2010-07-01

Analysis of Engineering Students Learning Styles on Level 7, Level 8 and Level 9 Programmes

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3rd International Symposium for Engineering Education, 2010, University College Cork, Ireland.

ANALYSIS OF ENGINEERING STUDENTS LEARNING STYLES ON LEVEL 7, LEVEL 8 AND LEVEL 9 PROGRAMMES

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Abstract: This contribution reports on research, carried out over three academic years, into the learning styles of engineering students, on a number of Level 7, Level 8 and Level 9 programmes at DIT, using the index of learning styles survey developed by Felder and Soloman (1991). The contribution explores the results obtained in detail, placing them particularly in the national context. The correlation between student performance and 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.

Keywords; learning styles, engineering students.

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, 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, over three 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 electrical/electronic 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 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 author's modules 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 243 students in the Level 7 class groups, 208 completed the survey form, giving a response rate of 86%. Of the 85 students in the Level 8 class groups, 71 completed the survey form, giving a response rate of 84%. Of the 138 students in the Level 9 class groups, 126 completed the survey form, giving a response rate of 91%. Thus, of the 466 students in all of the class groups, 405 completed the survey form, giving a response rate of 87%. 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 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 208 Level 7, Year 1 students who completed the survey in the 2007-10 period, 66% were classed as active learners (and by implication 34% 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	66%	75%	93%	67%	208
Level 8, Years 1, 3 and 4	66%	62%	90%	56%	71
Level 9	56%	78%	94%	58%	126
Overall DIT engineering students surveyed	63%	73%	93%	62%	405
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%	-
UCC, Process and Chemical Engineering (Byrne, 2007)	45%	70%	82%	68%	38

The DIT student cohort results, as revealed by this table, are compatible 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 DIT Level 7 and Level 9 students surveyed. Separate analysis is available for the Level 8 students surveyed, though the profiles generated are similar to those shown and are excluded for clarity. 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, there are similarities in student profiles for the sensing-intuitive, visual-verbal and sequential-global dimensions, with some differences in the active-reflective dimension; the difference shown in this dimension 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 suggests that there is a shift in distribution of learning styles between, in this case, first year and final year students on the equivalent of a Level 8 programme. The similarities of the profiles for the two DIT student cohorts suggest that the learning style survey would not be useful 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. This is confirmed by a statistical analysis performed by the author for the data available from DIT students on one Level 7 programme in the two academic years from 2007-9, in which 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). Therefore, the author has not found the link suggested between extreme learning style and lack of achievement in summative assessments, for a similar cohort of students at IT Tallaght, by Cranley and O'Sullivan (2005). In contrast, other work performed by the author shows that there is a highly statistically significant relationship, for example, between the terminal examination marks and lecture attendance over the two academic years for the DIT students mentioned above ($p=0.0006$, $n=66$).

Overall, a large percentage of both cohorts of DIT students have no strong learning styles preferences, except for the Visual-Verbal category, for which a large majority of students have a moderate or strong preference for visual learning. Interestingly, among the Level 7 students, a 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

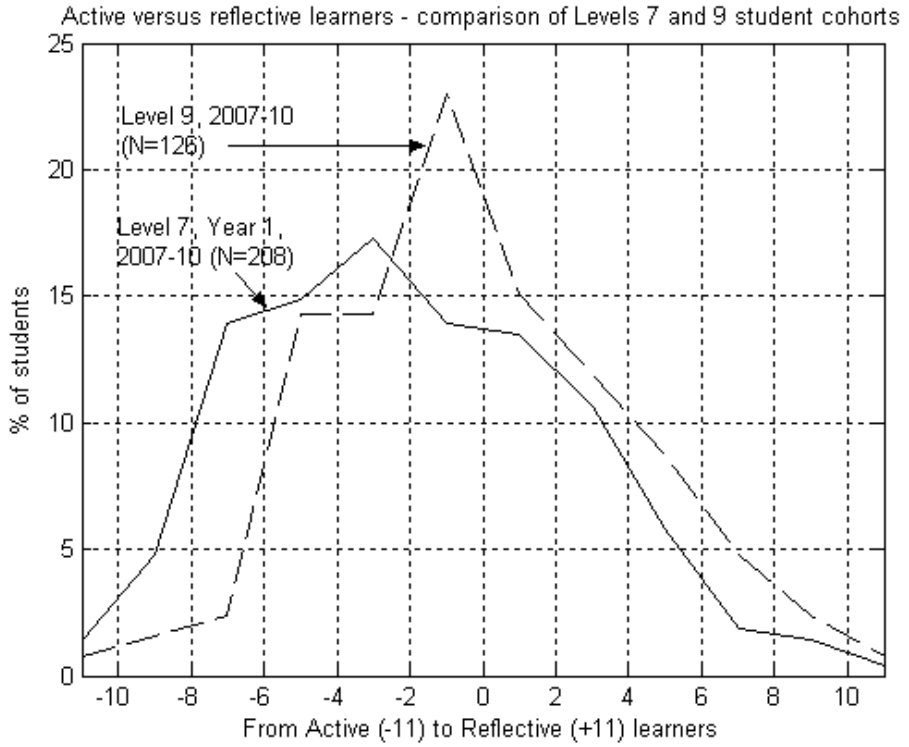


Figure 2: Sensing versus intuitive learners

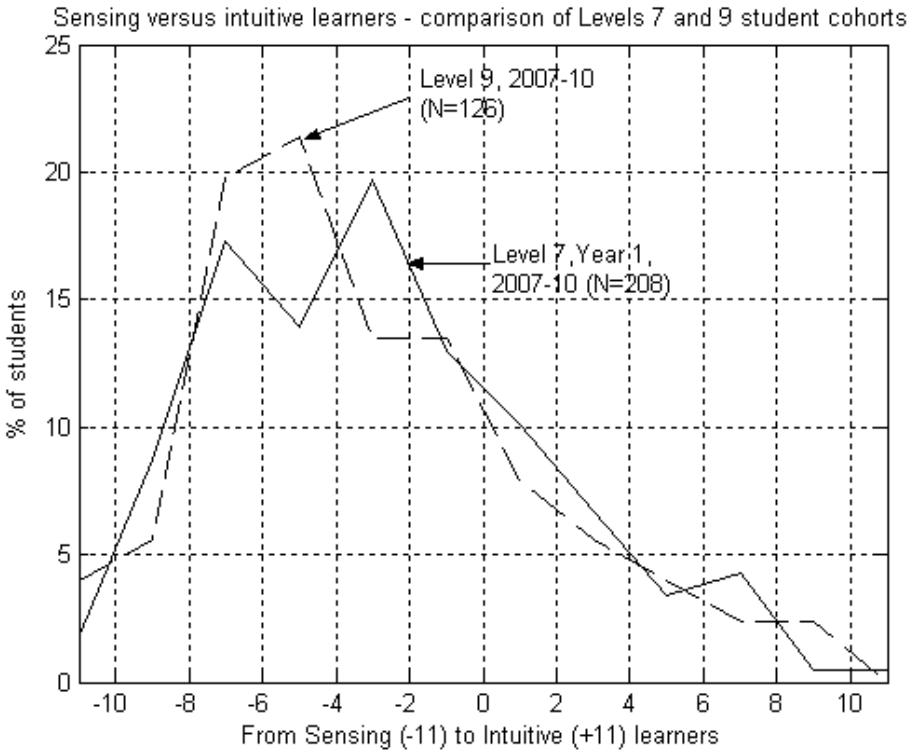


Figure 3: Visual versus verbal learners

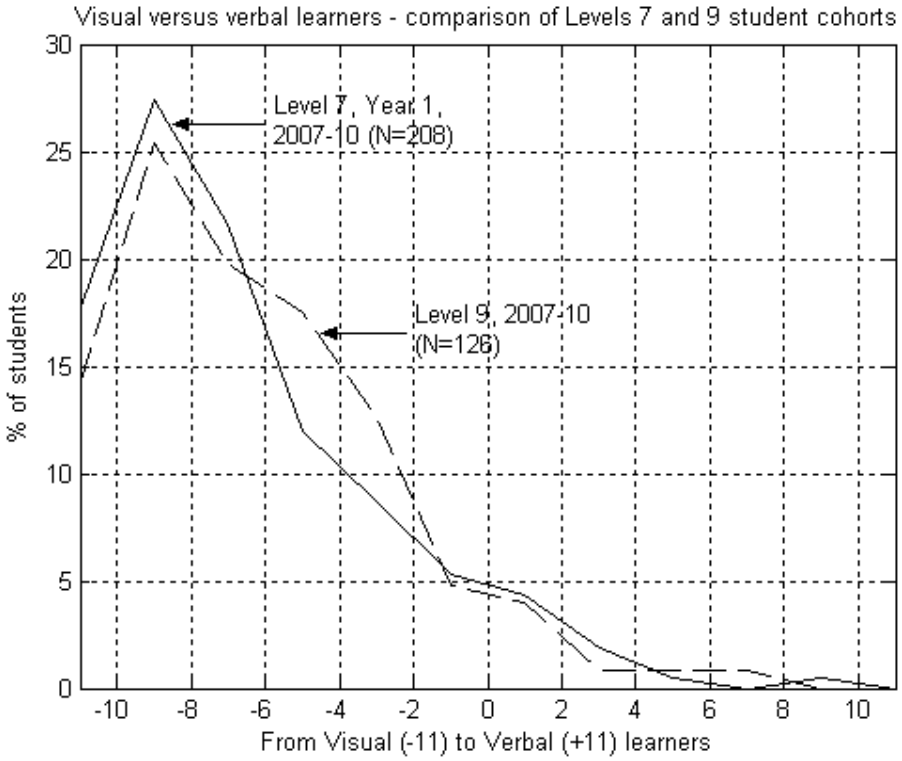
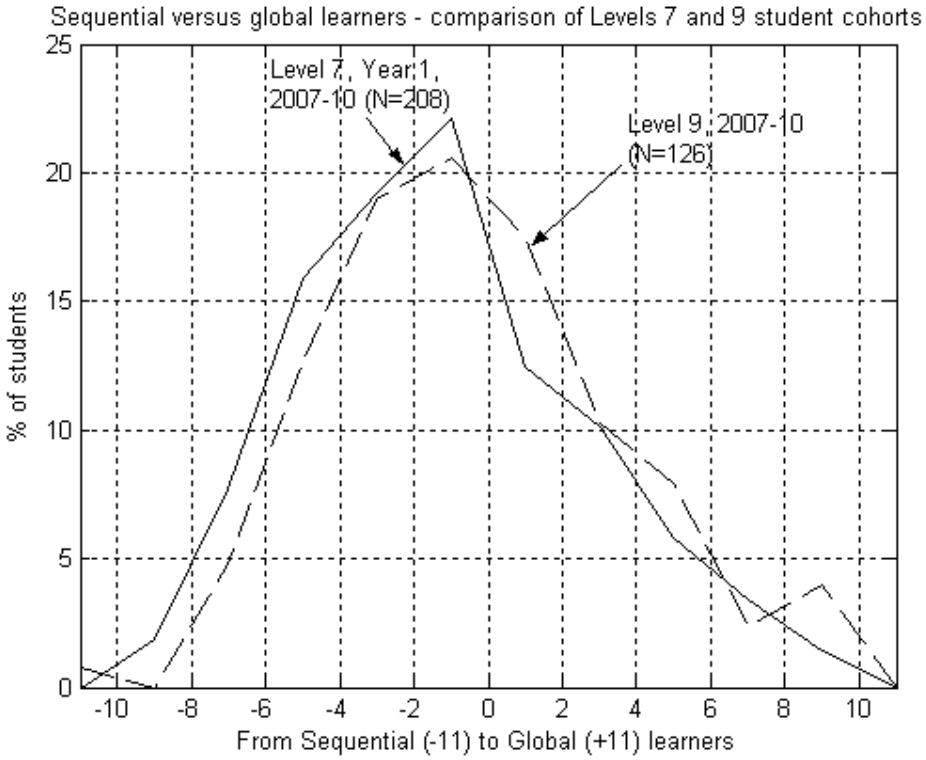


Figure 4: Sequential versus global learners



3. DISCUSSION AND 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 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. More generally, the author has found that learning style profile, as measured by the survey of Felder and Soloman (1991), and performance at assessments are not correlated in a statistically significant way. 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 (e.g. Cagiltay, 2008). Thus, it seems reasonable that the tailoring mentioned above 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.

4. REFERENCES

Byrne, E.P., 2007. Teaching and learning styles in engineering at UCC, *International Symposium on Engineering Education*, Dublin, Ireland. 17-19 September 2007.

Cagiltay, N.E., 2008. Using learning styles theory in engineering education. *European Journal of Engineering Education*, 33 (4), 415-424.

Cranley, F. and O'Sullivan, C., 2005. Analysis of learning styles on a first year engineering course, *International Manufacturing Conference*, Dublin, Ireland. 31 August-2 September 2005.

Felder, R.M., 1988. Learning and teaching styles in engineering education. *Engineering Education*, 78 (7), 674-681.

Felder, R.M. and Soloman, B.A., 1991. Index of learning styles questionnaire. Url: http://www.engr.ncsu.edu/learningstyles/ilsweb.html.

Felder, R.M., 1993. Reaching the second tier: learning and teaching styles in college science education. *Journal of College Science Teaching*, 23 (5), 286-290.

Felder, R.M., Felder, G.N. and Dietz, E.J., 1998. A longitudinal study of engineering student performance and retention. V. Comparisons with traditionally-taught students. *Journal of Engineering Education*, 87(4), 469-480.

Felder, R.M. and Spurlin, J., 2005. Applications, reliability and validity of the index of learning styles. *International Journal of Engineering Education*, 21(1), 103-112.

Montgomery, S., 1995. Addressing diverse learning styles through the use of multimedia: material and energy balance, *25th ASEE/IEEE Frontiers in Education Conference*, 1-4 November 1995.

Ni She, C. and Looney, L., 2007. Facilitating active learning in the classroom, *International Symposium on Engineering Education*, Dublin, Ireland. 17-19 September 2007.

O'Brien, M., 2008. Report on the learning styles profiling project. *Limerick Institute of Technology*, Ireland.

O'Dwyer, A., 2008. Learning styles of first year Level 7 electrical and mechanical engineering students at DIT, *International Symposium for Engineering Education*, Dublin, Ireland. 8-10 September 2008.

O'Dwyer, A., 2009. Analysis of learning styles of first year engineering students on two Level 7 programmes, *All-Ireland Society for Higher Education Conference*, Maynooth, Ireland. 27-28 August 2009. Url: http://ocs.aishe.org/index.php/international/2009/paper/view/72/26.

Rosati, P., 1999. Specific differences and similarities in the learning preferences of engineering students, *29th ASEE/IEEE Frontiers in Education Conference*. 10-13 November 1999.

Seery, N., Gaughran, W.F. and Waldmann, T., 2003. Multi-model learning in engineering education, *ASEE Annual Conference and Exhibition,* Nashville, USA. 22-25 June 2003.

Zywno, M.S., 2002. Instructional technology, learning styles and academic achievement, *ASEE Annual Conference and Exhibition,* Montréal, Canada. 16-19 June 2002.