Gender Differences in the Learning Preferences of Engineering Students

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Abstract

The results are compared of the responses of female and male engineering students to an Index of Learning Styles. This self-report forced-choice instrument classifies the learning preferences of the respondents on four scales; Active/Reflective, Sensing/Intuition, Visual/Verbal and Sequential/Global. Both male and female students showed a clear preference for Active, Sensing, Visual, Sequential learning. However, the female students' learning preferences were significantly more Reflective, Verbal and Sequential than the males'. The teaching and presentation of most engineering courses would be more effective for the majority of students if they contained elements which appealed to all learning styles, which, these results suggest would require them to incorporate and emphasise more Active, Sensing, Visual and Global components.

1. Introduction

Student learning styles are frequently modelled along dichotomous dimensions such as active/reflective, right-brained/left-brained or sensing/intuition. These dimensions, well described in the literature', represent continuous scales and an individual student might report his preference for one pole as strong or weak. Teaching approaches that address a variety of learning styles are more likely to be effective than those that emphasise fewer or perhaps only one style.

The Index of Learning Styles (ILS) is an instrument created and currently being developed[2,3,4] by Soloman and Felder to assess positions on four of these learning style dimensions. The ILS is the first draft of a research instrument, as yet unvalidated, which consists of twenty-eight forced-choice questions and which classifies the student's responses on the four scales: active/reflective, sensing/intuition, visual/verbal and sequential/global. The active/reflective scale derives from Kolb's learning style[5] model and is closely related to Jung's extravert/introvert dimension as described by the Myers-Briggs Type Indicator (MBTI)[6]. The sensing/intuition ILS scale also parallels the similar MBTI dimension and attempts to classify for the educational preference what the MBTI does for the personality preference.

The results described in this paper are the ILS responses from two groups of engineering students from The University of Western Ontario (UWO). The first-year group of students (408 males and 87 females) completed the ILS at the beginning of their program in October (1992 and 1993) and the senior students (284 males and 48 females, most of them in their fourth year) completed the ILS in March (1994, 1995 and 1996) towards the end of their program. The comparison of the first-year and fourth-year ILS responses has been recorded elsewhere[7]. Initially the male/female comparisons were analysed separately for fourth-year student ILS responses and also for first-year student ILS responses but the resulting gender response differences were the same as those contained in the gender comparison of the combined first-year fourth-year responses. Consequently, this paper records the ILS response differences by gender of the combined male responses (408 first-year plus 284 fourth-year) with the combined female responses (87 first-year plus 48 fourth-year).

2. **Active/Reflective Index on the ILS**

Active learners retain and understand information better after they have done something with it; discussed it, explained it or applied it. Reflective learners understand information better when they have taken time to think about it. Figure 1 shows the distribution of the responses on the active/reflective scale of the ILS of the female engineering students compared with the male engineering students. The responses shown on the histogram vary from +7 (high Active preference) to -7 (high reflective preference). The male engineering students declared a higher Active preference (72% Act.) than the female engineering students (59% Act.) and this difference was significant on a chi-square test ($p < 0.02$).

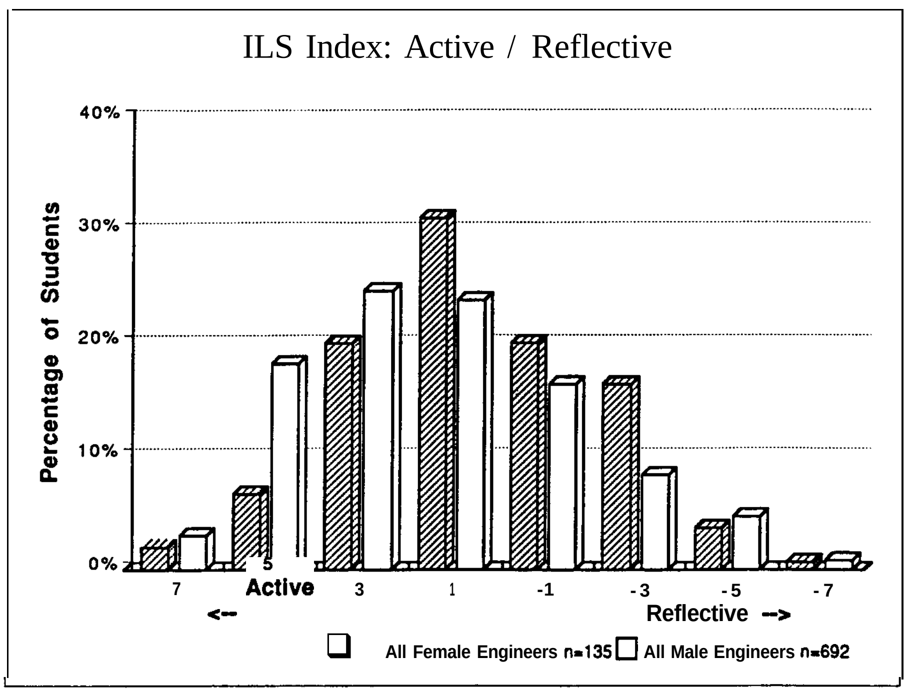

Figure 1: Distribution of the responses of male and female engineering students on the Active/Reflective Index of the ILS.

For most of the individual ILS items the student responses showed no significant differences by gender and they selected the more Active choice. Both male and female students understood something better after they had “tried it out”, “talked about it” or shared ideas in” group problem-solving sessions”. However, the males were significantly ($p<0.001$) more confident (reckless?) in “trying things out” rather than “thinking how to do it” and in exploring a new VCR by “plugging in and pressing buttons” rather than “reading the manual”.

3. Sensing/Intuition Index on the ILS

The sensing/intuition scale on the ILS like the similar dimension on the MBTI is concerned with perception. It expresses how the student becomes aware and describes her preference for gathering information in all settings including the educational one. The sensing student enjoys details, examples, experiences and well-learned routines but gets anxious about new complexities. The intuitive student prefers ideas, concepts and theory and trusts her inspiration to connect to increasing complexity. In engineering courses the S student might work many problems and become fluent in the problem details but fail to grasp the underlying concepts. On the other hand, the N student is more likely to grasp the concept but not bother to work sufficient application problems in order to obtain fluency. A separate study of these first year engineering students[4] found that their reported ILS S/N scores correlated well with their MBTI S/N scores, which affords some support for this scale of the ILS instrument.

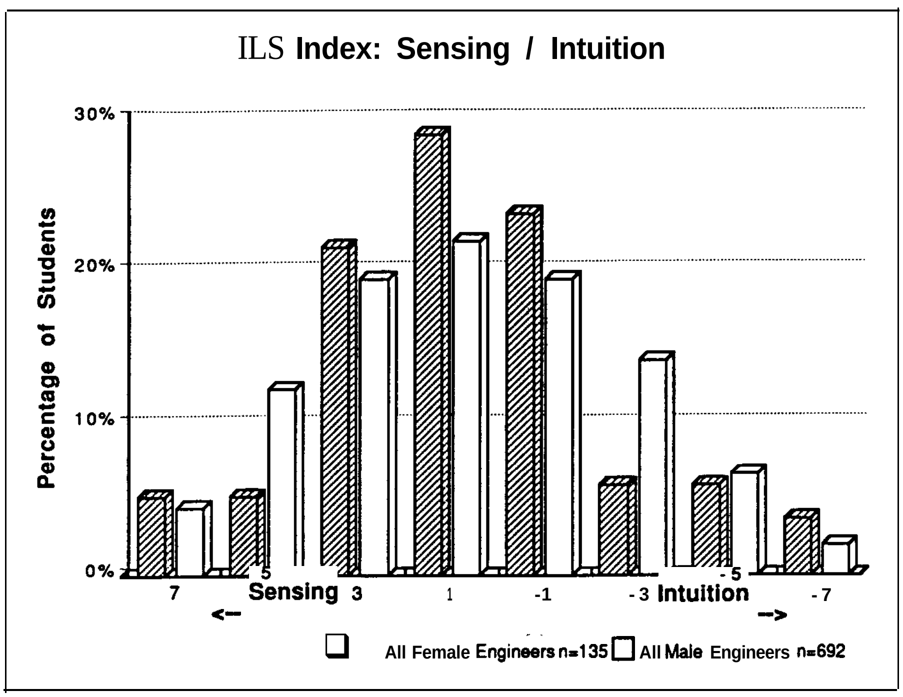

Figure 2: Distribution of the responses of male and female engineering students on the Sensing/Intuition Index of the ILS.

The distribution of female and male engineering student responses on the Sensing/Intuition scale of the ILS are shown in Figure 2. Both male and female students are mostly Sensing, 58%S and 61 %S respectively. All students claimed to be "aware of their surroundings", to be "realistic" rather than "imaginative" and they found it easier to to learn "facts" rather than "concepts". **The** male responses, though, were more Sensing than the female responses in preferring to teach a'course that deals with "real life situations" rather than "ideas and theories" ($p < 0.02$) and preferring to read something that "teaches new facts" rather than "gives new ideas" **($p < 0.001$).** However, the female responses were more Sensing on an item referring to being "careful about the details" rather than "having creative ideas" in their work ($p < 0.001$).

For effective teaching it is important for faculty to acknowledge their own natural inclination towards Intuition and to make conscious efforts to recognise the learning preferences of their Sensing students by frequently introducing specific examples, facts, details, models and practical applications.

4. **Visual/Verbal Index on the ILS**

Visual learners remember best what they see, for example, in pictures, diagrams, films or demonstrations. Verbal learners remember what they hear or, better, what they hear and then discuss. Engineering is a highly visual subject and makes important use of diagrams, drawings, charts, computers and laboratory work. Not surprisingly, nearly all students expressed a strong preference for visual learning as shown by their responses at Figure 3 to the visual/verbal scale of the ILS. The group of male students at 89% Vis. expressed a significantly stronger Visual preference than the group of female students at 69% Vis. ($p < 0.001$).

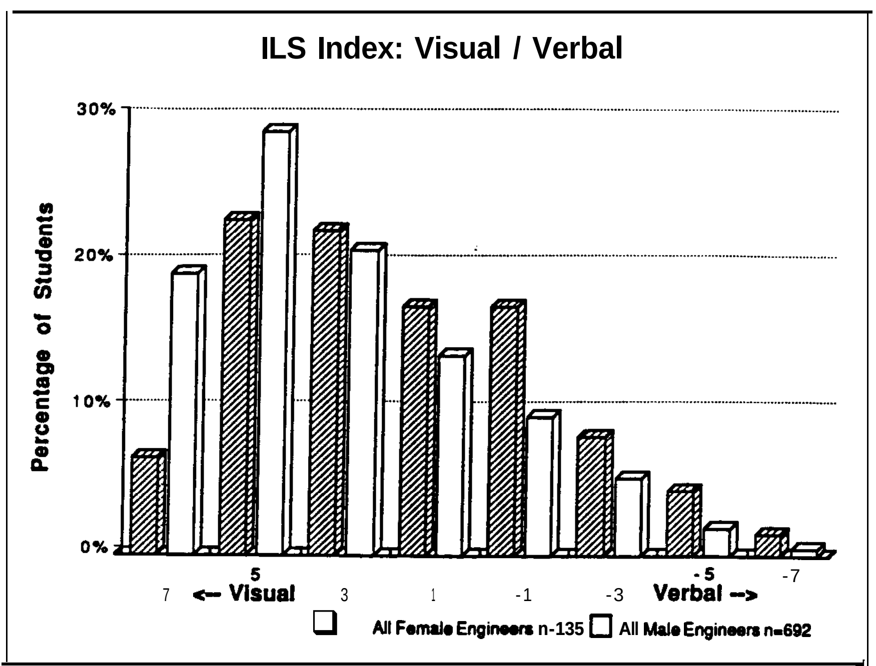

Figure 3: **Distribution of the responses of male and female engineering students on the Visual/Verbal Index of the ILS.**

Both groups of engineering students remember best "a picture" or "what they see" rather than "what they hear" but, conversely, they also prefer an instructor "who spent a lot of time explaining" rather than one "who put a lot of diagrams on the board". Probably, in this case, the students might appreciate the coaching, tutoring and automatic slowing-of-pace that follows from lots of explanations. The male students expressed a stronger Visual preference than the female students for new information to be presented as "pictures, charts and diagrams" rather than as "written directions or verbal information" ($p < 0.001$).

Even though engineering faculty acknowledge a visual preference for their own learning[7], they nevertheless teach in a predominantly Verbal mode using the spoken word, the written word and written mathematical expressions. Teaching verbally by lecturing, writing words and equations on the blackboard and assigning readings is considerably easier, of course, than taking the time to develop demonstrations, animations, flowcharts, diagrams and other visual aids and incorporate them in the lecture presentation.

5. Sequential/Global Index on the ILS

Sequential learners find it easier to learn material that is presented in a logical ordered progression of increasing complexity. They tend to think convergently and be good at analysis. Global learners learn in fits and starts. They cannot function without the big picture. They might struggle with new material and be unable to solve problems with it for days, or even weeks, until suddenly they "get it". They are often divergent thinkers and good at synthesis.

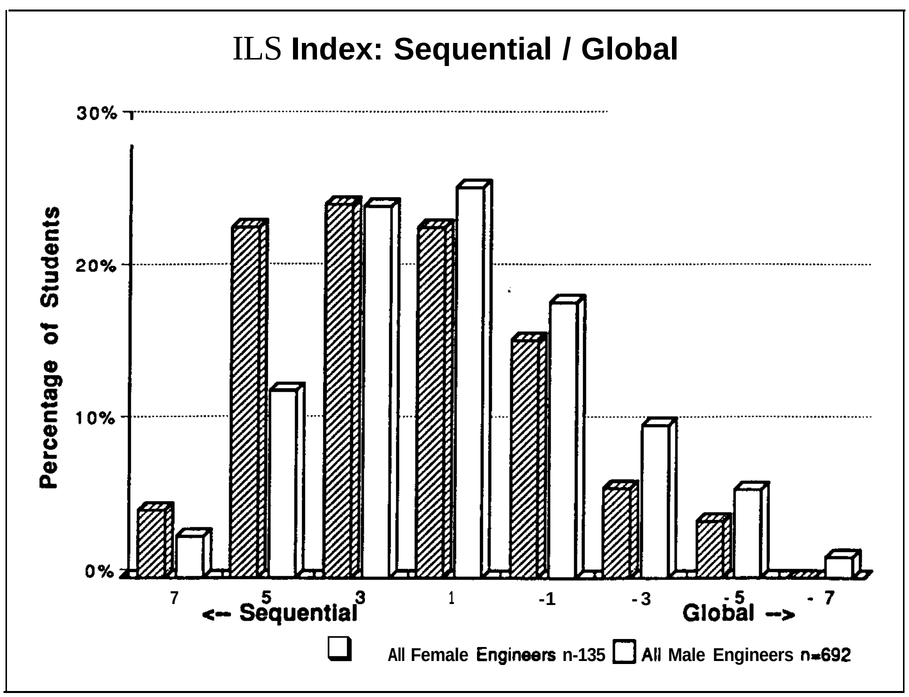

Figure 4: Distribution of the responses of male and female engineering students on the Sequential/Global Index of the ILS.

The distribution of the responses of male and female engineering students on the Sequential/Global index of the ILS is compared at Figure 4. Most students favored the sequential approach towards understanding but the female students preference at 75% Seq. was significantly stronger than the males' at 65 % Seq. ($p < 0.02$).

All students appreciated instruction that was presented "in clear sequential steps" and agreed that new material was "easier at the beginning and harder as it got more complicated". However, more males than females selected the Global responses on items describing learning as "totally confusing until it suddenly all 'clicks"' and also, that in solving math problems they sometimes "just see the solution and then have to figure out the steps" **($p<0.01$).**

Most college courses are taught in a logical stepwise progression that should suit the majority of students who are Sequential learners. However, frequent, deliberate and clear attempts by faculty to relate the course material to other fields and to the big picture should not only appeal to the significant minority of Global learners but also help the Sequential learners to develop their skills of synthesis.

6. **Conclusion**

Both male and female ILS responses showed a clear preference for Active, Sensing, Visual and Sequential learning. Female engineering students were significantly more Reflective, Verbal and Sequential than their male counterparts.

If most engineering faculty emphasise the Reflective, Intuitive, Verbal and Sequential styles in their teaching it would seem that their style is more naturally in tune with the female engineering students.

Engineering faculty should recognise that their classes of engineering students contain all types of learners, so effective instruction should try to make some appeal to each learning style in a balanced presentation. For improved teaching appeal to more student learning styles this would mean that most engineering lectures would be improved by the addition of more Active, Sensing, Visual and Global components.

References

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