Metacognition makes a difference: Identifying characteristics of successful tertiary students using path analysis.

Rosalind Murray-Harvey

School of Education

The Flinders University of South Australia

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Abstract

Academic achievement is the outcome of a complex system of learning and teaching relationships existing within the context of the university. A causal path model was developed and tested using a partial least squares path analysis procedure in order to examine the relationships among factors hypothesized to influence tertiary students' academic achievement. Of the eight predictor variables included in the model (Approach to Learning motives and strategies; Learning Style; Age; Sex; Locus of Control; Metacognitive Capability; and students' Self-Rated performance), Metacognitive Capability most clearly identifies successful students. Relationships among the other variables also provide valuable information about student learning outcomes.

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Student independence is a learner characteristic that is

highly valued by Australian university academics (Moses & Ramsden, 1992). It is not clear whether university teaching practices actually encourage this independence or merely reward students who already possess the attributes associated with independent learning. Whichever is the case, it is important to address the concepts related to personal responsibility for learning.

Personal responsibility in the learning process has been a theme in the literature concerned with self-regulation of learning and studying behaviour (Zimmerman, 1989). Notions of self-regulation are implicated in many aspects of learning and teaching in higher education. With regard to individual student factors, self-regulation infers that students understand how to capitalize on their learning style strengths (Dunn, Deckinger, Withers, & Katzenstein, 1990). Self-regulation also implies an internal locus of control of behaviour (Perry & Penner, 1990),

and a strong sense of 'self' - including such attributes as self-motivation, self-efficacy and self-direction (Brockett & Hiemstra, 1991; McCombs, 1989).

An internal locus of control of behaviour is particularly relevant in situations where students need to adapt or acquire new learning and study strategies in order to be successful. Perry and Penner (1990) claim that poor performance is frequently associated with low perceived control and, more importantly, that 'external' students are less likely to gain from quality instruction than their 'internal' peers. Students with an external locus of control - who attribute difficulties to lack of ability, such as believing other students to be more able than themselves, or to the actions of others; for instance, attributing poor grades to lecturers who are 'hard markers', are less likely to persist with their studies. According to Brockett and Hiemstra (1991) students who perceive themselves to be competent are likely to accept responsibility for their own learning and to take the initiative in planning and directing their learning.

Another factor related to self-regulation is metacognition. Metacognitive processes allow students to step outside themselves and be aware of their needs as learners, and then to make appropriate decisions to provide for those needs and monitor their progress (Clark-Thayer, 1987). A wealth of research evidence is now available to show that one of the marked differences between more and less successful students is their metacognitive capability (Meichenbaum, 1985; Weinstein & Van Mater Stone, 1992; Zimmerman, 1989). Weinstein and Van Mater Stone (1992) show that, apart from just knowing more, successful students are better able to organize and integrate their knowledge, they have more effective and efficient strategies for accessing, using, and applying their knowledge, and they do all

these things in a more self-regulated manner.

McCombs (1988) points out that attitudinal factors such as affect and motivation can moderate effective strategy use. Her work highlights the interaction of motivational variables, perceptions of competence, attributions for success or failure, and metacognition. While the individual student factors referred to above contribute in part to understanding why some students are more academically successful than others, it is also the case that instructional factors play a part in determining who will succeed at university.

Studies investigating students' approaches to learning provide evidence of the need to go beyond identifying relationships among individual student factors and to acknowledge the interactive nature of learning and teaching. The teaching-learning environment creates a context in which some students fare better than others academically. In shaping the characteristics of successful students, research on instruction provides evidence that teaching methods (Kirby, 1983; Ramsden, 1990), assessment practices (Ramsden, 1992; Vu, 1983), and the curriculum (Biggs, 1990; Ramsden, 1988), all have direct effects on perfomance. For instance. students' deep and surface approaches to learning seem to be as much affected by their perceptions of institutional requirements as they are to personal goals related to achievement (Biggs, 1987; Eley, 1991; Entwistle,1991). A typical surface approach combines a Motive that is extrinsic (avoiding failure by minimally meeting requirements) with Strategies that focus on selected details (reproduce information accurately). Teaching that overloads students with content, and assessments that emphasize recall of that content all foster surface approaches to learning. A deep approach combines a Motive that is intrinsic (desire to understand and to satisfy curiosity) with Strategies that aim to maximize understanding (read widely, discuss, reflect). Teaching can either cultivate or stifle students' curiosity. Time given to well-structured discussions, assessments that challenge students to reflect, and rewarding quality rather than just content in assignments, are likely to support deep approaches. Deep and achieving approaches are also purported to be associated with higher levels of metacognitive functioning, in Biggs' (1988) terms - metalearning. This relationship extends to learning outcomes in that metacognition is assumed to be a key component of academic achievement.

While the notion of interrelationships among variables may not be new, few studies have examined the complexity of these relationships, either in terms of their direct and/or indirect influences on eachother, or in terms of their relative effects on academic achievement. Keeves (1986) points out that:

Many studies have been carried out with variables that have been shown to be significantly associated with the outcome of student achievement...(However) it is not enough to report a simple bivariate relationship between a single factor and achievement outcomes. It is necessary at this time to develop causal models...and to examine the effects of critical variables...represented by the causal model. (p.118)

Following this advice, a path model is presented that examines a network of factors hypothesized to identify the characteristics of successful students.

Method

The population from which data were collected were 423 students who enrolled in Teacher Education, Nursing, Speech Pathology and Liberal Studies at The Flinders University of South Australia for the first time in 1991. The data for analysis were obtained from a sample of these students enrolled in the second year of their courses having achieved varying degrees of success in their first year. These 'successful' students represent a broad range of 'survival'. That is, the sample includes second year students who have fared poorly academically, and some who have failed some of their first year subjects, as well as students who achieved high grades in some or all of their subjects in first year.

Variables

Achievement. The criterion variable, ACHIEVEMENT is based on grade point average (GPA) data collated on three separate occasions, Semester 1 and 2 in 1991 and Semester 1, 1992. GPA scores were obtained for each student by summing the product of the grade score for each subject by its credit point value and dividing this total by the total value of credit points taken. Scores were assigned to grades as follows: Distinction=4; Credit=3; Pass1=2; Non-graded Pass=2; Pass2=1; Fail=0.

Two indicators of performance describe achievement outcomes. Grade point average (GPA) represents the quantitative ACHIEVEMENT measure and Structure of the Observed Learning Outcome (SOLO) score represents the qualitative measure. The SOLO taxonomy levels (Biggs & Collis, 1982) reflect the notion of developing quality of response. The SOLO taxonomy has been previously used to describe quality of learning outcome in several studies (Kratzing, 1990; Trigwell & Prosser, 1991; Van Rossum & Schenk, 1984) and is similarly used in this study.

Qualitative differences in learning outcome were obtained using the SOLO Taxonomy to rate students' responses to a written task according to their level of structural complexity. The task required students to:

Write a letter to a prospective student in the same course as

you, who is thinking of enrolling in the subject that has been the most important to you, to persuade them that they should do it.

All responses could be rated in terms of SOLO levels ranging from Unistructural to Extended Abstract.

Approach to Learning and Studying. The Study Process Questionnaire (SPQ) (Biggs, 1987a) was used to determine students' approaches to learning and studying. The SPQ consists of 42 self-report items each with Likert five-point scales inquiring about three motive-strategy dimensions: surface (instrumental/reproducing); deep (intrinsic/meaning); and achieving (need achievement/organizing). Scores are calculated on a motive and a strategy for each scale and the two scores (motive + strategy) can then be summed to give a general approach score. In addition to raw scores ranging from 7 to 35, the scales can be reduced to deciles. Table 1 reports decile scores for ease of interpretation.

Learning Style. Students' learning styles are their reported preferences on the Productivity Preference Environmental Survey (PEPS) (Price, Dunn & Dunn, 1991). The PEPS consists of 100 items presented on a Likert scale of 1 (strongly disagree) to 5 (strongly agree) yielding scores for 20 elements measured in four areas: (1) Environmental preferences (sound, light, temperature, and design); (2) Emotional preferences (motivation, persistence, responsibility, and the need for structure or flexibility); (3) Sociological preferences (self-oriented or peer oriented, authority oriented, and several or varied ways); (4) Physical needs (perceptual preferences [auditory, visual, tactile, kinesthetic], time of day, intake and mobility). Raw scores for each of the 20 scales can be converted to standardized scores with a range from 20 to 80, a mean of 50 and a standard deviation of 10. A standard score of 40 or less indicates that the individual does not prefer the element when they work or study while a standard score of 60 or higher indicates a preference for the element. Table 1 reports standard scores for ease of interpretation.

Locus of Control. The extent to which students believe that the locus of responsibility for achievement is internal rather than external was measured by the Locus of Control of Behaviour (LCB) scale (Craig, Franklin & Andrews, 1984). The LCB contains 17 items to which respondents indicate the perceived source of control of behaviour along a six-point scale from Strongly Disagree to Strongly Agree. At one end of the continuum, a student who tends to assume that achievement is most likely to result from personal effort and initiative would score as

strongly internal. At the other end of the continuum, a student who tends to believe that achievement is largely a matter of circumstance, either chance or as a result of the actions or decisions of others, would score as strongly external. The method of scoring assigns low scores to internal responses and high scores to external responses. Therefore, in order to interpret the influence of LOCUS on other variables in the model, negative values indicate internal locus of control and positive values indicate external locus of control.

Perception. Students rated their own performance relative to peers on a five-point scale as follows: 1=Quite Poor; 2=Below Average; 3=Average; 4=Above Average; 5=Excellent.

Metacognitive Capability. The two components of metacognition - awareness and control of learning processes - are incorporated within the METACOGNITIVE capability construct in the model. Control in the context of this study refers to specific learning and studying behaviour. This strategic sense of control as it relates to METACOGNITIVE capability is expressed in terms of internal and external attributions but this interpretation is not assumed to be synonymous with the more general notion of causality as it applies to locus of control.

Students responses to open-ended statements that related to their learning and studying behaviour were rated on two scales. The awareness scale rated awareness of learning processes from minimal to strong awareness, and the control scale rated control of learning processes from strong external to strong internal attributions for ease or difficulty with learning and studying. A total METACOGNITIVE capability score was obtained by summing the calculated awareness and control scores. The statements on which students commented were:

1. I find it easy/difficult to learn from lectures because...
2. The best way for me to learn for a test is...
3. When I have difficulty with an assignment question I...
4. I remember information best by...
5. Problems with my studies are mainly due to...

Procedure

The path model was developed on conceptual grounds, guided by previous research on characteristics of successful students, and by empirical evidence derived from exploratory correlational analysis. The path model was tested using latent variables path analysis with partial least squares (LVPLS) (Lohmoeller, 1987) This procedure offers the possibility to form constructs (latent variables) from observed variables as well as the estimation of effects between related constructs. Moreover, LVPLS permits the calculation of causal links not only between the latent variables

and the outcome measure but also between the explanatory constructs.

Correlation coefficients were calculated for all the variables. It was decided to include variables that showed significant correlations $p \leq 0.05$ with any other variable. In all, ten latent variables (constructs) were developed from the 23 selected manifest variables. The directly observed (manifest) variables (those on which data were gathered) are shown in rectangular boxes (Figure 1). The ellipses indicate the indirectly observed (latent) variables which are derived from the manifest variables.

Initially, a fully recursive path model was entered into LVPLS and successively 'trivial' (non-significant) paths were removed. The general recommendation (Sellin & Keeves, in press) is to exclude MVs from the outer model equations if their loading estimates are < 0.40. Consequently, only seven of the 20 elements that reflect learning style in the Dunn Model are shown to be relevant to the LEARNING STYLE construct in this model. With regard to the Approach to Learning construct, neither Surface Motives nor Surface Strategies contributed to their respective MOTIVES and STRATEGIES latent variables, and so were removed from subsequent analyses.

To determine when path coefficients in the inner model are accepted, or rejected as insignificant, twice the standard error for correlation coefficients for a simple random sample was used as a recommended, conservative cut-off criterion (Guilford & Fruchter, 1978). Since, in this analysis, the smallest number of cases for a latent variable is 72, the standard error of a correlation coefficient for the relationship between any two latent variables in the model is approximately equal to 0.10, and under these circumstances any path coefficient greater than ±0.20 (i.e. greater than two standard errors [$p \geq 0.20$ ($1/\sqrt{N}$ by 2]) may conservatively be taken to be of significance.

insert Table 1 about here

Table 1 lists the manifest variables (MVs). The latent variables (LVs) are underlined. Table 1 also lists the Population size (n), Means and Standard Deviations. All LVPLS estimations use the outward mode and these are recorded as factor loadings. Two latent variables were exogenous. They are the sex of the student (SEX) and the students' age (AGE). Eight endogenous variables are postulated. They are the two outcome measures, ACHIEVEMENT and SOLO; the two components of Approach to Learning, MOTIVES and STRATEGIES; LEARNING STYLE; METACOGNITIVE capability; LOCUS of control; and PERCEPTION.

Results and Discussion

In all, ten latent variables were included in this path model. Eight variables represented characteristics of students believed to influence each of the two outcome variables, one a qualitative and the other a quantitative measure of academic performance. The qualitative measure, SOLO, was also postulated to be related to the final achievement outcome measure of GPA.

insert Table 2 about here

The key factors in the model have been identified and summarized in Table 1 The results of the LVPLS analysis are presented graphically in Figure 1. The path estimates reported in Figure 1 indicate the significant direct (p) effects that each of the predictor latent variables have on each other and on the outcome measures of achievement. Significant direct (p), indirect (i), and total (t) effects of inner model variable relationships are reported, with correlations (r), in Table 2. Readers interested in a more detailed exposition of the principles underlying LVPLS are referred to Husén and Postlethwaite (in press).

The final solution of the hypothesized model indicates that the latent variables collectively explain 44 per cent of the variance in ACHIEVEMENT. LVPLS analysis also provides other indices of goodness-of-fit that affirm the stability and reliability of the model (Sellin & Keeves, in press). They are: (1) the communality coefficient = 0.71; (2) the mean of squared multiple correlations of LVs = 0.21; (3) the root mean square of the covariances between the residual of the MVs and the residual of the LVs and MVs (RMS Cov (E,U) = 0.06; (4) the redundany Coefficient = 0.17; and the reliability coefficients of Tucker-Lewis = 0.37 and Bentler Bonett = 0.60. Four iteration cycles were required for convergence of the model.

ACHIEVEMENT is best explained by METACOGNITIVE capability (p=0.45) and then by PERCEPTION (p=0.21). Note also that SOLO, which was used as an alternative measure of student learning outcome, contributes to ACHIEVEMENT (p=0.22). AGE is the only LV found to have a direct effect on SOLO (p=0.23).

Insert Figure 1 about here

SOLO and Achievement. The finding here indicates some degree of overlap between quantitative and qualitative assessments of learning. This means that in the assignment of grades, lecturers are making judgements about the students' ability to integrate meaningfully the material covered and not merely their ability to reproduce the content of the subject.

Age and SOLO. AGE is the only LV that has a direct influence on quality of learning measured as SOLO. The effect of AGE on SOLO (p=0.23) indicates that for older students achievement is

represented by a greater depth and quality of learning and this in turn positively affects their final ACHIEVEMENT. The significant positive path coefficient from AGE to SOLO and on to ACHIEVEMENT indicates that it is the older students who are the high achievers. It is possible to infer from this that it is not a consequence of teaching practices that students have achieved a high level of structural complexity in their learning. A more plausible explanation is that older students are more intrinsically motivated to seek meaning and integrate knowledge. Furthermore, their METACOGNITIVE capability allows them to achieve high grades (p=0.22) without compromising on quality.

Approach to Learning and Achievement. Recent research (Murray-Harvey, 1993) revealed that in their first year, students' approaches were represented by Surface, Deep and Achieving motives and strategies with considerably higher loadings for Deep and Achieving. Nevertheless, Surface motives and strategies contributed significantly to the latent variables of MOTIVES and STRATEGIES. The findings here indicate that by second year, students are reporting fewer surface motives and less use of surface strategies. These students are more deeply motivated and employ more deep and achieving strategies.

The reasons for an absence of any relationship between approach to learning variables (MOTIVES and STRATEGIES) and ACHIEVEMENT are not clear. Despite the fact that second year students' approaches reflect predominantly Deep and Achieving motives and strategies it seems that MOTIVES and STRATEGIES are not a significant factor influencing ACHIEVEMENT relative to the other variables in the model.

There is a strong direct effect of MOTIVES on STRATEGIES (p=0.54) which lends further weight to the hypothesized congruence between strategies and motives posited by Biggs (1987). Biggs argues that it is good 'psycho-logic' for students to select strategies that will enable them to achieve their desired goals (MOTIVES). While support for Biggs' congruence hypothesis has not been consistent (See Biggs, 1987), the results here, and from the previous analysis based on data from first year students, do support congruence between STRATEGIES and MOTIVES.

Metacognitive Capability, Motives, Strategies and SOLO. The lack of a relationship among METACOGNITIVE capability, MOTIVES and STRATEGIES (Approach to Learning) and SOLO was an unexpected finding. There is considerable evidence from other research (Trigwell & Prosser, 1991) that, while teaching and assessment practices may not necessarily encourage or reward deep and achieving approaches, with the result that there is no correlation between these approaches and grades, there is a positive correlation between these approaches and qualitative measures of learning outcome, such as SOLO scores. Such an

association was not obtained in this study. Also, it was anticipated, on the basis of previous research (Biggs, 1987), that METACOGNITIVE capability would be related to students' approaches to learning and studying. However, this was found not to be the case, While there is a significant correlation (r=0.30) between METACOGNITIVE capability and STRATEGIES, the strength of this association is not reflected in the path effects produced by the analysis.

Metacognitive Capability. The characteristic that best identifies successful students is their METACOGNITIVE capability. This latent variable has the most powerful effect on ACHIEVEMENT in the model (p=0.45). Students who are aware of, and able to effectively manage their learning and studying behaviour, are the high achievers.

Locus of Control and Metacognitive Capability. The absence of a direct path between LOCUS of control and METACOGNITIVE capability may seem implausible because both constructs represent notions of personal control over behaviour. Therefore, it is important to reiterate that control, as it has been incorporated within the METACOGNITIVE capability construct, is related to specific learning and studying situations. LOCUS of control reflects a more global sense of the perceived source of control governing a person's behaviour. The current analysis makes it clear that it is important to distinguish between LOCUS of control as an attribute of the person, and control in the more strategic sense as it applies to learning and studying behaviour. This does not negate a relationship between the two types of control. The indirect path of LOCUS to METACOGNITIVE capability through LEARNING STYLE indicates that internal locus of control does have an influence on METACOGNITIVE capability. And through METACOGNITIVE capability, internal locus of control can be seen to positively affect ACHIEVEMENT.

METACOGNITIVE capability also plays a central role as a mediating variable for LEARNING STYLE, AGE and PERCEPTION.

Metacognitive Capability, Learning Style, Age and Perception. The relationships among AGE, PERCEPTION and METACOGNITIVE capability show that it is the older students who are able to rate their performance relative to peers more accurately than younger students. The fact that self-rated performance is also connected to METACOGNITIVE capability and that both self-rated performance (PERCEPTION) and METACOGNITIVE capability directly influence ACHIEVEMENT shows how important it is for students to be able to make realistic assessments of their academic capabilities, and to use this awareness to direct their learning in ways that will enhance their academic performance. It seems that it is the students' age that facilitates this process.

Age. AGE is a pivotal factor in identifying successful students. As well as older students' ability to rate more

accurately their academic competence (PERCEPTION) and to behave more metacognitively, increased age is also a significant factor in the development of internal locus of control. The strengthening relationship between age and locus of control is well documented in the psychological literature so the strength of the relationship between AGE and LOCUS was not an unexpected finding in this study.

Perception. Successful students have positive self-PERCEPTIONS of their academic competence. The value of gathering this information from students is highlighted when the influence of PERCEPTION on other variables that also have an impact on ACHIEVEMENT is observed. As mentioned previously, students who see themselves as more competent behave more metacognitively. Their self-PERCEPTIONS also influence their MOTIVES. Positive self-perceptions appear to be related to Deep and Achieving motives. Furthermore, positive self-PERCEPTIONS are shown to influence LEARNING STYLE. It seems that on an 'emotional' level, students who perceive themselves to be good students are encouraged to be more Motivated, more Persistent and more Responsible. They also seem to be more independent (Peers) and more adaptable students (Several Ways).

Learning Style. LEARNING STYLE influences ACHIEVEMENT indirectly through its effect on METACOGNITIVE capability. The importance of Motivation, Persistence and Responsibility, preference for independent study (Peers), and ability to cope in varied learning situations (Several Ways) are learning style characteristics related to METACOGNITIVE capability in this model and so indirectly affect ACHIEVEMENT. Students who prefer to work with peers, who prefer a less formal learning environment, who are less responsible and who do not function easily in varied learning settings are not well equipped to cope with the demands of tertiary studies.

Conclusion

Academic achievement is the outcome of a complex system of learning and teaching relationships which take place within the context of the university. One way to identify the factors that contribute to academic achievement is to examine the characteristics of 'successful' students, that is, those who have negotiated their first year course of tertiary studies and are now in second year. Such an analysis can isolate variables that are more directly related to academic achievement within the university context and less influenced by presage factors such as school background and prior performance, or by university selection and admission policies.

The findings of this study are informative on two levels. At the student level, it has been possible to isolate several

factors that are characteristic of successful students. At the institutional level, it has been possible to assess the impact of teaching and assessment practices on student achievement.

Quality of learning outcome, measured by a SOLO score, is reflected in the students' overall achievement measured as GPA. This indicates a connection between quantitative and qualitative measures of learning outcome. Other research has pointed to large discrepancies between qualitative and quantitative assessments of learning outcome (Ramsden, 1988, 1992, Trigwell & Prosser, 1991), so it is heartening to discover that within some sectors of higher education, efforts are made to reward quality learning. It must be noted, however, that the relationship between the two measures, while significant, is still weak. Also, AGE is the only variable that is related to SOLO, so it seems that achieving high grades that are also quality rich is more a result of the students' age than any other factor in the model. Quality of learning outcome is an issue that must continue to be addressed for reasons that are revealed by examining other relationships in the model, notably the absence of any direct effect on SOLO of LVs other than AGE.

The lack of a relationship between MOTIVES and STRATEGIES and either SOLO or METACOGNITIVE capability is an unexpected finding in the light of such strong support from other research for the interconnectedness of these variables. Further research is needed to investigate the nature of these relationships.

LEARNING STYLE influences ACHIEVEMENT through its effect on METACOGNITIVE capability but does not influence ACHIEVEMENT directly. The learning style characteristics of second year students that have been identified in this model are of interest for several reasons. They are the same characteristics that identified high achievers in first year (Murray-Harvey, 1993). This indicates stability over a one year period. In other words, there appears to be a learning style profile that differentiates more successful from less successful students. Successful students are motivated, persistent, responsible learners who prefer to work alone rather than with peers, and who can readily cope in varied instructional settings. The results of this study indicate that students who prefer to learn in other ways may not be catered for in the university system as it is currently structured.

The characteristics that identify successful students are primarily their METACOGNITIVE capability and their ability to make accurate, positive, self-assessments of their academic competence (PERCEPTION). The development of such abilities might have been attributed to quality teaching practices within the university were it not for the obvious influence of AGE on these abilities. Clearly, it is more a function of the age (and wisdom of experience?) of the students that they are metacognitively capable and more self perceptive than it is a function of teaching practices. Students' METACOGNITIVE capability and self

PERCEPTION of their performance have a direct effect on ACHIEVEMENT. While METACOGNITIVE capability stands out as the characteristic that most clearly identifies successful students, the relationships among other variables in the model also provide valuable information about student learning outcomes.

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Table 1
List of Observations

Variables Description and Coding	N	Mean	SD	PLS Estim
ACHIEVEMENT [outward mode]				
Achiev.91 Grade point average for 1991	402	2.13	.73	.91
GPAS3 Grade point average for first semester,1992	356	2.36	.83	.91
MOTIVES (APPROACH) [outward mode]				
Surface Motive	283			
Deep Motive	283			
Achieving Motive	283			

6.29
5.66
6.44

2.72
2.90
2.72

.89
.84

STRATEGY (APPROACH) [outward mode]
Surface Strategy
Deep Strategy
Achieving Strategy

283
283
283

5.31
5.62
6.68

2.72
2.85
2.67

.86
.87

LEARNING STYLE [outward mode]
Motivation Maintains a high level of interest
Persistence Stays 'on task' until work complete
Responsibility Conforms to expectations
Light Preference for bright light when studying
Design Prefers formal seating arrangement (table,chair) when studying
Peers Prefers to study alone rather than with peers
Several Ways Learns in varied ways

251
251
251
251

251
251
251

48.33
50.64
45.06
52.94

51.45
52.08
49.17

6.89

6.37
8.79
8.02

8.52
9.36
8.83

.81
.72
.75
.42

.50
-.52
.62

LOCUS of Control [unity mode]
Internal locus scores low indicated by negative value and external locus scores high indicated by positive value: Locus of Control of Behaviour Scale (Craig, Franklin & Andrews, 1984)

83

25.49

7.66

1.00

PERCEPTION [unity mode]
Self-perception of performance 1=Quite Poor to 5=Excellent
226
3.38

.60
1.00

AGE [unity mode] Age of Student At March,1991: 17-53 years
423
22.07
7.34
1.00

SEX [unity mode] Sex of Student Male=1; Female=2
423
1.00

METACOG [unity mode]
Metacognitive Capability 10-point scale measuring awareness and control of learning processes: 1=very low to 5=very high

72

5.92

1.16

1.00

SOLO [unity mode] SOLO score Adapted from the Structure of the Observed Learning Outcome (SOLO) Taxonomy (Biggs & Collis, 1982) 5-point rating scale: 1=prestructural, 2=unistructural, 3=multistructural, 4=relational, 5=extended abstract.

72

3.15

.65

1.00
* LVPLS Estimation reported as factor loadings for outward mode.
Note: Standard scores provided for Learning Style (Mean=50, SD=10) and decile scores for Approach to Learning.
Table 2
Latent Variables: Direct Indirect and Total Effects

Variables Direct
Effects (p) Total
Effects (t) Indirect
Effects (i) †Corr.
(r)

Achievement
Sex
Age
Locus of Control
Perception
Learning Style
Metacognitive Capability
Motives (Approach)
Strategies (Approach)
SOLO
Variance explained: 44%
*
*
*
.21
*
.45
*
*
.22

*
.27
*
.35
.*
.45
*
*
.22

*
.27
*
.14
*
*
*
*
*

.18
.34
-.28
.43
.38
.59
.11
.16
.37

SOLO
Age
Learning Style
Metacognitive Capability
Variance Explained: 5%
.23
*
*

.23
*
*

*
*
*

.23
.25
.25

Motives (Approach)
Age
Locus of Control
Perception
Learning Style
Variance explained: 22%
*
-.20
.23
.21

.18
-.29
.29
.21

.18
*
*
*

.15
-.33
.33
.38

Strategies (Approach)
Age
Locus of Control
Perception
Learning Style
Metacognitive Capability
Motives (Approach)
Variance explained: 50%
*
*
*
.29
*
.54
*
-.29
.23
.40

*
.54
*
-.29
.23
.11
*
*
.23
-.31
.31
.50
.30
.65
Learning Style
Sex
Age
Locus of Control
Perception
Variance explained: 32%
*
*
-46
27

*
.22
-46
.27
*

.22
*
*
.11
.27
-50
33
Metacognitive Capability
Age
Perception
Learning Style
Variance explained: 25%
.22
.25
.20

.35
.30
.20

.13
*
*

.36
.39
.34
Perception
Age
Variance explained: 10%
.31

.31

*

.31

Locus of Control
Age
Variance explained: 9%
-.31
-.31
*
-.31
† Latent Variable correlations significant at the level of $p<0.05$. * Path coefficient <0.20.
Note: LVs with all paths <0.20 not reported.

Note: Negative value for locus of control denotes greater internality.

Figure 1. Path model: Characteristics of successful students.