the results on table 1 and 2 the results were appalling. For Phase 4 A and B, there was a pass rate of only 10.5%. Given that two of the questions are encountered in some form or other on their Phase 4 Electric Science examination, we can see that there is a huge drop in standard in mathematics ability. The same can be said of Phase 6, where the pass rate was a little better at 16.5%.

6 CONCLUSION

Clearly there is an urgent need to reintroduce mathematics as a core subject for Phase 4 and Phase 6 as soon as possible. I propose mathematics should be a core subject and coursework and problem solving could be conducted on a home computer either individually or as a group. Indeed the actual mathematics class should be held in a room where every student has access to a computer, where MATHCAD and other aids could be used to optimum advantage. This would make the teaching of mathematics much more exciting for the students. This involves a mixture of academic vocational education training and paid employment where school studies, training and work all fit together

The mathematics course is discontinued for Electrical Apprentices in DIT Kevin Street but continues as a core subject for apprentices in DIT Bolton Street. The apprentices also have to sit an exam at the end of their course. This should be reintroduced to Kevin St as an immediate requirement. Government to strengthen their mentoring and support for out of work apprentices and those at risk of losing their apprenticeship. Create a higher quality education and training experience for apprentices and employers to increase participation Develop and progressively implement a more seamless apprenticeship, re-entry deferral and support system All government infrastructure projects will aim to secure at least 10% of the total contract labour hours be taken by apprentices

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