Cognitive Structures Developed in TAFE Classes

by

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1.0 INTRODUCTION

The purpose of this study is to identify and document the characteristics of TAFE classes and to examine the interrelationships among settings, cognitive holding power, teacher and student actions, classroom environment and cognitive structures. The design of the study allowed some comparisons to be made across different setting variables, e.g. theory versus practical classes and across colleges and trade areas. Hence, both descriptive and comparative results are provided (where possible). However, because of imbalances in the design, exhaustive comparisons between these categories are not undertaken, although overall effects are reported where possible.

Theoretical and practical instruction, in three trade areas, across three TAFE colleges are studied in classes taken by new and experienced teachers with apprentices and prevocational students. The instruments are synthesised from theory and research concerned with the representation of cognitive structures (Anderson, 1982; Evans, 1991; Ryle, 1949; Stevenson, 1991; Taylor, 1991; Taylor and Evans, 1985) the processes of skill acquisition by learners (Anserson, 1982; Glaser, 1984; Gott, 1989; Scandura, 1981), environmental and institutional press (Murray, 1938; Pace and Stern, 1958); measurement of classroom environments (Rentoul and Fraser, 1979; Stevenson, 1990), and the factors which affect student utilisation and development of cognitive structures needed for transfer (Evans, 1991; Posner, 1982; Stevenson, 1991). The differentiation of instructional approaches is based on the extent to which emphasis is placed on the development of propositional knowledge, specific (first order) procedures and second and third (higher) order procedures.

The study contributes to an understanding of teaching and learning in TAFE classes in the following ways. Firstly, it conceptualises TAFE teaching practices in terms of setting and cognitive theories, and reports practices in selected settings as a basis for further study. Secondly, it provides preliminary data for comparing some aspects of TAFE teaching. Thirdly, it establishes the relative emphasis on different kinds of cognitive structures in the selected settings. Fourthly, it enables an initial examination of the relationships among variables affecting teaching and learning TAFE. Finally, it helps to clarify the need for further research and theory development.

2.0 METHOD

The model of teaching and learning (e.g. see Stevenson, 1986) used in these studies is:

Setting Characteristics
V
Cognitive Holding Power Teacher and Student Actions
V
Classroom Environment
V
Development of Student Cognitive Structures

To explore these relationships a sample of classes in TAFE colleges was selected, and variables, from each part of the model, were measured in these classes. Details are given in the following sections.

2.1 Sample

Twenty-seven trade classes, each of 1.5 to 2 hours duration, were selected. Trade courses were chosen which were regarded as unique to TAFE - Motor

Mechanics, Fitting and Machining, and Butchery. To ensure observed actions included representative TAFE learning settings, 10 teachers from three Queensland Colleges of TAFE, with a range of experiences, were selected to participate in the study. New teachers were defined as those still in training or within two years of having completed their initial Diploma programme. Two or three lessons from a syllabus unit for each teacher and, where possible, both theory and practical classes were included. Classes of both apprenticeship and prevocational students were sampled. Teachers and most of the 127 students were male. The average student age was 18.4 years.

Classes, categorised according to classification variables, are detailed in Table 1.1. It was possible to collect data for all classification variables; however, a symmetrical factorial design was not achieved because it was not possible to observe both theory and practical classes for each teacher or to have both new and experienced teachers for each trade area in each college. Nevertheless, since the primary focus of the research was to develop a conceptual framework to encompass a wide range of instructional activities, rather than to undertake comparisons, this limitation was accepted.

(Insert Table 1.1 about here)

2.2 Instruments

The variables and corresponding instruments were as follows.

Classroom variables
Research instruments

Teacher and Student Actions
Video coding

Teacher and student interview
Cognitive Holding Power
Cognitive Holding Power Questionnaire

(CHPQ), (Stevenson, 1990)
Classroom environment
Individualised Classroom Environment

Questionnaire (ICEQ Student Actual),

(Rentoul and Fraser, 1979)

Validated instruments (ICEQ, CHPQ) were chosen where possible. For variables where there were no validated instruments, instruments were used which permitted at least two measures of each variable. Details of data collection and instruments follow.

2.2.1 Video-coding

TAFE classes were video-recorded, and coded from a schedule (See Table 2.1). Initial pilot instruments were based on timing the length of classroom events and assigning a code and time to each event. However, considerable inference was involved in determining whether events were discrete or parts of larger events. It was therefore decided to code events over fixed time intervals. Following trialing of time interval lengths ranging from 30 seconds to 3 minutes, one minute intervals were found to reflect the range of discrete instructional events and the range of cognitive structures being developed in actual classes.

(Insert Table 2.1 about here)

A subcode of X was used to denote absence of any of the categories of learning aids and a subcode of N was used to denote an absence of instruction, in which case all other categories were coded X.

The whole code for any minute can be read as a sentence which describes the classroom action. For example, PLVWICT can be read as: The teacher (L) presents (P) information (T) to the entire class (V), using written material (W), images (I) and concrete objects (C) as aids. Parts of the code can also be interpreted in sentence form (See Table 3.4). For example, ESFA can be read as student(s) (S) elicit (E) knowledge about how to perform a skill (A) in a small group (F). Each lesson was coded, independently, by two or three coders, and all differences reconciled jointly by the researchers.

The final schedule incorporated seven categories of coding for teacher and student actions, classroom resources and inferred cognitive structures. This seven-part code is referred to as the whole code. Each whole code can be read as a sentence which describes aspects of the classroom action. Each part of the code corresponds to the subject, verb, direct or indirect object or qualifier of the sentence represented. Various parts of the code (subcodes) also have meaning in terms of actions and sentences and are treated separately in some analyses. A four-part code, referred to as a main code (or main subcode or main actions), is used in several analyses. Section 2.3.3 provides further details of the full range of categories, actions, codes and subcodes.

Initial subcodes for inferred cognitive activities were based on categories suggested by the literature (Anderson, 1982; Evans, 1991; Ryle, 1949; Stevenson, 1991), but as trialing proceeded, these categories were modified to capture more of the observable teacher and student behaviour and inferred categories of cognitive activity. The final codes were: Use of knowledge that; use of knowledge about how; use of specific procedures; use of higher order procedures; and monitoring. Knowledge about how was introduced because teachers and students were often engaged in interactions which involved explanations about how a procedure should be undertaken without either teacher or student actually preforming the procedure. This category is similar to that of "potentially knowing how" of Taylor (1991) and Taylor and Evans (1985). The category, monitoring, was introduced to capture the action where the teacher moved around checking on student procedures and correcting techniques and approaches and where students used teacher evaluative comments to modify their knowledge and strategies.

2.2.3 Questionnaires

Student perception of the cognitive holding power of the learning environments was measured using Stevenson's (1990) Cognitive Holding Power Questionnaire (CHPQ). The two subscales of this instrument are First Order Cognitive Holding Power (FOCHP) and Second Order Cognitive Holding Power (SOCHP), measuring the extent to which students are pressed into using specific routinized procedures (FOCHP) or into using their second order procedures for interpreting new situations and addressing associated problems (SOCHP). The scales have reliability of ‡=0.82-0.86 for FOCHP and ‡=0.77-0.87 for SOCHP.

Rentoul and Fraser's (1979) Individualised Classroom Environment Questionnaire (ICEQ) was used to measure five subscales (Participation, Personalisation, Independence, Investigation and Differentiation) of classroom environment. Actual classroom environment as perceived by students was measured. Alpha reliabilities, reported by Fraser (1980, 1981) for high school settings are 0.61-0.79.

In using the ICEQ in TAFE, high significant inter-correlations among scales were found (for 6 of the possible 10 combinations with classes as the unit of analysis and 9 out of 10 with students as the unit of analysis) (Table 2.2). Because of the apparent association between dimensions in the TAFE setting, individual items on the ICEQ were factor analysed using a principal factor analysis, and varimax rotation. Seven factors were generated. Items with a factor loading greater than 0.4 in each factor were compared with the items which comprise Fraser's (1980, 1981, 1989) dimensions. It was found that all of the items in factor 2 belonged in Fraser's Personalisation dimension; and all of the items on factor 4, Investigation. In factor 1, seven of the 11 items corresponded with those in Fraser's Participation dimension; in factor 3, five of the six items, Independence. Factor 7 consisted entirely of Differentiation items and in factor 5, three of the four items also belonged to Differentiation. Hence, it was concluded that Fraser's theoretical constructs may still apply to TAFE settings, and that, despite the intercorrelations, the dimensions were appropriate. There was insufficient data to reassign items to the dimensions, and so the assignment of items to Fraser's dimensions was utilised. However, the reliabilities of the ICEQ dimensions for this study with TAFE students are 0.58 for Participation, 0.61 for Independence, 0.65 for Investigation, 0.43 for Personalisation, and 0.16 for Differentiation.

For these reasons, the analyses of ICEQ variables in this study must be treated with caution.

2.2.4 Interviews

Parallel schedules were used to interview the teacher and two students from each lesson. Two questions were asked - one relating to what was taught and one to how it was taught. The responses were classified in terms of use of cognitive structures (See Appendices 1 and 2) and analysed in terms of agreement and disagreement between students and teacher. Agreements were compared with data from video-coding in the following section.

2.2.5 Comparison of Interview data and Video-recorded data.

To validate the approach taken in video-recording and coding, interview data was compared with coded data from recordings. As a further check on validity of the video-coded data, the whole codes and variously sized subcodes where compared with each other and with interview data as follows.

Table 2.3 presents the content analysis of interview data, for the 27 classes overall, where there is consistent agreement among teacher and student interviews. The table demonstrates the predominance of teacher at the centre of learning in explaining, demonstrating, revising and recapping of knowledge that - new information, conceptual understanding, principles and theory. In comparison, Table 2.4 presents the percentage of overall time for each one-part, video coded variable and a brief description of the variable. (Table 2.2 provides a fuller description of the codes.) The variables with high percentage of use - the teacher presenting information to everyone, using various aids - accords well with the content analysis of the interview data.

Table 2.5, shows the relative frequencies of whole seven-part codes for the sixteen top ranking video codes overall. These sixteen whole codes capture 54 percent of all the action coded, and again indicate the dominance of teacher presentation of information to the whole class using various teaching aids. This analysis is in line with the interview data and establishes a close correspondence for the seven-part and one-part codes as the units of analysis.

(Insert Tables 2.3, 2.4, 2.5 and 2.6 about here)

In Table 2.6, an intermediate sized, four-part (main) code is used as the unit of analysis for video-coded data. The 27 most frequent main subcodes (1% or more of total time) and their representation as verbal sentences are presented, together with the percent of time each occurred. The top few codes of this table accord well with the interview data. The six top ranking main codes account for 59 percent of all action and show a strong affiliation with the sixteen top codes of Table 2.5.

The patterns reported in this section for overall data are also apparent

for each of the lessons considered separately. Thus, there is a high degree of consistency among interview data and video coding data using unit sizes of one, four and seven-part codes. Four-part main codes are used as the unit in many of the analyses which follow because they satisfactorily reflect the whole codes and one-part codes; because of their parsimony; and because they maintain associations among important parts of the subcodes (i.e. among the subject, verb and direct and indirect objects of the sentence they represent).
It was concluded that videorecording and coding provided a valid representation of the classes.

2.3 Procedure

2.3.1 Administration of Questionnaires

The Student Actual form of the ICEQ and the Cognitive Holding Power Questionnaire were administered to all students at the end of each lesson.

2.3.2 Interviews

The teacher and two students, selected by the teacher, were interviewed, separately, at the conclusion of each lesson.

2.3.3 Video-recording and coding

Each lesson was video-recorded and coded. The camera operator focused on the teacher and student interactions with the teacher to capture those activities with direct teacher involvement in line with Brophy and Good (1986) and Flanders (1965). (Indirect effects will be reported in later papers from this series of studies.) These interactions and the corresponding group size, teaching aids and inferred knowledge structures were coded as foreground events - defined as teaching or learning in which the teacher was engaged. For example, the teacher may have been explaining a theoretical concept to the entire class. However, sometimes, when the teacher actions involved only part of the class, other actions occurred with the other students. These latter actions were coded as background. For example, the teacher may have been monitoring the work of a single student completing an exercise (foreground) while the remainder of the class was working individually on the same or different exercises (background). If no teaching or learning relevant to the lesson was apparent in both foreground and background, then that minute was deleted from the analysis. Situations like this occurred, for example, when there was a short break or when the teacher was discussing travel arrangements for a forthcoming field trip or waiting for teaching aids to arrive.

A code was assigned to the principal foreground (and background where present) actions every minute. The action which occupied the greatest time interval during the minute was the one used to determine the appropriate code.

Of the 2309 coded minutes, 48% involved only foreground action; 9% only background and 42%, both foreground and background. The total percentage of minutes in which foreground action was present was 90%. The analysis of variables from video-recordings in this paper refers only to the foreground action. There is a limitation of this approach - since students completing qusetionnaires may hve been reflecting not only on the foreground action in the lesson, but also any background action, comparisons among video-coded data and data from questionnaires must be treated with caution. However, student perceptions provided in interviews accorded well with foreground data from videorecordings.Further analyses will establish whether the main conclusions of this study are confirmed when all minutes in which there is background action are deleted.

2.4 Analysis

Measures of all variables in this study can be expressed in terms of individual classroom lessons, and this is the primary unit of analysis. Other units of analysis are used to investigate relationships among variables of the same type. For example, the student is the unit of analysis for the ICEQ and CHPQ scales. The minute is the unit of analysis among video-coded variables.

Interview data was processed by content analysis and all statistical analyses were undertaken using SAS.

3.0 RESULTS

In each of the following sections, both descriptive and comparative results are provided (where possible). However, because of imbalances in the design, exhaustive comparisons between these categories were not undertaken, although overall effects are reported in appropriate sections. Analysis focuses primarily on foreground events, as this captures teacher actions and interactions with students. The results are reported in several sections, as follows.

In 3.1, the range of different teaching and learning actions is discussed to portray the nature and diversity of TAFE classrooms. In 3.2, comparisons are made across theory and practical classes.

The press for first and second order cognitive holding power is reported in 3.3. The relationship among teacher and student actions and different kinds of cognitive holding power are examined; so too are the relationships between cognitive holding power and setting variables. The implications of the data for the validity of the Cognitive Holding Power Questionnaire in TAFE classes, are discussed. In 3.4, the results for the ICEQ dimensions (Personalisation, Participation, Independence, Investigation and Differentiation) are reported. The relationships among these variables and teacher and student actions are examined. In 3.5, the relationships among CHPQ scales and ICEQ scales are discussed.

3.1 Range and Prevalence of Teaching and Learning Actions

The main foreground coding permitted sixty unique four-part main subcodes. Forty-seven of these were actually used for the 2,309 minutes of action across 15 theory and 12 practical classes of 10 teachers. However, 20 codes occurred at frequencies of less than 15 in 2,309. The other 27 top ranking subcodes account for 96 percent of all foreground action and knowledge categories. The mode, 'Teacher presents information to the whole class' (PLVT) accounts for 23 percent, and the top six subcodes account for 59 percent of all actions. This broad view of the teaching and learning action in TAFE classes seems to imply a high level of uniformity amongst teachers, but a finer analysis reveals some diversity and differences between settings, as discussed below.

Table 2.6 also gives the six most frequent subcodes and percentages (with modes highlighted) for each of the six experienced and four new teachers. The pattern indicates some diversity of teaching styles but with no obvious differences between experienced and new teachers. With the exception of one teacher, more than 65 percent of teaching time can be described by a different set of six modal main subcodes for each teacher. The exceptional case, a new teacher, used 34 of the 47 subcodes observed in the entire study, so that the top six subcodes capture only 54 percent of the total lesson time for this teacher. Four of the 47 subcodes were also unique to this teacher, but each occurred only once in 2,309 minutes. The mode for this teacher is also the mode for five other teachers and for the sample as a whole, so that this teacher, while exceptional, is not so distinct as to need exclusion from further analysis. One other teacher has an unusual profile in that the set of top six subcodes for that teacher does not contain the sample mode of PLVT. This is explained by the fact that this teacher taught only practical classes and those classes have distinct characteristics as discussed below.

Classroom actions were compared across the different lesson classifications in the study - teacher experience, type of student (apprenticeship or prevocational), type of lesson (theory or practical), trade area and college. The twelve most frequent foreground main actions (accounting for 81 percent of total lesson time) were tabulated against the top five main actions for each classification variable (Table 3.1). Percentage of time for each action is shown, with modes highlighted, and the diversity of actions indicated by the total number of distinct codes utilised.

(Insert Table 3.1 about here)

The dominance of teacher presentation to the whole class (PLVT) is again obvious, this being the mode for all categories except practical classes. While there are some differences between classes of new and experienced teachers, between classes with apprentices and prevocational students, and among trade area and college, the main apparent difference is between theory and practical classes. Not only is the mode different for theory and practical classes, but only one of the top five actions (teacher not active, but students working in the background) is common to both. The difference between percent of total action accounted for by the top fourteen actions (76 for theory; 42 for practical) also indicates that the diversity of action is much greater in practical classes.

There are less striking differences among trade areas, where actions in Trade 3 are more uniform than in other trades (20 compared to 42 and 38 different actions) and where there is more presenting and less eliciting for Trade 2 than for Trades 1 and 3.

Thus, there is a degree of diversity of teaching and learning activities across teachers and, in some cases, within the classes of a single teacher. Nevertheless, the most common teaching actions for individual teachers is the presentation of information to the whole class. Actions emphasised in theory classes appear to be qualitatively different from those in practical classes and Trade Area 1 has less emphasis on the elicitation of information from the whole class by the teacher. The next section explores further the patterns in TAFE classrooms by comparing classes from different settings.

3.2 Comparisons Across Theory and Practical Classes

To achieve more detailed comparisons between theory and practice, results for each of the 15 one-part foreground codes for each lesson were summarised as the percentage of total time (See Table 3.2). An additional variable of diversity of actions was calculated as the total number of distinct actions for each lesson. To establish differences between theory and practical classes, the data for the 27 classes on the 16 variables were analysed using a multivariate analysis of variance for overall effects and using Student's T-test for each of the variables separately.

There are differences ($p<0.001$) between the theory and practical classes on the foreground variables as determined by a multivariate analysis of variance ($F = 22.96$; $df = 15,11$). Twelve of these variables show significant differences between theory and practical classes using Student's T-test (Table 3.2).

(Insert Table 3.2 about here)

The types of cognitive activity in practical and theory classes were also significantly different. In practical classes there were more demonstrations and more practising of specific skills (first order procedural knowledge) and more knowledge about skills such as these. There was also more monitoring by the teacher. By contrast, in theory classes, non-skill propositional knowledge (information) predominated.

Actions in practical classes were more varied than those in theory classes. During practical sessions, students initiated more actions; engaged in more one-to-one and small group interactions; and used more concrete learning materials. On the other hand during theory classes, teachers initiated more actions; interacted with the whole class more often; and used more verbal information.

These data indicate that distinctive features of theory classes compared with practical classes are the teacher-centred, whole class action focused on information from spoken words and text, with less emphasis on procedural and intellectual skills.

The distinguishing features of practical classes were the greater diversity of activities, more centred on an individual or small groups of students interacting with the teacher. Equipment and other concrete materials were used to demonstrate or practise skills, or to furnish a backdrop for information about how to perform specific skills. There was also greater monitoring by the teacher in practical classes.

These data suggest that background action needs further analysis in practical lessons.

3.3 Cognitive Holding Power

The relationships expected among setting characteristics (such as the teacher, the course, the theoretical/practical orientation of the lesson or the college) and cognitive holding power can be depicted as shown in Figure 1.

(Insert Figure 1 about here)

To examine these relationships, analyses of variance, using the General Linear Model of SAS because of uneven cells, were conducted for main effects (Table 3.3). The setting variables which explained significantly most variance in First Order Cognitive Holding Power are, in descending order: Teacher, Trade area, College, Course Type (Apprenticeship or Prevocational), and Level of teacher experience. For Second Order Cognitive Holding Power, the variables, in descending order, are: Teacher, College, Trade area, Theory/Practical, and Course Type.

(Insert Table 3.3 about here)

From the means, the directions of the effects are as follows. More experienced teachers are more likely to press students into using first order procedures; practical settings are more likely to elicit second order cognitive activity; and apprentices are more likely to be challenged with higher order cognitive activity. Because few teachers taught in more than one setting, it was not possible to explore possible interaction effects.

The relationships suggest that characteristics of the setting, including features of the college and the immediate learning setting, the nature of the content, and the characteristics of the teacher and students all influence the levels of First and Second Order Cognitive Holding Power created in the setting. This finding accords with setting theory (Barker, 1978) and with concepts of press (Pace and Stern, 1958). It also accords with the conceptualisation of Cognitive Holding Power (Stevenson, 1991).

3.3.1 Effects of Cognitive Holding Power on Other Variables

To examine the relationship among Cognitive Holding Power and teacher and student actions, correlations of class means for First and Second Order Cognitive Holding Power with diversity and class means of other foreground one-part variables were examined. The class was chosen as the unit of comparison because the questionnaire data is based on classes of students and video data is based on minutes of the class. The results are given in Table 3.4.

(Insert Table 3.4 about here)

From the table, significant relationships accord with predicted effects as follows.

(a) Teacher and student actions

Presentation is positively associated with First Order Cognitive Holding Power and is inversely related to Second Order Cognitive Holding Power. Teacher initiation of action is negatively associated with Second Order Cognitive Holding Power, while student initiation of action is positively associated. Second Order Cognitive Holding Power is more likely to involve interaction of a teacher with an individual student and less likely to involve the entire class. When Second Order Cognitive Holding Power is created, there is more likely to be a wider range of different activities in the classroom, possibly due to the greater initiation of activities by students; and the greater involvement of the teacher with individual students.

(b) Content

The teaching of knowledge about how to achieve a goal is more likely to be associated with First Order Cognitive Holding Power than Second Order Cognitive Holding Power. Teacher monitoring of student work (and providing evaluative feedback) is more likely to be associated with Second Order Cognitive Holding Power than First Order Cognitive Holding Power (although analyses reported below clarify this relationship further).

The relationship between the analysis and theoretical concepts can be depicted as shown in Figures 2 and 3.

(Insert Figures 2 and 3 about here)

To explore further the relationships between cognitive holding power and teacher and student actions, main actions (combining both teacher and student actions and the associated knowledge structures which are the subject of the actions) were examined. Main action codes were assigned a number corresponding to the percentage of time occupied by each category of main action. A stepwise forwards and backwards linear regression was performed for each of First and Second Order Cognitive Holding Power, using four-part main action codes (e.g. PLVT). The results were as given in Table 3.5 and depicted in Figure 4.

(Insert Table 3.5 about here)

The relationships of main actions to Cognitive Holding Power confirms and elaborates the analysis using main subcodes. The analysis suggests that specific procedures or knowledge about specific procedures is associated with First Order Cognitive Holding Power. Similarly for teacher monitoring of the whole class. On the other hand, monitoring elicited by students accounts for 54% of the variance of Second Order Cognitive Holding Power. Presentation, by the teacher is negatively associated with Second Order Cognitive Holding Power; and propositional knowledge is negatively associated with both forms of Cognitive Holding Power.

3.4 ICEQ Classroom Environment Dimensions

Analyses of variance, using a General Linear Model (because of the uneven study design) were conducted on student perceptions for each of the ICEQ dimensions, Personalisation, Participation, Independence, Investigation and Differentiation. The Type III analysis of SAS was used, so that main effects are reported only where the variable added significantly to the explanation of variance, when added last to the analysis. Results are given in Table 3.6, and the directions of effects are given in Table 3.11.

(Insert Tables 3.6 and 3.7 about here)

These results must be treated as tentative because of the high correlations among ICEQ dimension in TAFE environments and the low reliability of some scales, especially Differentiation, as reported in Section 2.2.3. However, there is some evidence that higher levels on each aspect of classroom environment are produced more by newer teachers.

3.5 Relationships among ICEQ and CHPQ

A forwards and backwards stepwise linear regression was used to examine the relationships among ICEQ dimensions and First and Second Order Cognitive Holding Power. Again the results must be treated tentatively because of the inter-correlations among ICEQ dimensions and low reliabilities in a TAFE setting. The analysis was conducted on the basis of using students as cases, rather than class means, to give a fine grained analysis. Variables were retained if they added significantly to the explanation of variance. The variables retained in the analysis were as follows:

First Order Cognitive Holding Power ($R2 = 0.13$) ($df=1,231$)

Personalisation ($r2=0.03$, $p<0.01$).
Independence ($r2=0.10$, $p<0.001$).

Second Order Cognitive Holding Power ($R2 = 0.25$) ($df=4,228$)

Personalisation ($r2=0.01$, $p<0.05$).
Participation ($r2=0.05$, $p<0.001$),
Independence ($r2=0.03$, $p<0.01$), and
Investigation ($r2=0.16$, $p<0.001$)

(Insert Table 3.8 about here)

From the directions of the simple correlations (using students as the cases) (Table 3.8), it appears that First Order Cognitive Holding Power may create a classroom environment where there is high personalisation and low independence. Together, these two ICEQ variables explain only 13% of the variance in First Order Cognitive Holding Power, with most of the explained variance due to lack of Independence.

It appears that Second Order Cognitive Holding Power may create a classroom where there is high participation, personalisation and investigation, but low independence. Together, these ICEQ variables explain 25% of the variance in Second Order Cognitive Holding Power, with most of the explanatory power due to Investigation.

The relationships can be depicted as shown in Figure 5.

(Insert Figure 5 about here)

4.0 CONCLUSION

This study has documented the range of teaching and learning actions which occurred in 27 TAFE classes taken by 10 teachers, teaching 3 trade courses, and involving 127 prevocational and apprenticeship students. Data obtained from video-recordings accorded well with that obtained from teacher and student interviews. However, the ICEQ, used to measure aspects of classroom environments did not hold up well for the studied settings. A limitation of the study was the uneveness of the study design, brought about by the unavailability of teachers in each cell of Table 2.1. Another limitation of the study was the possible confounding effects of background actions on the relationships analysed between foreground and other variables. For these reasons, further analyses which minimise the possibility of these effects are needed, and the findings of the study need to be replicated.

The relationships found among variables suggest that characteristics of the setting, including features of the college and the immediate learning setting, the nature of the content, and the characteristics of the teacher and students all influence the levels of First and Second Order Cognitive Holding Power created in the setting. This finding accords with setting theory (Barker, 1978) and with concepts of press (Pace and Stern, 1958). It also accords with the conceptualisation of Cognitive Holding Power (Stevenson, 1991).

In the observed classes, there was a degree of diversity of teaching and learning activities across teachers and, in some cases, within the classes of a single teacher. Nevertheless, the most common teaching actions for individual teachers was the presentation of information to the whole class. This emphasis is of concern in technological instruction in times of rapid change. While preparation for a changing and increasingly technological work place requires the development of deep conceptual understanding, expertise also requires an emphasis on student initiation of activity, on the development of intellectual and manual skills and on the development of higher order thinking. For example, for the development of the deep conceptual understanding required for changing technology, the approach recommended by Collins, Brown and Newman (1989) would be appropriate. While during early stages of learning, modelling of new procedures and scaffolding are suitable, teachers should fade from the supportive role to encourage learners to confront the complexity of realistic demands and engage in higher order learning themselves.

The study suggests that propositional knowledge (where it is unrelated to the acquisition of a skill) is negatively associated with both forms of Cognitive Holding Power. This is not surprising as both scales of the CHPQ are concerned with procedural knowledge. Evidence was adduced that specific procedures or propositional knowledge directly related to the acquisition of specific procedures is associated with first order cognitive holding power; similarly for teacher monitoring of the whole class. These findings provide evidence for the validity of the First Order Cognitive Holding Power dimension of the CHPQ. It supports the view that press can be created in a TAFE learning setting to cause students to focus on a lower order subset of cognitive structures. Teacher imposed monitoring is related to First Order Cognitive Holding Power, presumably because it is the teacher, rather than the student who is undertaking any higher order thinking. It is the teacher who is providing appropriate specific procedures for the student to correct inadequate techniques or strategies.

On the other hand, second order cognitive holding power is associated with monitoring when it is elicited by students; and negatively associated with presentation by the teacher. Again, this finding provides corroborating evidence for the validity of this dimension of the CHPQ. When students undertake problematic activities and encounter difficulties, they seek checks from the teacher.

Results obtained in this study using the ICEQ, must be treated as tentative because of the high correlations among ICEQ dimensions in TAFE environments, and low scale reliability. However, from examining the relationships among ICEQ and CHPQ dimensions, it was found that the major correlations are consistent with the theoretical concepts. For example, pressing students into utilising second order cognitive procedures emphasises processes of enquiry and student active participation; and requiring students to use first order procedures or copy teacher specific procedures does not allow students to make decisions, and control their learning and behaviour. Personalisation is positively correlated with both kinds of press, but explains little of the variance in either case. It is surprising that independence is also negatively correlated to Second Order Cognitive Holding Power, albeit with little explanatory power. More data and further analysis would be needed to explore this association further. One possible explanation could be that imposing a Second Order Cognitive Holding Power takes choice of tasks away from students, even though they have to rely on their own cognitive resources to deal with the nature of the problematic tasks. Another possibility is that, when students are pressed to work independently, they become lost or confused and do not engage in higher order procedures.

In examining differences among setting characteristics, it was found that there are some differences between classes of new and experienced teachers, between classes with apprentices and prevocational students, and across trade areas and colleges. For instance, more experienced teachers are more likely to press students into using first order procedures; newer teachers are more likely to create a classroom environment with higher levels of Personalisation, Participation and Investigation; and apprentices are more likely to be challenged with higher order cognitive activity.

However, the main apparent difference is between theory and practical classes. The distinctive features of theory classes compared with practical classes are the teacher-centred, whole class action focused on information from spoken words and text, with less emphasis on procedural and intellectual skills. The distinguishing features of practical classes were the greater diversity of activities, more centred on an individual or small groups of students interacting with the teacher. Equipment and other concrete materials were used to demonstrate or practise skills, or to furnish a backdrop for information about how to perform specific skills. Practical settings are more likely to elicit second order cognitive activity; and there were more higher order skills evident in the form of problem solving than in theory classes and greater monitoring by the teacher.

Thus, some of the concerns about TAFE teaching and learning, overall, do not apply as fully to practical classes, where there the actions accord more with those needed for the development of transferable higher order skills.

Overall, the study has provided some confirmative evidence for relationships among variables in the model used in designing the study. The relationships can be depicted as shown in Figure 6.

Further work is needed using studies with more balanced cells in the design. Further work is also needed to examine the measurement of classroom environment variables in TAFE.

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Copies of tables, figures and appendices are available from the authors.

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