A study of the understanding of knowledge and learning of a cohort of mature age students

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Abstract: *In 2005 the authors began a longitudinal research project to explore the factors that influence student success in the Master of Engineering Practice program which was offered for the first time in Semester 2, 2004. This distance education program enables experienced Engineering Technologists to use their workplace learning to gain a qualification at the Professional Engineer level.*

This research was initiated because the admission of some students into the program is based on the recognition of their prior workplace learning. Cantwell and Scevak (2004) highlighted the problems that students may encounter when they gain entry to a university on this basis. To explore this issue four previously validated questionnaires were used to gather data on: student approaches to learning, their epistemological beliefs, learning style preferences, and strategic flexibility.

This paper reports on a preliminary analysis of the data gathered from the students who enrolled in the program during the period 2005-2009. In the longer term, when the sample size has grown and more students have graduated, the data will be analysed to explore the relationship between the measured factors and success at university.

Introduction

The context for this research is the innovative Master of Engineering Practice (MEP) program. This program was designed to enable experienced Engineering Technologists to use their workplace learning to gain an accredited award that qualifies them to work as a Professional Engineer. The program is accredited by Engineers Australia, and provides an alternative pathway to the Bachelor of Engineering program. It is offered in the distance education mode and students would normally require three years of part-time study to complete the 12 unit program. The entry requirements for the program are:

1. A Bachelor of Engineering Technology (or an equivalent award) or membership of Engineers Australia at the Engineering Technologist level; and
2. At least five years of relevant experience in the engineering industry.

The program structure and pedagogies are based on the theories and practices associated with distance education, adult learning, reflective practice, negotiated curriculum, and the self-assessment of workplace learning (Dowling, 2006). The program is highly flexible as each student negotiates an individual Pathway to Graduation Plan as part of the first course in the program: ENG8300 Self-assessment Portfolio.

Table 1 shows the enrolment and retention data for the program since it was first offered in 2004. Although enrolments have grown over the last two years, the high attrition rate has meant that few students have graduated. Two factors contributed to the high attrition rate up to 2007: Increased workloads due to skill shortages in their workplaces; and after completing ENG8300 Self-assessment Portfolio, some students transferred to the Bachelor of Engineering or another USQ program after recognising they did not have the workplace experience, or requisite skills, to be able to undertake the MEP program. In time, this study may identify other factors that contribute to the attrition rate.

Table 1: MEP commencing students for the period 2004 – 2009.

Status	2004*	2005	2006	2007	2008	2009*	Totals
Commencing	6	19	7	18	42	19	111
Active	1	6	2	13	40	19	81
Cancelled	4	11	3	4	2		24
Graduated	1	2	2	1			6

*The commencing data for 2004 and 2009 are based on one semester only.

The research questions

The longitudinal research project is being undertaken to identify the key factors that influence academic success in the Master of Engineering Practice program. Specifically, the research seeks to answer the following questions:

1. Is the academic performance of students in the MEP program influenced by their belief systems relating to knowledge and learning, the type of prior tertiary education they have experienced, and/or the number of years of relevant engineering experience they have?
2. Do the mature age students in the MEP program have similar learning style preferences to those of school leavers entering undergraduate engineering programs?

The results of the research will be used to:

- Inform the teaching and learning pedagogies employed in the Master of Engineering Practice program; and
- Review two of the entry requirements for the MEP program: (a) the number of years of relevant experience required and, (b) the prior educational experience of those students who enter without a Bachelor of Technology degree.

This paper reports on the preliminary results obtained from the data collected using four questionnaires that explore student understanding of knowledge and learning.

Theoretical frameworks

One of the modules in the study materials for the course ENG8300 Self-assessment Portfolio is designed to facilitate the development of the students' reflective skills so that they are able to identify and define their learning from a range of workplace experiences. Four questionnaires were included in the module to prompt student thinking about their understanding of knowledge and the way they learn.

The Index of Learning Styles

The first questionnaire is the Index of Learning Styles (ILS) which was developed by Felder and Silverman (1988) to help academic staff to identify the preferred learning styles of the engineering students in their class and then adopt pedagogies that would address the learning needs of those students. The ILS consists of 44 questions, each with two possible responses, (a) or (b). The ILS can be completed online, with the automated results indicating the participants preferred learning styles in one of two categories on each of the following four dimensions, with each preference based on the answers for eleven of the questions (Felder & Spurlin, 2005):

- The Active – Reflective dimension: Active learners learn by doing something active (e.g. discussing information, experimenting, trying something etc.) while Reflective learners learn by thinking about information or a situation.
- The Sensing –Intuitive dimension: Sensing learners are concrete learners who are practical and like facts and processes while Intuitive learners like exploring theories and possibilities.
- The Visual-Verbal dimension: Visual learners prefer to learn through pictures, plans, graphs etc. while Verbal learners prefer to learn from written and spoken information.

- The Sequential-Global dimension: Sequential learners prefer to learn by incrementally stepping through information in a linear and logical manner. Global learners prefer to take a holistic view and learn in larger steps.

Participant preferences are rated *mild*, *moderate*, or *strong* in one of the categories on each of the four dimensions.

Student understanding of knowledge of learning

Cantwell and Scevak (2004*)* highlight the problems that students may encounter when they enter a university program with advanced standing based on the recognition of prior workplace learning. Through their industry experience they may have acquired a belief in the structural simplicity of knowledge which may lead to surface learning rather than deep learning. If this belief is retained during their university program then it is likely to impact on their academic performance (Cantwell and Scevak 2004). Trowler (1996) noted that once these students enter the university environment they are asked "…to convert practical knowledge … into a form of propositional knowledge which is conceptual, explicit, coherent and organised along discipline lines" (Trowler, 1996 p. 20). Thus, a student's ability to reflect on their workplace experience and then convert it propositional knowledge may be hindered by their understanding of knowledge.

The three questionnaires used by Cantwell and Scevak (2004) were also used in this study, each using a five-point Likert scale:

1. Schommer's (1993, 1998) Epistemological Beliefs Questionnaire (42 questions, short version) measures student understanding and beliefs about the nature of knowledge. The first measure, *Simple knowledge*, differentiates between a belief that knowledge is simple and exists in separate packages, and a belief that knowledge is more complex and interrelated. The second measure, *Certainty of knowledge*, differentiates between a belief that knowledge is static and a belief that knowledge may change and grow over time. The third measure, *Innate ability*, differentiates between a belief that knowledge is acquired through strategic behaviour and a belief that the ability to acquire knowledge depends on a person's innate ability. The final measure, *Quick learning*, differentiates between a belief that time and effort are involved in acquiring knowledge and a belief that knowledge acquisition is unrelated to time and effort.
2. Biggs' (1987) Study Process Questionnaire (42 questions) is a measure of the learning approaches used by students, where the approaches represent an interaction between motivation and strategy. Students using the *Deep approach* are motivated to adopt strategies that they believe will lead to mastery. Students using the *Surface approach* are motivated by the need to pass rather than by the intrinsic value of mastering a subject. Students using the *Achieving strategy* are motivated by a competitive need to achieve institutional objectives. This approach may be linked to either the surface or the deep approach.
3. Cantwell and Moore's (1996) Strategic Flexibility Questionnaire (21 questions) uses three self-regulatory orientations to report on the manner in which students metacognitively deal with issues of complexity in learning. The first self-regulatory orientation, *Adaptive control*, reports on a student's preference for adapting learning strategies to suit the task. The second orientation, *Inflexible control*, reports on a student's preference for tried and trusted routines, and the third orientation, *Irresolute control*, reports on students' belief in their ability to formulate and implement a strategy to undertake a complex task.

Methodology.

While students are encouraged to complete the four questionnaires as part of the reflective practice module in the first course in the program (ENG8300 Self-assessment Portfolio), submission of the results is voluntary under the requirements of the Ethics approval for the project. It has therefore taken five years to accumulate 53 sets of data, of which 50 sets were found to be valid. The data was analysed using the statistical software package SPSS v16.

Results

The results are discussed in two sections: Learning style data; and Knowledge and learning data.

Learning styles

The results of the analysis of the 48 valid sets of ILS data are shown in Table 2. Normally ILS data is reported on a scale from 0-11 for one of the two categories on a dimension (e.g. Active or Reflective). For statistical reasons, however, the data for this project was analysed on a 12 point scale (0-11) for each learning style dimension. Thus, scores between 0 and 5 represent one category of the dimension (e.g. Reflective) and scores between 6 and 11 represent the other category of the dimension (e.g. Active). The data is compared to the data resulting from an analysis by Felder & Spurlin (2005) of data from ten eligible student cohorts at seven universities.

Table 2: Summary of ILS results

<table>
<tr><th>ILS Scale</th><th>Chart</th></tr>
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Active (44%) / Reflective (56%)

Mean: 5.4. Std. Dev. 2.28. n=48

Approximately 60% of the students are clustered around the centre of the scale and show only a mild preference for either the Active or the Reflective learning style. Overall, there is a slight preference for learning through reflection.

Felder & Spurlin (2005): Active (61% Std Dev 6%)

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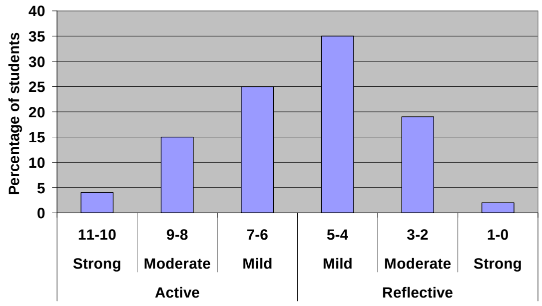

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Sensing (69%) / Intuitive (31%)

Mean: 6.88. Std. Dev. 2.53 n=48

The majority of students show a preference for learning through sensing (concrete learning), with just over 50% of them showing a mild or moderate preference for this learning style.

Felder & Spurlin(2005): Sensing (63% St Dev 8%)

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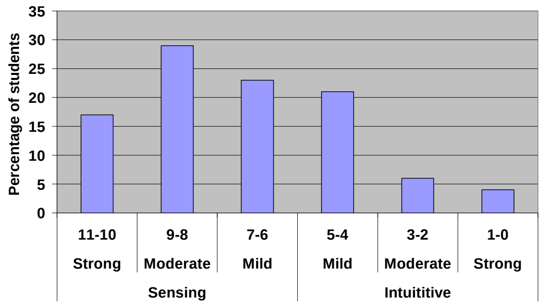

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Visual (88%) / Verbal (12%)

Mean: 8.4. Std. Dev. 2.21 n=48

Nearly 90% of the students show a preference for visual learning, with 73% having a moderate to strong preference for this learning style. In fact, eleven students scored 11 on this scale, the maximum score.

Felder & Spurlin (2005): Visual (82% St Dev 8%)

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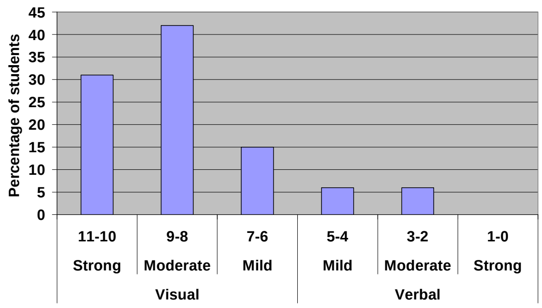

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Sequential (61%) / Global 39%)

Mean: 5.94. Std. Dev. 2.28 n=48

Approximately 65% of the students are clustered around the centre of the scale and show only a mild preference for either the Sequential or the Global learning style. Overall, there is a slight preference for learning information sequentially.

Felder & Spurlin (2005):Sequential(59% St Dev 7%)

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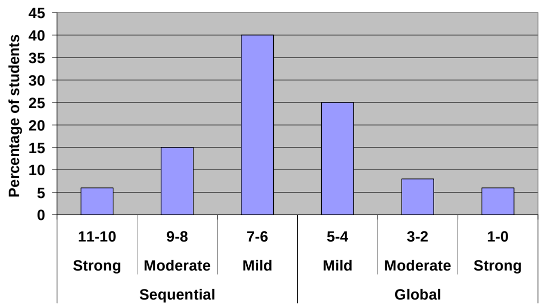

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These results suggest that the learning preferences for this group of mature age engineering students are more reflective than active, more sensing than intuitive, much more visual than verbal, and more sequential than global. When compared to the results of the Felder & Spurlin (2005) study, the MEP student data was similar on the Sequential-Global scale, and slightly stronger on the Sensing and Visual measures. The major difference is that the MEP students are reflective learners, unlike the undergraduate students in the Felder and Spurlin study who exhibited a preference for active learning. The reasons for this significant difference (44% vs 61%) are not apparent from the current data, however, the project team will collect and analyse additional data to determine if the age and/or engineering experience of the MEP students influence the data for this measure.

The students' preferences for reflective learning suggests that they are well equipped to reflect on their workplace experiences and identify their learning from those experiences, a key pedagogy in the MEP program. The inclusion of the module on reflective practice in the first course facilitates this process, and this has been acknowledged by students in a number of unsolicited written comments.

Knowledge and learning questionnaires

The results of the three questionnaires are reported separately in the following sections.

Epistemological beliefs

The mean scale responses for the 50 students who completed the Epistemological Beliefs Questionnaire are shown in table 3. Cantwell and Scevak's (2005) RPL Industry group data is included in the table for comparison purposes. The results for the MEP students are consistent with those of the RPL Industry students.

Table 3: Comparison of the reported epistemological beliefs of MEP and RPL Industry groups

Belief	MEP Students (n=50)	RPL Industry Students (n=33)
Simple knowledge	2.96	2.92
Certainty of knowledge	2.50	2.41
Innate ability	2.04	2.17
Quick learning	2.24	2.26

Approaches to learning

The mean scale responses for the 50 students who completed the Study Process Questionnaire (SPQ) are shown in table 4. Cantwell and Scevak's (2005) RPL Industry group data is included in the table for comparison purposes. The MEP students show a significant bias towards the deep approach to learning rather than the surface approach, and when compared to the RPL Industry students. Cantwell and Scevak (2004) reported that this finding is consistent with those of other studies of mature age students.

Table 4: Comparison of the reported approaches to learning of MEP and RPL Industry groups

Approach to learning	MEP Students (n=50)	RPL Industry Students (n=33)
Surface approach	3.17	3.12
Deep approach	3.68	3.49
Achieving approach	3.35	3.25

Self-regulatory control

The mean scale responses for the 50 students who completed the Strategic Flexibility Questionnaire are shown in table 5. Cantwell and Scevak's (2005) RPL industry data (n=33) is included in the table for comparison purposes. The MEP students show a bias towards adaptive control processes, particularly when compared to irresolute control processes. This bias is stronger than that reported for the RPL Industry students on these two measures.

Table 5: Comparison of reported approaches to self-regulatory control

Control type	MEP Students (n=50)	RPL Industry Students (n=33)
Adaptive control	3.21	3.37
Inflexible control	3.08	3.03
Irresolute control	2.53	3.05

Discussion

These results indicate that the MEP student cohort has similar characteristics for these measures as the RPL Industry students. It is too early to assess the impact of these factors on academic performance as only 30 of the students have a GPA and many of those GPAs are only based on the results of one or two courses. This is because MEP students study part-time and take longer to complete a program.

Conclusion and recommendations

The preliminary results of the study give a valuable insight into the way MEP students approach learning, and into their understanding of the structure of knowledge. The ILS data will be combined with ILS data collected from cohorts of on-campus and distance education undergraduate engineering students to explore the reasons for the MEP students' preference for the *Reflective* learning style.

The students' progress in the Master of Engineering Practice program will continue to be tracked over the coming years so that mature GPA's are used in future analyses of the data. Data on each student's years of relevant work experience, and prior qualification, will also be added into the database.

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