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Analysis of learning styles of first year engineering students on two Level 7 programmes

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Abstract: This paper investigates the learning styles of first year, Level 7, mechanical and electrical engineering students at DIT, over two academic years, using the index of learning styles survey as developed by Felder and Soloman (1991). Student learning styles on these programmes are compared with the results from other such surveys. The correlation between student performance and their individual learning styles is examined. Knowledge of the strongly visual learning style of these cohorts of students may be used to improve the learning environment.

1. 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 (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 co-workers (e.g. 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 preformed 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)) and internationally (e.g. Montgomery (1995), Rosati (1999), Zywno (2002), Felder and Spurlin (2005)). This paper extends the work of O'Dwyer (2008) by focusing on the learning styles of first year Level 7 engineering students over two academic years; the correlation, or lack of it, between first year engineering student performance and their individual learning styles is also examined.

The two Level 7 student cohorts surveyed, in the 2007-8 and 2008-9 academic years, were from the DT009/DT016 electrical engineering Level 7 programme and the DT006 mechanical engineering Level 7 programme. In both cases, the on-line ILS survey form was printed out, distributed to the students for completion in week 1 of the author's 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. Of the 86

DT009/DT016 class group (over two years), 67 completed the survey form; of the 103 DT006 class group (over two years), 80 completed the survey form, giving an overall response rate of 78%. It should be mentioned that student participation was voluntary, with no student exposure to any risks or reprisals for refusing to participate (as in the study performed by Zywno (2002)).

2. Analysis

The data was analysed and the learning style preferences (in percentages) are recorded in Table 1 for the two student cohorts surveyed. Table 1 also shows data from comparable student cohorts. 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 35 DT009/DT016 students who completed the survey in 2007-8, 69% were classed as active learners (and by implication 31% were classed as reflective learners), 77% were sensing learners (so that 23% were intuitive learners), and so on.

Table 1: Reported learning style preference in percentages.

Sampled Population	A	S	Vs	Sq	N
DT009/DT016, Level 7, Year 1, 2007-8	69%	77%	94%	71%	35
DT009/DT016, Level 7, Year 1, 2008-9	66%	75%	91%	78%	32
DT006, Level 7, Year 1, 2007-8	66%	57%	97%	60%	35
DT006, Level 7, Year 1, 2008-9	64%	77%	93%	53%	55
Overall, Level 7, Year 1, 2007-9	66%	72%	94%	64%	157
Second Level Students. Mean age 16.4. Studying Engineering for the Leaving Cert (Seery *et al*. (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%	-

The DIT student cohort results, as revealed by this table in broad terms, are compatible 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. These figures also include data from nine other learners on the DT003 Level 7, Year 1 programme, gathered in 2008-9; this data does not change the results significantly. Having completed the survey, each learner is 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. Clearly, a large percentage of students have no significant preferences, except for the Visual-Verbal category, for which a large majority of students have a moderate or strong preference for visual

learning. Particularly interestingly, the majority of students show no strong preference for active learning; traditionally, Level 7 programmes place particular stress on active learning in laboratories and workshops.

Figure 1: Active versus reflective learners

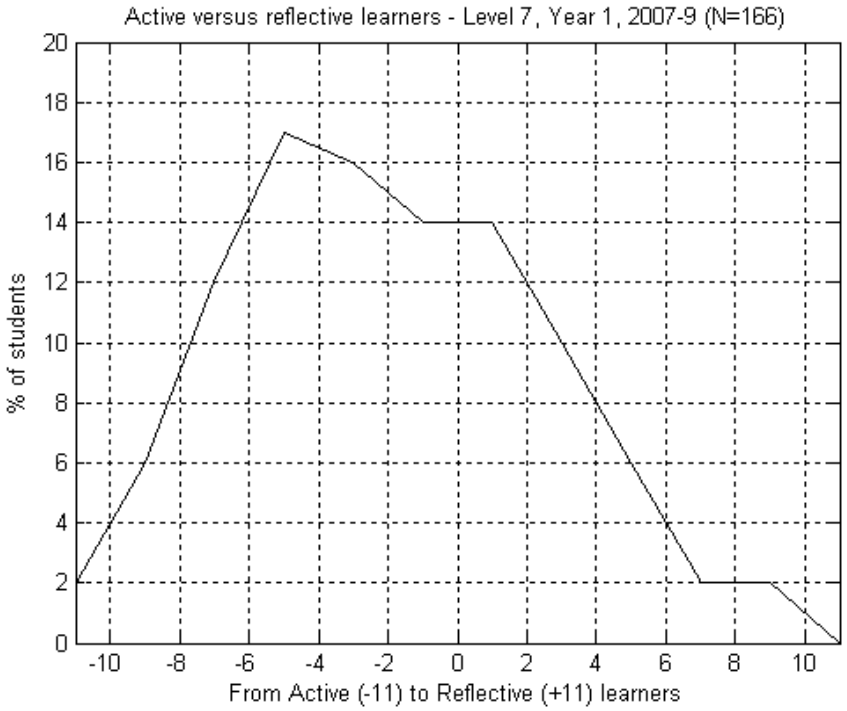


Figure 2: Sensing versus intuitive learners

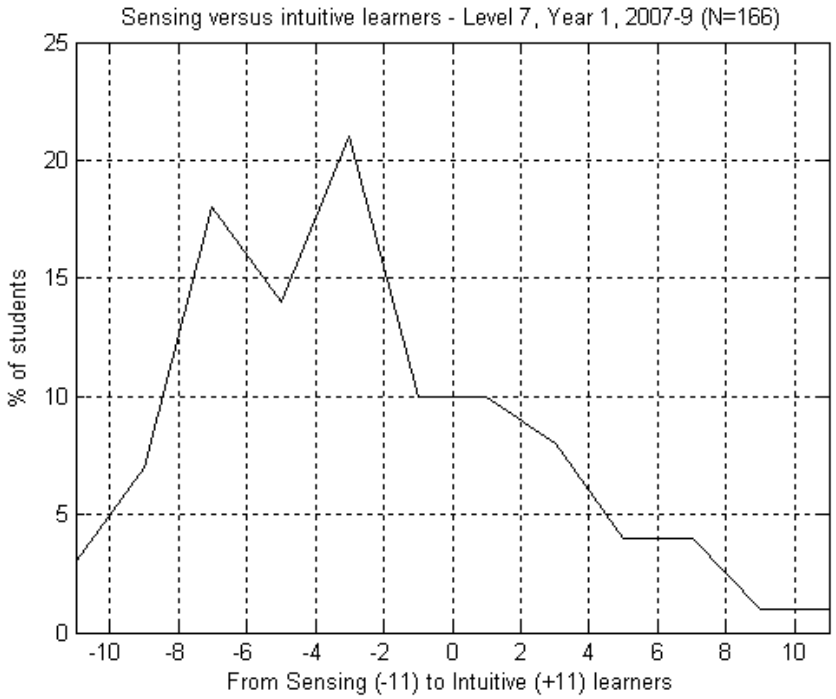


Figure 3: Visual versus verbal learners

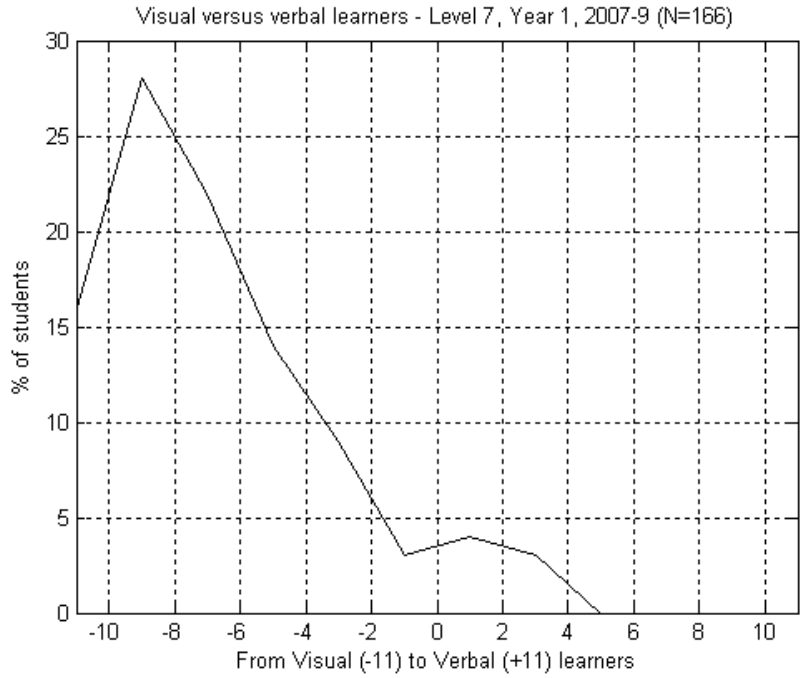
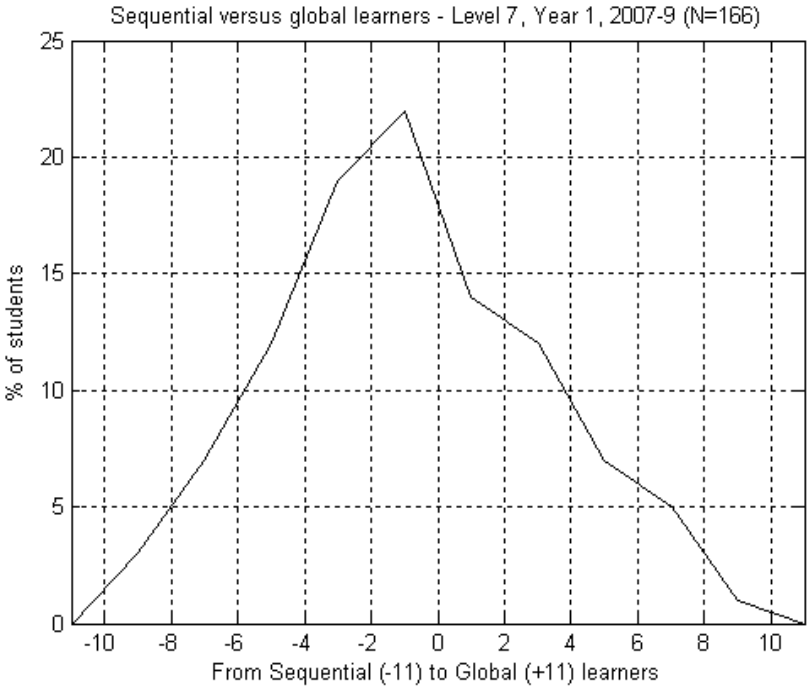


Figure 4: Sequential versus global learners



3. Correlation between student performance and individual learning style

Results are reported for the Electrical Systems subject on the DT009/DT016 programme, for which the author has academic responsibility. This subject, in common with many first-year subjects in programmes with Level 7 awards, is

knowledge or fact-based. It is a central technical subject in the programme, and learning in the subject is progressed further in the remaining two years of the programme. The subject is divided into two thirteen-week modules; in each module, students attend two hours of lectures and two hours of laboratories in the subject each week. The subject is assessed in the following manner:

- Terminal examination (50% of subject mark), held after the completion of the second module. This examination has a compulsory question and five other questions, three of which are to be attempted. Two of these five questions are in multiple-choice format.
- Laboratory work (25% of the subject mark); this is assessed continuously.
- Individual student project work (12.5% of the subject mark), assessed halfway through the second module.
- Module 1 assessment (12.5% of the subject mark); in 2007-9, this was an exclusively multiple-choice examination, held after the completion of the first module.

The results of the ILS survey informed instruction in the subject in the 2007-9 academic years. Lecturing was done using PowerPoint, with extensive visual material employed. Lectures are also made available on the WebCourses online environment. This is partly because attendance at lectures is unsatisfactory; in addition, the subject was followed by a significant number of part-time students. Active learning in the lecture environment was prioritised, with approximately 35% of the lecture time devoted to student problem solving exercises, with the aim of increasing the depth of knowledge of the material. In addition, the module 1 assessment and the terminal examination were changed to incorporate more visual components in the questions.

In a statistical analysis performed by the author for the data available in 2007-9, it is clear that learning styles and performance at assessments are not correlated in a statistically significant way. For example, the p value for the relationship between the terminal examination mark and the sequential/global scale is 0.43 (n=55). Interestingly, there is a borderline statistically significant relationship between laboratory assessment marks and reflective learners in the first semester of the 2008-9 academic year (p=0.058, n=26), suggesting that the laboratory work is not engaging active learners in this semester. In contrast, other work shows that there is a highly statistically significant relationship, for example, between the terminal examination marks and lecture attendance over the two academic years (p=0.0006, n=66).

4. Conclusions

The index of learning styles survey is a useful tool to identify the most preferred student learning mode, for both student and lecturer. It provides rapid feedback 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. Such tailoring allows 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.

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