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Extending the Biggs 3P Teaching and Learning Model: A Structural Equation Modeling Approach

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EXTENDING THE BIGGS 3P TEACHING AND LEARNING MODEL: A STRUCTURAL EQUATION MODELING APPROACH

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Abstract

A structural equation modeling approach is used to build understanding of the Biggs 3P model of teaching and learning within the tertiary institution sector. A learning quality dependent construct is used to show the Biggs 3P construct blocks do display significant two way interactions between each and every construct, and so act as an interlinked system.

Keywords: Learning modes, tertiary, education, flexible, blended, traditional, student outcomes, student perception

Introduction

Tertiary institutions typically deploy unique combinations of unique learning offerings and learning activities as engagement tools for their student cohorts, This research builds on the Biggs [9] 3P model of teaching and learning. The three P's are tools Biggs engages to relate : (1) presage as the learning characteristics existing prior to the learning engagement; (2) process as the student learning experiences capture tool, and product as the overall student learning outcomes capture toolkit. The Biggs 3P model is shown as Figure 1. Biggs suggests that learning outcomes that result are complex, and that they operate in interaction with each other. He suggests the general direction of effects may be represented by heavy arrows as shown in Figure 1, and that both student factors and the teaching context jointly drive the system towards a common set of learning outcomes. Biggs also explains that no two classes, or any teacher-student engagements are exactly the same, and Biggs believes the teacher and the individual student engaging in the teaching and learning processes will likely achieve quite different results. Biggs also indicates that each specific institution has impact on the teaching and learning process. Thus, with many complex variable intertwining any change in one area likely shows as an affect in another. Thus the 3P model delivers a teaching and learning system.

Biggs 3P model shows each pathway between construct blocks as bi-directional teaching and learning pathways, with bold arrows representing key directional resultants that ultimately influence student learning outcomes [9][30][56].

The student factors construct block captures the measures of Boyatzis and Kolb [12], Caladine [15], Allen, Bourhis, Burrell and Mabry [1] , Collins and Moonen [19], Duke [28], Biggs [9], Kretovics [44], and Delielioglu and Yildirim [24][25].

The teaching context construct block captures three areas traditional, blended and flexible teaching are captured by works by Chickering, Gamson, and Barsi [16], Moore [52][53], Nikolova and Collins [57], Caladine [15], Beattie and James [6], Miller and Groccia [51], Johnson and Johnson [39][40], Novak [58] , McCarthy and Anderson [49], Navarro and Shoemaker [55], Nunan, George, and McCausland [59], Smith [60], Collins and Moonen [19], Baugher, Varanelli, and Weisbord [5], Biggs [9], Moore and Kearsley [54], Theroux [63], Dabbagh and Bannan-Ritland [22], Gamliel and Davidovitz [31], Hill [36], Delielioglu and Yildirim, [24][25], Bliuc, Goodyear, and Ellis [10] , and Hughes [38], Brew [13], Georgouli, Skalkidis, and Guerreiro [32] ,Hamilton and Tee [35], and Yudko, Hirokawa and Chi .

The learning focused activities construct block captures learning experience related areas, and is built from works by: Wade, Hodgkinson, Smith, and Arfield [64], Miller and Groccia [51], Arbaugh, [4], Dill and Soo, [26], Marks, Sibley, and Arbaugh [48], Davis and Wong [23], Finch [29], Douglas, McClelland, and Davies [27], and Sun, Tsai, Finger, and Chen [61].

The learning outcomes construct block captures both learning skills deployed and learning quality aspects as outlined by: Wade, Hodgkinson, Smith, and Arfield [64], Collis and Moonen [18][19], Smith [60], Chiu, Hsu, Sun, Lin, and Sun [17], Holsapple & Lee-Post [37], Lee [45], Alves and Raposo [2], McFarland and Hamilton [50], Johnson, Hornik, and Salas [41], Lowry, Molloy, and McGlennon [47]; and Sun, Tsai, Finger, and Chen [61].

Based on measures built from the works outlined above, we reconstruct the constructs and relationship blocks from Figure 1 into our four independent construct test approaches of Biggs 3P model. This approach is portrayed as Figure 2.

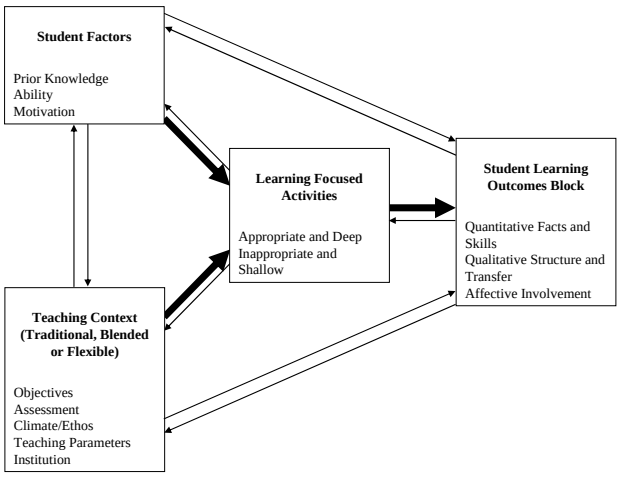

Figure 1: Biggs 3P Model, Biggs (2003 p.19)

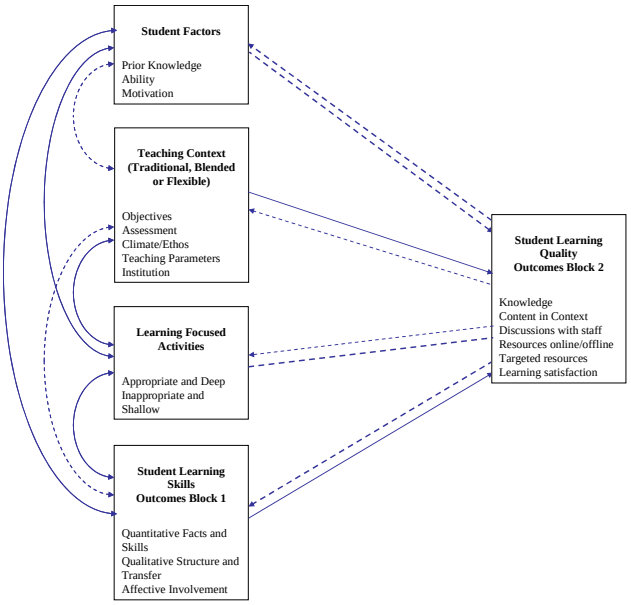

Figure 2: Four independent construct test of Biggs 3P model

In Figure 2 the teaching contexts interact with the student learning processes of student factors, the student learning focused experiences and the student learning outcomes blocks. These four Biggs 3P construct blocks are mapped using structural equation modelling against one additional outcomes construct block (that captures aspects of traditional blended and flexible learning quality). This additional outcomes block is used to test whether the four construct blocks of Biggs 3P do indeed show two-way path interactions. We test this approach using a blended learning mode teaching environment via a multiple campus first year tertiary student study. Here, both a face-to-face and value adding on-line and/or simulation learning mix is used to suitably engage students. If the Biggs 3P construct blocks show significant covariance, and paths to the outcomes block are all sufficiently strong, and the model fit is suitably strong, then these observed construct blocks may be used to further extended the Biggs 3P model into an initial observed variable set. This has application for studies like Hamilton and Tee's (2008) business 'value enhancement approach to tertiary institution learning modes, graduate attributes and business enhancement', and may then show how overall teaching and learning mode systems can better align with graduate employer desires.

Research Study

The Biggs 3P model was tested using a structural equation modeling approach. First year business undergraduate students in weeks five and six of their first semester at university, across the campuses of a regional Australian university were the subjects of this study. Data capture of three hundred and seventy three students occurred during March 2009. To ensure measurement suitability a seven-point Likert scale was used across all student survey measures except for those concerning demographics. The survey measures tabulated in Appendix 1 were used to build the structural equation model shown in Figure 3. The added learning quality construct driver block was developed under maximum likelihood in AMOS 16, and via a factor reduction processes. This learning quality construct was used as the dependent variable and as the driver to enable the testing of interactions effects between Biggs's 3P teaching and learning constructs.

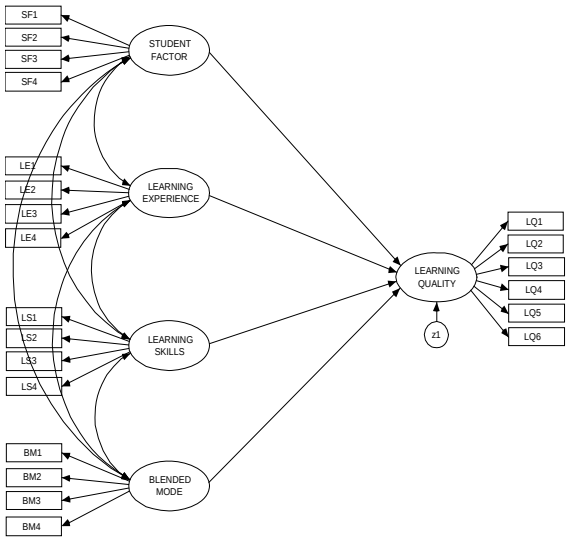

Figure 3: Four independent construct test of Biggs 3P model

Results

The independent construct test approach of Biggs 3P model when tested under Amos 16 showed some case (or potential construct) items when examined within the theoretical context of each scale necessitated removal during factor reduction – either for substantive or statistical reasons [3] .

Unidimensionality, reliability and convergent and discriminant validity were evaluated for the remaining acceptable construct items. Modification indices above 4, standard residuals were above two, and standard parameter estimates under 0.50 were all removed. The composite reliability for each construct was 0.75 or greater.

Structural equation modeling outputs is displayed in Figure 3 along with a relevant 'goodness-of-fit' data table. The construct validity was excellent across the model, with a chi squared to degrees of freedom ratio around the value 'two'. The RMSEA, RMR, CFI, GFI, AGFI, and TLI values all indicate a sound but not excellent model fit. This is because the output variable learning quality is not capturing the full learning driver block. Satisfaction, value, service and communication construct blocks also need to be included here, but this was beyond the data collection of this study. The GFI minus AGFI ratio remained under 0.06, and supported a degree of fit. The Bollen-Stine p (2000 bootstraps), for the blended teaching mode model remained under but near 0.05, and further validated the model fit [8][46][7][42][14][43][21][11][33]. This pathways model delivers sound quality results, and bootstrapping (2000 bootstraps), supported by near normal ML charts, is used to indicate the avoidance of possible calculation misspecification errors, and to further validate model fit [33].

All paths shown in Tables 1 and 2 are significant at $p < 0.05$ and all have reasonable loadings. All covariance paths shown in Tables 3 and 4 are significant at $p < 0.05$, and all have moderate loadings. Thus, the four construct blocks of Biggs 3P model each display different, but moderately strong interactions, when mapped against the learning quality construct block. This supports Biggs 3P model where significant interactions between the construct blocks are expected. The moderate covariance levels indicate the constructs are different, but do show interaction effects.

Table1: Regression Pathways

PATHS (REG WTS)			Estimate	S.E.	C.R.	P
LEARNING_QUALITY	<---	STUDENT_FACTOR	.263	.074	3.540	***
LEARNING_QUALITY	<---	LEARNING_EXPERIENCE	.498	.137	3.627	***
LEARNING_QUALITY	<---	LEARNING_SKILLS	.218	.082	2.645	.008
LEARNING_QUALITY	<---	BLENDED_MODE	.130	.055	2.385	.017

Table 2: Regression Path Value Between Constructs

PATH LOADINGS (STANDARDIZED REG WTS)			Estimate
LEARNING_QUALITY	<---	STUDENT_FACTOR	.292
LEARNING_QUALITY	<---	LEARNING_EXPERIENCE	.469
LEARNING_QUALITY	<---	LEARNING_SKILLS	.193
LEARNING_QUALITY	<---	BLENDED_MODE	.168

Table 3: Covariance Pathways

COVARIANCE PATHWAYS			Estimate	S.E.	C.R.	P
LEARNING_EXPERIENCE	<-->	LEARNING_SKILLS	.221	.049	4.508	***
BLENDED_MODE	<-->	LEARNING_SKILLS	.218	.048	4.520	***
STUDENT_FACTOR	<-->	LEARNING_SKILLS	.207	.043	4.818	***
BLENDED_MODE	<-->	LEARNING_EXPERIENCE	.313	.062	5.064	***
STUDENT_FACTOR	<-->	LEARNING_EXPERIENCE	.306	.057	5.390	***
BLENDED_MODE	<-->	STUDENT_FACTOR	.286	.054	5.352	***

Table 4: Biggs Construct Covariance Pathways

COVARIANCE PATHS (STANDARDIZED CORRELS)			Estimate
LEARNING_EXPERIENCE	<-->	LEARNING_SKILLS	.624
BLENDED_MODE	<-->	LEARNING_SKILLS	.448
STUDENT_FACTOR	<-->	LEARNING_SKILLS	.495
BLENDED_MODE	<-->	LEARNING_EXPERIENCE	.605
STUDENT_FACTOR	<-->	LEARNING_EXPERIENCE	.689
BLENDED_MODE	<-->	STUDENT_FACTOR	.469

Conclusions

The structural equation modeling approach used shows that the Biggs 3P model of teaching and learning for first year tertiary institution students does display interaction between each of the construct blocks. These two way interactions each of differing path strength as suggested by Biggs, constitute an interlinked system, and these may be used in structural equation modeling studies to further investigate the linkages between tertiary institution learning modes, graduate attributes and business enhancement [35]. To improve this study the outcomes driver set should capture satisfaction, value, service, quality and communication constructs.

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Appendices

Appendix 1: Construct Items

Code	Question
	Student Factor
	Tertiary student learning environment interactions should develop:
SF1	The ability to understand the practical implications of course-acquired new knowledge
SF2	Ideas and solutions processes
SF3	Enhanced knowledge suitable for a student's planned future career
SF4	Added value to the student's skills portfolio
	Learning Experience
LE1	My quality learning experiences are best delivered by face-to face individual instruction from the
LE2	Each of my tertiary teachers should engage with me by pre-defined project tasks
LE3	Tertiary learning should offer the mix of theory and practice that I can be negotiate to best suit my
LE4	Tertiary learning should offer a sequencing of topics that I can be negotiate to best suit my needs
	Learning Skills
LS1	Student-teacher, individually-agreed, course delivery is the best way to improve my behavioural skills
LS2	Face-to-face learning is the best way to improve my information skills
LS3	Face-to-face learning is the best way to improve my analytical skills
LS4	A mix of face-to-face and on-line learning is the best way to improve my behavioural skills
	Blended Mode
BM1	It is absolutely important for students to access tertiary learning materials as library resources (on-line and/or off-line)
BM2	It is absolutely important for students to access tertiary learning materials as library books and borrowable resources
BM3	It is absolutely important for students to access tertiary learning materials as texts and course websites
BM4	Highest value leaning is best provided by a mix of face-to face and technology enhanced on-line interactive websites and discussion boards
	Learning Quality
LQ1	Tertiary learning environment face-to-face learning makes students master knowledge by drills and
LQ2	Tertiary learning environment face-to-face learning makes students always learn content that is linked by the teacher to its most appropriate contexts
LQ3	It is absolutely important for students to access tertiary learning materials as face-to face discussions with the teacher, lecturer, instructor and/or mentor
LQ4	Tertiary student learning environment interactions should develop customer (student) satisfaction
LQ5	Tertiary learning should offer suitable learning resources that may be varied to best suit my needs
LQ6	My quality learning experiences are best delivered by allowing me to select my preferred assessment items and grading systems