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## A study of the learning styles of engineering students at Dublin Institute of Technology

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### Abstract

*This article reports on research carried out over five academic years into the learning styles of engineering students on a number of Level 7, Level 8 bachelor programmes and Level 9 masters programmes in the Dublin Institute of Technology (DIT) using the index of learning styles survey developed by Felder and Soloman (1991). The article explores the results of the research placing them particularly in the national context. The most significant finding is that awareness of the strongly visual learning style of these cohorts of students is likely to be used to improve the learning environment in the future.*

**Keywords:** Learning styles; engineering students; surveys; longitudinal study .

### Introduction

In a seminal paper Felder (1988) suggested that engineering students in particular have four dimensions to their learning styles. Each of the dimensions is described in opposite terms such as active *versus* reflective, sensing *versus* intuitive, visual *versus* verbal, and sequential *versus* global. In summary, active learners learn by trying things out or working with others, while reflective learners learn by thinking things through or working alone; sensing learners are oriented towards facts and procedures, while intuitive learners are oriented towards theories; visual learners prefer visual representation of presented material, while verbal learners prefer written or spoken explanations; sequential learners learn in incremental steps, while global learners are systems thinkers who learn in large leaps. Felder measures student learning styles by means of an Index of Learning Styles (ILS) on-line survey (Felder and Soloman, 1991), composed of 44 multiple-choice questions, with two possible answers for each question. In a series of papers, Felder and collaborators (Felder *et al.*, 1998; Felder and Spurlin, 2005) suggested that most engineering students are active, sensing, visual and sequential learners.

A considerable number of studies have been performed using the ILS questionnaire, both in Ireland (e.g. Seery *et al.*, 2003; Cranley and O'Sullivan, 2005; Byrne, 2007; Ni She and Looney, 2007; O'Brien, 2008; O'Dwyer, 2008, 2009) and internationally (e.g. Montgomery, 1995; Rosati, 1999; Zywno, 2002; Felder and Spurlin, 2005). This paper extends the work of O'Dwyer (2009) who reported on the learning styles of Level 7 year 1 students over two academic years, by considering the learning styles of students following a number of engineering programmes at Levels 7, 8 and 9 on the Irish National Framework of Qualifications (NQF) over five academic years.



The Level 7 student cohorts surveyed were enrolled on Year 1 of the DT009/DT016 electrical engineering, DT006 mechanical engineering and DT003 automation engineering programmes. The Level 8 student cohorts surveyed were enrolled on Year 3 of the DT235 medical physics and bioengineering, and Years 1 and 4 of the DT021/DT081 electrical/electronic/computer engineering programmes. The Level 9 student cohorts surveyed were enrolled on the DT092 advanced engineering, DT087/DT088 mechanical engineering, DT702/DT703 sustainable electrical energy engineering, DT704/DT705 pharmaceutical process control and automation and DT015/DT711 energy management programmes. In all cases, the on-line ILS survey form was printed out, distributed to the students for completion in week 1 of the module and the survey results were collated. A summary of the results, with explanations, and how the average results would inform the author's subject teaching in the semester was provided to the students in week 2 of the module; in addition, each student received their own individual survey result. In total, 260 Level 7 students, 184 Level 8 students and 195 Level 9 students completed the survey form. Altogether, 89% of students who attended the modules completed the form; it should be mentioned that student participation was voluntary, with no student exposure to any risks or reprisals for refusing to participate (Zywno, 2002).

### Analysis

The data were analysed and the learning style preferences in percentages recorded as in Table 1 below for the student cohorts surveyed. Table 1 also shows data from other engineering student cohorts in Ireland; data from engineering student cohorts in the USA, Canada and Brazil are available elsewhere (Montgomery, 1995; Rosati, 1999; Felder and Spurlin, 2005). The table structure is similar to that used in a table by Felder and Spurlin (2005), with *A*, *S*, *Vs*, *Sq* and *n* standing for Active, Sensing, Visual, Sequential and number (of students), respectively. Thus, for example, of the 260 Level 7, Year 1 students who completed the survey in the 2007-12 period, 67% were classed as active learners (and by implication 33% were classed as reflective learners), 75% were sensing learners (so that 25% were intuitive learners), and so on.

**Table 1:** Reported learning style preference in percentages.

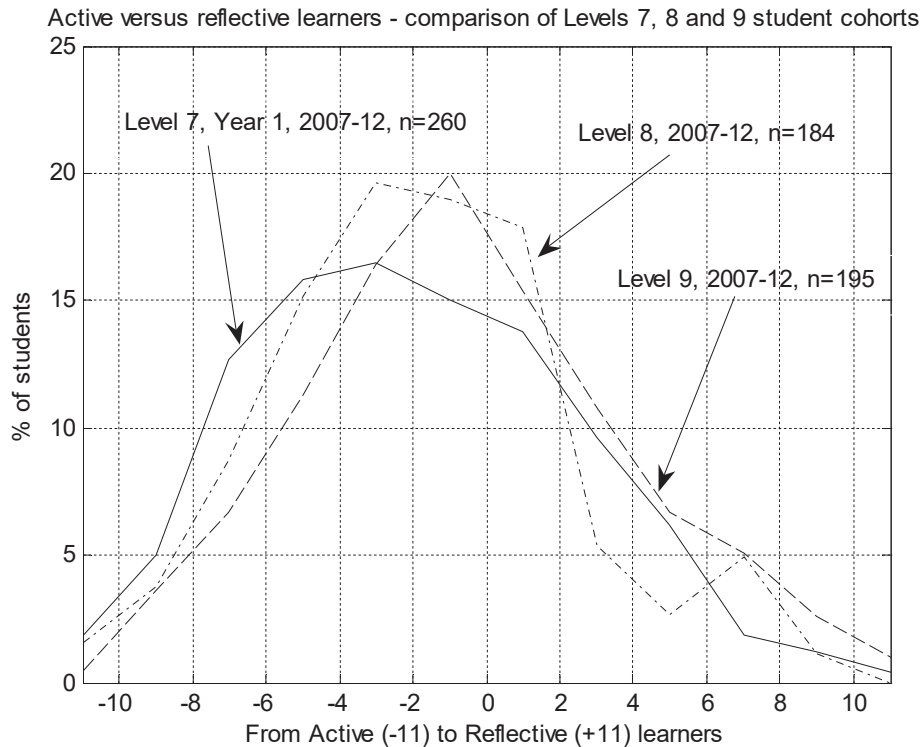
Sampled Population	A	S	Vs	Sq	n
Level 7, Year 1	67%	75%	92%	69%	260
Level 8, Years 1, 3 and 4	68%	69%	90%	66%	184
Level 9	60%	78%	94%	58%	195
Overall DIT engineering students surveyed	65%	74%	92%	65%	639
Second Level Students. Mean age 16.4. Studying Engineering for the Leaving Cert (Seery <i>et al.</i> , 2003)	70%	79%	91%	58%	163
LIT engineering students; predominately Year 1 data (O'Brien, 2008)	70%	80%	86%	54%	101
Cranley and O'Sullivan (2005):					
IT Tallaght, Level 7, Year 1, 2002-3	81%	63%	85%	29%	-
IT Tallaght, Level 7, Year 1, 2003-4	78%	52%	88%	26%	-
IT Tallaght, Level 7, Year 1, 2004-5	69%	67%	76%	37%	-
UCC, Process and Chemical Engineering (Byrne, 2007)	45%	70%	82%	68%	38



The DIT student cohort results, as revealed by this table, are comparable in broad terms with other such results and with Felder's conclusions, mentioned previously, that most engineering students are sensing, visual, active and sequential learners. Strikingly, the DIT student cohort tend to be very visual learners.

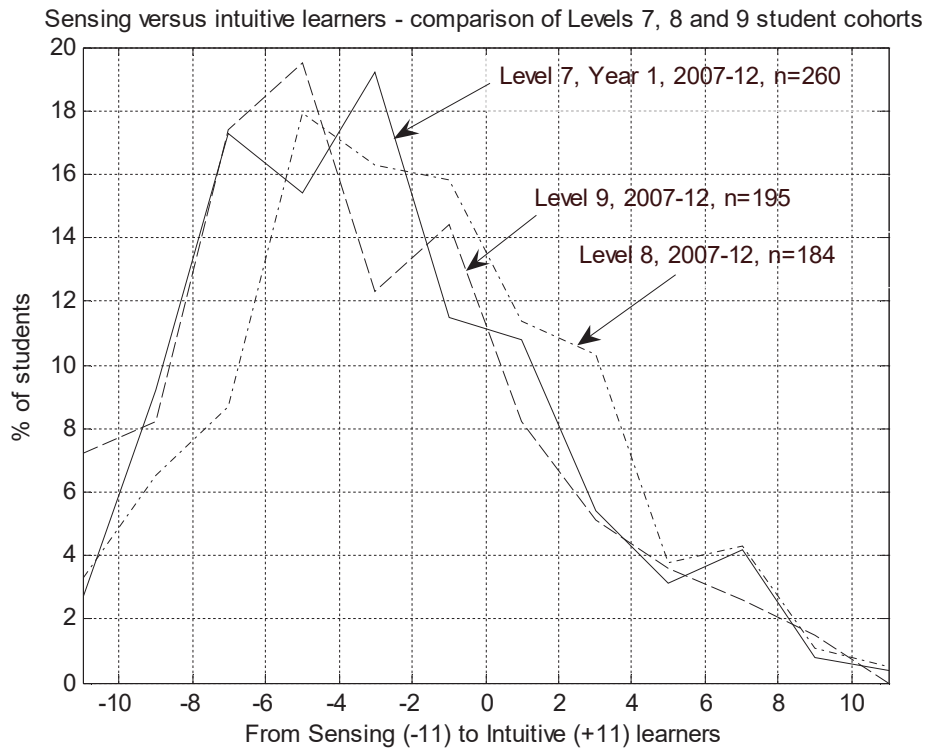
More detailed analysis of the data is shown in Figures 1 to 4, in which strengths of the reported preferences are indicated for the students surveyed. These data were generated from the survey results, with each learner assigned a point on the scale from  $-11$  to  $+11$  for a given dimension. For example, in the active-reflective dimension, a learner scoring  $-11$  is a strongly active learner, with a learner scoring  $-1$  being a marginally active learner; a learner scoring  $+11$  is a strongly reflective learner.

**Figure 1: Active versus reflective learners**

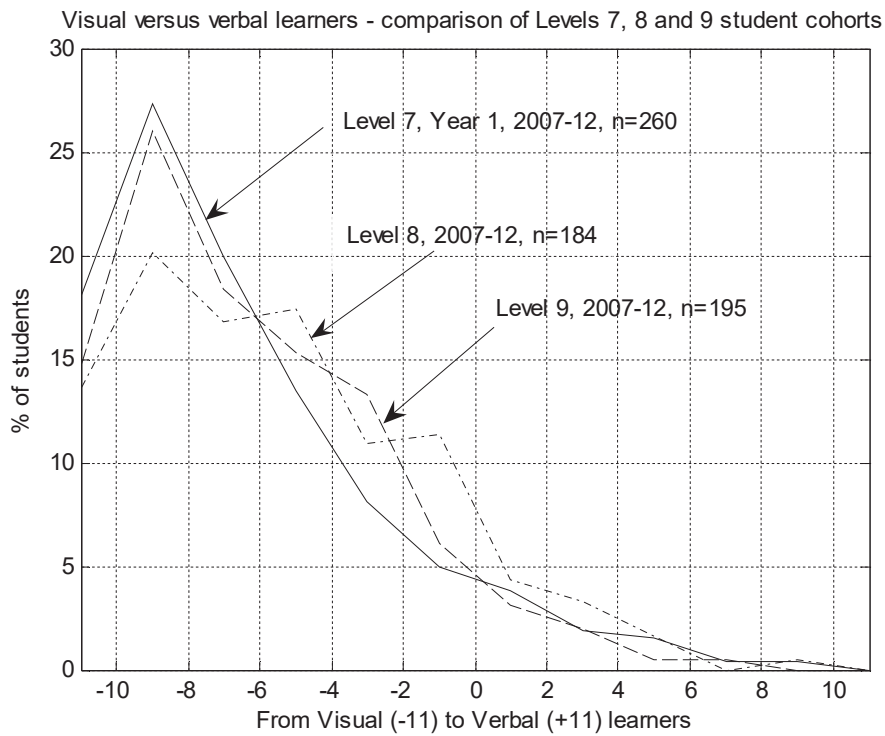


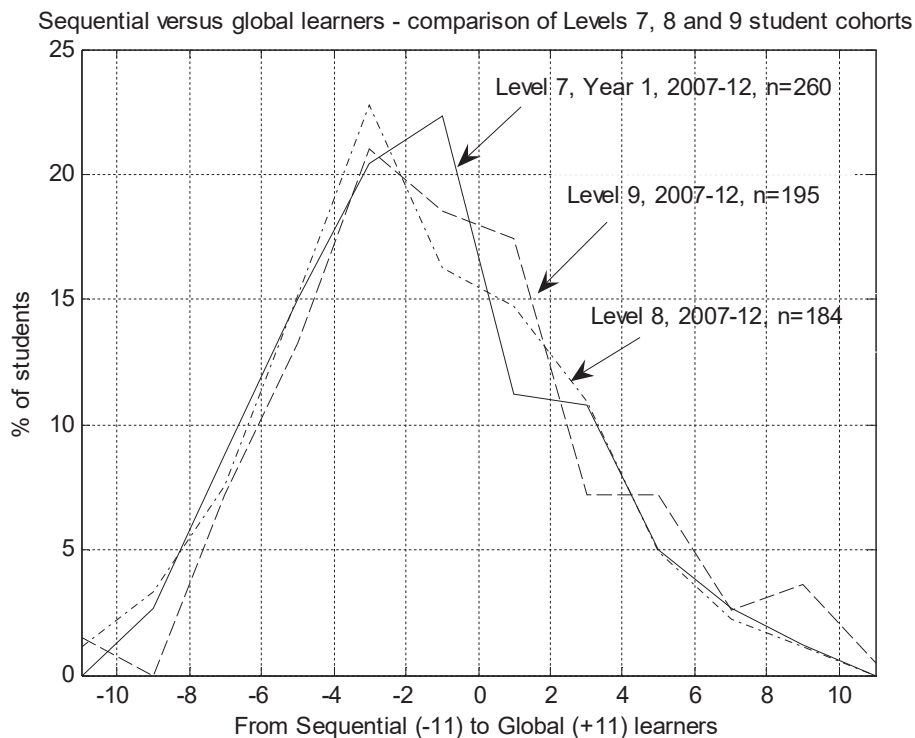


**Figure 2: Sensing versus intuitive learners**



**Figure 3: Visual versus verbal learners**



**Figure 4: Sequential versus global learners**

### Discussion and conclusions

Clearly, there are similarities in student profiles for the sensing-intuitive, visual-verbal and sequential-global dimensions, with some difference in the active-reflective dimension. This difference is as expected, considering the level of the student cohorts. The results in Figures 2 to 4 point to an interesting contrast to the conclusion of Zywno (2002) who suggested that there is a shift in distribution of learning styles between first year and final year students on the equivalent of a Level 8 programme.

Cranley and O'Sullivan (2005) suggest that the learning style survey can be used as a diagnostic tool to predict first-year Level 7 students who may be in danger of not progressing to the second year of their programme. They link an extreme learning style to lack of achievement in summative assessments for such students. However, the similarities of the learning style profiles for the three DIT student cohorts suggest that the learning style survey would not be useful for such a diagnosis. In some preliminary work, a statistical analysis performed by the author for the data available from DIT students on one Level 7 programme in the 2007-9 period makes it clear that learning styles and performance at assessments are not correlated in a statistically significant way. In contrast, other work performed by the author (O'Dwyer, 2011) shows that there is a statistically significant weakly positive correlation between lecture attendance and terminal examination performance for the Level 7 student cohort over the 2007-10 period ( $n=93$ ,  $p=0.0013$ ,  $r=0.33$ ). However, there is some evidence that a link exists between assessment



performance and student learning style, using other surveys which are based on Kolb's learning style inventory (Cagiltay, 2008).

The index of learning styles survey is a useful tool to identify the most preferred student learning mode for both student and lecturer. It facilitates rapid feedback to both, and allows the lecturer to tailor, to some extent, both teaching techniques and assessments to the clear visual learning preference that is evident from the survey results. It seems reasonable that such tailoring should allow improvement in the student retention rate. It is desirable to create an overall learning environment across all subjects to appeal to as wide a range of learning styles as possible. Teaching methods to reach students who span the spectrum of learning styles have been suggested by Felder (1993) for example. In a final comment, it is interesting that a majority of students show no strong preference for active learning; traditionally, engineering programmes place particular stress on active learning in laboratories and workshops.

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