Teaching and learning: A SEM blended learning systems approach

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ABSTRACT *A first year tertiary student structural equation modeling (SEM) approach builds understanding of blended learning. The Biggs's 3P teaching and learning systems model displays significant two way interactions between each of its presage, process, and product constructs and validates this Biggs approach as a dynamic interactive learning system. The student learning processes occurs through teacher contributions, mixed with learning interactions and feedback systems. Greater learning, knowledge and skills transfer is possible when students are suitably pre-prepared/pre-skilled for the ensuing learning experiences and the variety of teaching/learning interactions to be encountered.*

Keywords: tertiary teaching mode, flexible, blended, traditional, learning outcomes, biggs

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Introduction

Tertiary institutions typically deploy combinations of instructional modes (traditional, and/or blended and/or flexible approaches) as they seek to proactively engage students and to add value to their learning experiences (Blankson & Kyei-Blankson, 2008).

Traditional or face-to-face learning modes continue to change and to include mixes of direct student learning instructional approaches (Bonk & Graham, 2005; Reisslein, Seeling, & Reisslein, 2005; Michinov & Michinov, 2008). Traditional educators have altered, and enhanced the focus of their learning-related presentations, engagements and instructional materials (Hamilton & Tee, 2010) and have improved classroom interactions and enhanced the quality of the traditional learning processes (Johnson & Johnson, 1999; Bliuc, Goodyear, & Ellis, 2007; Simmering, Posey, & Piccoli, 2009). However, traditional face-to-face educators control and direct the learning environment (Beattie & James, 1997; McCarthy & Anderson, 2000; Gamliel & Davidovitz, 2005; Bonk & Graham, 2005; Hughes, 2007) with student specific-learning and content-related tasks allocated by the educator (Moore & Kearsley, 2004) and aimed at generally promoting higher order thinking whist also sustaining motivation (Navarro & Shoemaker, 2000).

The blended learning mode captures the 'what', the 'where', and the 'when' of learning (Hill, 2006). Blended learning can extend the classroom learning environment at the task level, the activity level, the course or program level, or even at the institutional level (Bonk &

Graham, 2005). Blended learning is defined as a combination of instructional media learning systems, and it typically links face-to-face instruction with computer-assisted student learning and management systems (Baugher, Varanelli, & Weisbord, 2003; Bonk & Graham, 2005; Georgouli, Skalkidis, & Guerreiro, 2008; Yudko, Hirokawa, & Chi, 2008).

The blended learning mode offers additional student learning approaches that complement, and change, the students learning and critical thinking processes into various levels of blended learning engagements (EL-Deghaidy & Nouby, 2008; Sendag & Odabasi, 2009). Such approaches include: (1) on-line competitive simulations, (2) business negotiations and role plays, (3) interactive and dynamically changing business case and problem solving activities, (4) virtual classrooms suites, (5) video conferencing or teleconferencing (to external locations), (6) social networks, (7) gaming-style interactive networks and virtual world learning, and (8) numerous workplace-linked direct learning tools. At the higher-end of blended learning, some limited flexible choice options (like personal or team-based negotiated additions) may also be included in the educator's learning mode offerings. These higher-end blended learning approaches move the student's blended learning solution towards a flexible learning approach.

The flexible learning mode captures stronger experiential aspects and occurs within an: 'anytime', 'anywhere', 'anyhow' learning environment. It encapsulates the 'what', the 'where', the 'when' and the 'how' of the learning occurrence (Hill, 2006), and must manage/administer the individual student along with access, content, delivery style, logistics and productivity (Silva & McFadden, 2005). Bryant, Campbell, & Kerr (2003) believe flexible learning is learner and individual needs focused. Collins & Moonen (2002) add class time, course content, instructional approach, learning resources, location, technology used, entry and completion dates, and communication media as other components of the flexible learning framework. Hill (2006) mixes flexible delivery of learning with high degrees of strong pathways flexibility. The 'how' dimension of flexible learning captures individual student processes, and the quality of experiences along with the learner's personal characteristics, learning style, work responsibilities, learning needs and desires, and personal circumstances (Nikolova & Collins, 1998; Smith, 2001). Thus, flexible learning is a complex mix of timing flexibility, content flexibility, entry requirements, instructional and resources deployment approaches, and delivery logistics (Collis & Moonen, 2002), which may also deliver aspects of the 'why' associated with the learning process. Such curricula may provide individualized (and student-negotiated) services (Hamilton, 2007).

Thus, full flexible learning is a multi-dimension construct, encapsulating: flexible mode of delivery, flexible access to learning resources, flexible curriculum and assessment, flexible scheduling and flexible study pathways. Here, tertiary students undertaking learning at their choice of location and time, may (or may not) have need to attend the tertiary institution's campus, and to pace and timeframe their learning, as opposed to the more prescribed instructional requirements under traditional or blended learning.

Flexible learning also allows the student with and appropriate prior learning to 'mix and match' cross program materials as learning unit modules most appropriate to the content they individually want to learn. Here, learning contracts, or independent study may be used and without compromising academic standards (Wade et al., 1994).

Hence, although traditional, blended and flexible learning modes are different, differences significantly relate to respective instructional approaches (Duke, 2002; Levy, 2005; Reisetter, Lapointe, & Korcuska, 2007; Georgouli, Skalkidis, & Guerriro, 2008). Here, blended learning modes within the tertiary educator's applied delivery processes may be embedded within the chosen blended instructional mode delivery systems. A shift from traditional mode instruction to blended mode instruction also moves the engaged student learner into a blended learning mode. The above three instructional modes are summarized in Table 1.

Table 1. Characteristics of instructional modes

Learning Mode Characteristics		
Traditional	**Blended**	**Flexible**
Fully instructor-controlled and instructor-centred environment	Partially instructor-controlled and instructor-centred environment	Fully student-centred learning with instructor acting as learning advisor
Instructor-determined learning resources set for student use	Some optional learning resources available for student use eg WebCT, Blackboard or course CD's	Student negotiated and agreed options regarding learning resources used
Fixed curriculum content and assessment items	Limited negotiated curriculum content and assessment items	Fully negotiation on curriculum content and assessment items
Fixed time and place for learning and assessment	Limited time and place flexibility for learning and assessment	Fully-flexible time and place scheduling, with multiple starting and end points for learning and assessment
Fixed study pathways after recognition of prior learning	Limited choice of study pathway combinations after recognition of prior	Full choiced of study pathway combinations after recognition of prior learning established
Fixed entry (or exit) points	Limited choice of entry and exit points	Student negotiated choice of entry and exit points

Learning is a system process engaging exchanges between both the instructor and the student (Biggs, 2003). A shift in the instructional mode approach also changes the student learning experiences and student learning outcomes (Hamilton & Tee, 2010). Many modern tertiary learning institutions have adopted blended learning as their preferred instructional and learning engagement approach (Hill, 2006; Hofmann, 2008; Oh & Park, 2009).

This study employs a structural equation modeling (SEM) approach to examine the dynamic nature of the Biggs 3P learning system. It aims to measure the two-way blended learning knowledge-transfer paths within the Biggs 3P learning systems, and then to assess where changes to the mix of the learning components show the greatest effect on the knowledge paths within this learning system. It seeks to determine whether shifts in gender emphasis within the learning system are understandable, and whether these shifts provide a mechanism to refine component items within the learning system, and thereby enhance both the learning experiences and the learning outcomes.

This paper is organised as follows. First, we examine the tertiary learning system from a Biggs 3P learning perspective. Next, we deploy our research model and discuss the findings of our research. Lastly, we provide a range of research implications and offer directions for future study.

BIGGS 3P learning systems: Tertiary learning model

Tertiary institutions create unique combinations of student learning offerings and activities which then build into their students' net learning outcomes (Ramdsden, 1984; Biggs 1987; 1999; Prosser & Trigwell, 1999; Blankson & Kyei-Blankson, 2008; Hamilton & Tee, 2010).

Over time, Biggs has explained this institutional teaching and learning process via his 3P learning systems model (Biggs, 1978; 1987; 1993; 1999; 2003). He suggests three P's (*presage*, *process*, and *product*) represent different learning factor levels and their components contribute towards the student's learning process outcomes.

Presage factors set the learning environment characteristics prior to the learning engagement. Here, the student factors construct of: prior-knowledge, abilities, intelligence, personality and home background, represents student incoming personal learning influences, whilst teaching context factors construct groups instructional mode, subject area, course structure, and learning tasks as enablers of the learning environment.

Process factors house the approaches students adopt towards their learning. These learning focused activities may involve surface learning and/or deep learning and/or achieving strategies approaches.

Product factors identify the strategies students engage in their learning acquisition processes. These student learning outcomes may be the quantifiable measures of academic achievement and/or the qualitative measures of how well material is learned or experienced, and may result in a net grade or set of graduate attributes.

The Biggs's 3P learning systems model interrelates the 3P'd as shown in Figure 1. It uses two-way arrows to capture the bi-directional components of engaged student learning and knowledge flows. Each learning arrow represents a *linear* interaction between any two of the interconnecting teaching-learning relationships. The emerging student learning outcomes construct captures the combined net interaction effects of the contributing system. The bold arrows represent the strongest student learning interaction effects - with both the student factors and the teaching context jointly drive the teaching and learning system towards the student's resultant set of learning outcomes.

Biggs emphasizes all institutional classes differ and no two teacher-student engagements are exactly the same – with the teacher and the engaging student each acquiring different outcomes from the learning processes. Biggs indicates the impact of an institution alters the systemic strengths of the contributing two way relationships between presage, process, and product components (Biggs, 1993), and therefore alters student learning outcomes.

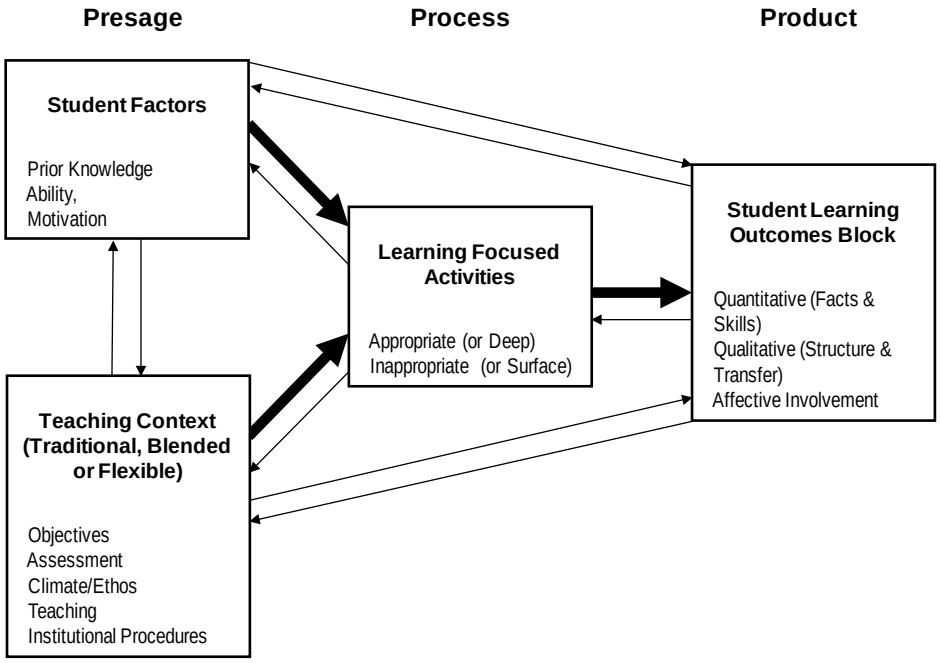

Figure 1. Biggs 3P learning systems model (adapted)

Early Biggs 3P model research focused on linear one-way linkages between specific elements of the teaching context construct and/or the learning factor construct (Biggs, 1979; 1987; 1993; 1999; Biggs & Kirby, 1984; Hall et al., 1995; Prosser & Trigwell, 1999; Duff, Boyle, & Dunleavy, 2004; Lucas & Meyer, 2005; Nijhuis, Segers, & Gijselaers, 2005; 2008). Such part model studies and various component linkages studies offer little insight into understanding of the full model, yet Biggs 3P model continues to exert influence within the teaching and learning arena (Flood & Wilson, 2008; Nemanich, Banks, & Vera, 2009).

Recently, Biggs 3P learning systems model (Biggs, 1999: 2003) has shifted emphasis towards a dynamic and interactive teaching and learning system of complex learning variables, that includes a diversity of institutional teaching and learning modes such as traditional, blended, and flexible approaches (Graham, 2006; Hofmann, 2008; Oh & Park, 2009; Hamilton & Tee, 2010). However, such increased complexity has not altered the fundamentals of the 3P model, with any change in teaching context or across a learning factor construct generating different results into net student learning outcomes (Biggs, 2003; Flood & Wilson, 2008; Nemanich, Banks & Vera, 2009).

To date, only Hall et al. (1995); Drew and Watkins (1998), and Wong and Watkins (1998) have examined the full Biggs 3P learning systems model as a combined presage, process and product system, but again each study adopts a restrictive linear approach that generates differing answers. In addition each study negates the systemic nature of the Biggs 3P approach to teaching and learning.

From a blended learning perspective, this SEM research approach now examines the dynamic nature of this interactive teaching and learning system, and gathers measures concerning the path strengths embedded within the Biggs's 3P model of Figure 1. It checks whether the Biggs bold arrows towards student learning outcomes actually represent the strongest impacts on student learning outcomes (Biggs, 2003; Flood & Wilson, 2008; Nemanich, Banks, & Vera, 2009).

Tertiary blended learning model constructs

The student factors construct measures of personal and related motivational skills possessed by tertiary students prior to their learning engagement are captured by: Boyatzis and Kolb (1995), Caladine (1999), Kretovics, (1999), Allen et al. (2002), Collins and Moonen (2002), Duke (2002), Biggs (2003), and Delielioglu and Yildirim, (2007; 2008).

The teaching context construct is situation-specific and builds the tertiary environment that facilitates learning. It includes instructional modes (traditional, blended and flexible), subject area, course structure, and learning tasks. We measure this by capturing traditional, blended and flexible teaching-related measures in similar manners to those of: Nikolova and Collins (1998), Beattie and James (1997), Miller and Groccia (1997), Caladine (1999), Johnson and Johnson (1999), Novak (1998), McCarthy and Anderson (2000), Navarro and Shoemaker (2000), Smith (2001), Collins and Moonen (2002), Baugher, Varanelli, and Weisbord (2003), Biggs (2003), Moore and Kearsley (2004), Dabbagh and Bannan-Ritland (2005), Gamliel and Davidovitz (2005), Hill (2006), Delielioglu and Yildirim, (2007; 2008), Bliuc, Goodyear, and Ellis (2007), Hughes (2007); Georgouli, Skalkidis, and Guerreiro (2008); Hamilton and Tee (2008), and Yudko, Hirokawa and Chi (2008).

The tertiary learning focused activities construct captures learning experience-related areas, and is built from works by: Wade et al. (1994), Miller and Groccia (1997), Arbaugh (2000; 2002), Dill and Soo (2005), Marks, Sibley, and Arbaugh (2005), Davis and Wong (2007), Finch, (2008), Douglas, McClelland, and Davies (2008), and Sun et al. (2008).

The learning outcomes construct captures both learning skills deployed and learning quality aspects as outlined by: Wade et al. (1994), Collis and Moonen (2001), Smith (2001), Chiu, et al., (2005); Holsapple and Lee-Post (2006), Lee (2006), Alves and Raposo (2007), McFarland and Hamilton (2007), Johnson, Hornik, and Salas (2008), Lowry, Molloy, and McGlennon (2008), and Sun et al. (2008).

Data collection and analysis

Based on the constructs outlined above, and further summarized in Table 2 as valid measurement blocks, we rebuild the four Biggs 3P model constructs of Figure 1 as four independent SEM constructs, and test each covariance path (as portrayed as Figure 2) for significance (as suggested by Biggs and others) Our study measures these four Biggs 3P model constructs as a system for the blended teaching and learning situation.

Figure 2 presents the four Biggs 3P model constructs as a full set of SEM covariances (representing the presence of bi-directional networking effects). All standardized loads and covariances for this blended learning mode study are significant at $p < 0.01$ and capture first year tertiary students five to six weeks into their university year (and across multiple campuses). Two hundred and forty three female students and one hundred and thirty male students of average age twenty six were surveyed in 2009 using seven point Likert scale (strongly agree [1] to strongly disagree [7]) questionnaire items. Survey responses indicate both gender groups display suitable understanding as to what constitutes a blended mode instructional environment.

Table 2. Item measures and data capture assessment

Literature Source	Measurement Item	Item Code	Item Load	Mean	Std Dev
Boyatzis & Kolb, 1995; Caladine, 1999; Allen, Bourhis, Burrell & Mabry, 2002, Biggs, 2003.	**Student Factor (Cronbach Alpha 0.86)**				
	Growing knowledge suitable for my planned future career	SF1	0.81	6.06	0.94
	Adding value to my student skills portfolio	SF2	0.82	5.98	0.96
	growing my ability to reflect and to refine learned concepts	SF3	0.77	5.88	0.96
	enabling me to understand the practical implications of my course-acquired new knowledge	SF4	0.73	6.05	0.92
Wade et al., 1994; Miller & Groccia, 1997; Arbaugh, 2000, 2002; Marks, Sibley & Arbaugh, 2005; Davis & Wong, 2007; Douglas, McClelland & Davies, 2008; Sun et al., 2008.	**Learning Experience (Cronbach Alpha 0.75)**				
	A range of direct and indirect communications with my lecturer	LE1	0.78	5.53	1.12
	A range of direct and indirect communications with my fellow students in the course	LE2	0.77	5.30	1.16
	My lecturer being readily accessible on-line or face-to-face	LE3	0.58	5.58	1.18
Boyatzis & Kolb, 1995; Duke, 2002; Kretovics, 2006; Alves & Raposo, 2007;McFarland & Hamilton, 2007; Delielioglu & Yildirim, 2007 2008; McFarland & Hamilton, 2007; Lowry, Molloy & McGlennon, 2008.	**Learning Skills (Cronbach Alpha 0.96)**				
	The breadth of my learning experiences is appropriate	LS1	0.91	5.95	1.11
	The depth of my learning experiences is appropriate	LS2	0.95	5.87	1.15
	My acquired learning skills add value to my net learning experience	LS3	0.95	5.84	1.12
	Contacts with my instructors affect my learning quality	LS4	0.92	5.87	1.15
	The information skills I acquire add to my learning experiences	LS5	0.86	5.83	1.12
	The behavioural skills I acquire add to my learning experiences	LS6	0.76	5.42	1.37
Caladine,1999; Delialioglu & Yildirim, 2007;2008; Wade, Hodgkinson, Smith & Arfield, 1994; Collis & Moonen, 2001; Smith, 2001; Holsapple & Lee-Post, 2006, Alves & Raposo, 2007, Johnson, Hornik & Salas, 2008.	**Blended Mode (Cronbach Alpha 0.74)**				
	On-line web chat rooms, forums, activities	BM1	0.65	4.34	1.60
	Course-wide email, phonecall and online communication channels	BM2	0.63	5.15	1.34
	Pre-defined interative learning/project tasks	BM3	0.56	5.24	1.11
	Multimedia modes like podcasts, downloads, prerecorded lectures	BM4	0.76	4.79	1.54

Here, both a face-to-face instruction and value-adding on-line learning tasks along with knowledge and skills simulations are deployed to engage these students. The three strongest covariance paths (learning experience: to student factor, to learning skills and to blended mode) are in line with Biggs (2003) predictions of strongest path strength from each

construct. It should be noted that these path strength values may vary under different teaching and learning mode situations (especially under some flexible learning situations), and also across different tertiary year levels.

In addition, tertiary institution value enhancement approaches may be combined with learning modes, graduate attributes and business enhancement, and may then elucidate extensions to the Biggs 3P alignments. Here, overall teaching and learning modal systems may be extended through to employer-desired graduate attributes (Hamilton & Tee, 2008).

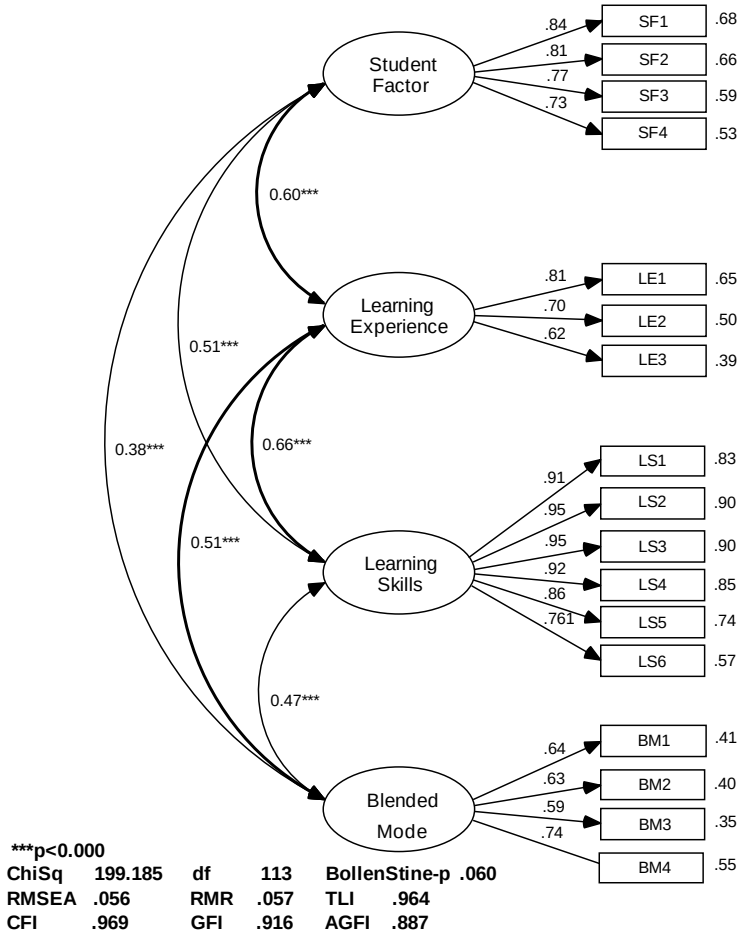

Figure 2. Four independent construct test of Biggs 3P model

We now build the Biggs 3P teaching and learning model into the SEM model shown as Figure 3. Each maximum likelihood construct item is developed from theoretical contexts (Table 1) and relevant literature items (Table 2). Under SEM, these items are unidimensional and each loads significantly ($p < 0.01$), onto just one Biggs construct. All standardized item loads vary from 0.59 to 0.95, indicating each item delivers substantial contributions to the net model interactions. All paths and the covariance show standardized and significant ($p < 0.01$) β weights. All modification indices are below 4 and all standardized residuals are below 0.05, and the resultant construct composite reliabilities (each > 0.75) each contribute deliver excellent model fit (Hair et al., 2010).

The RMSEA, RMR, CFI and TLI values all indicate excellent model fit. The GFI minus AGFI ratio remains under 0.06 and again supports high quality fit (Byrne, 2001; Blunch, 2008; Cunningham, 2008; Hair, et al., 2010).

The near normal ML charts supported by an excellent Bollen-Stine p indicate the avoidance of possible calculation misspecification errors, and further validate model fit (Cunningham, 2008; Hair et al., 2010).

This Presage (inputs) to Product (outputs delivered) forward mode for blended learning, validated under a bootstraps (2,000 times) approach, confirms an excellent model exists with a $\chi 2$/df equal to 1.76 and a Bollen-Stine p greater than 0.060. As predicted by Biggs the key internal paths of this mode are stronger than the external model paths, and all paths are significant ($p < 0.01$). Thus, this model shows Presage effects onto student learning experiences to be very significant, with this construct then generating considerable learning skills (Product) output effects.

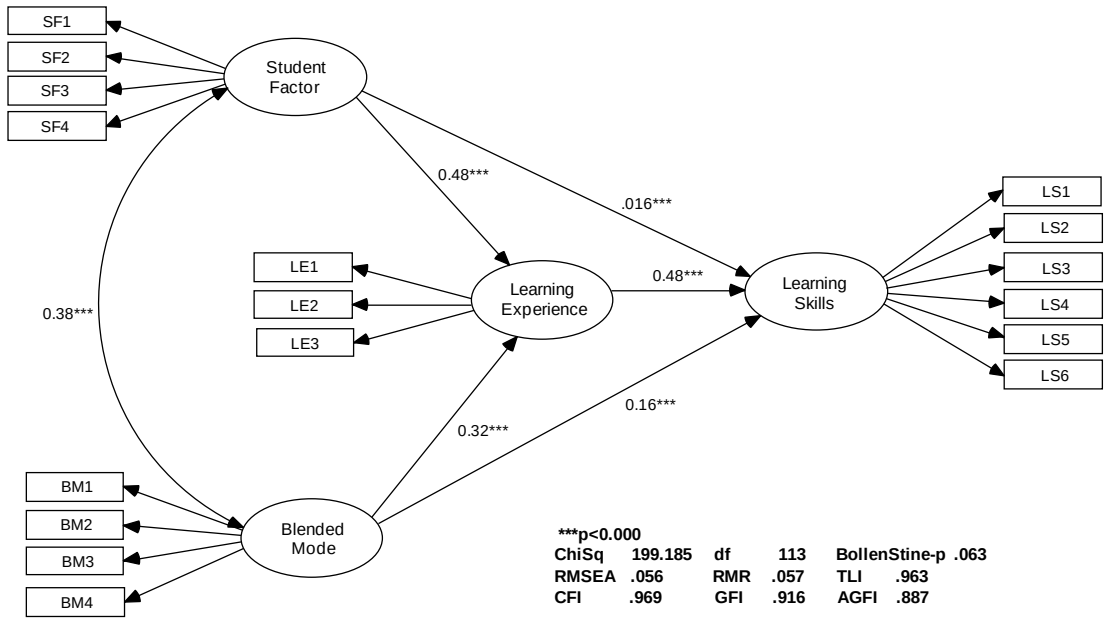

Figure 3. Biggs 3P Presage (input) to Product (output) forward approach

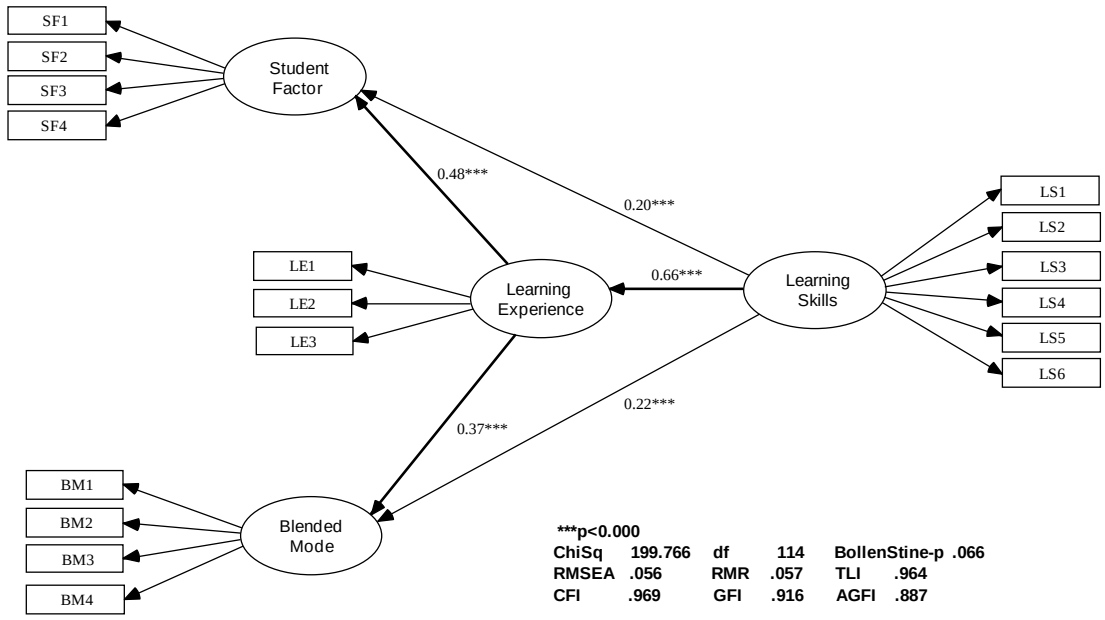

Figure 4. Biggs 3P Product (output) to Presage (input) feedback approach

Next we investigate under SEM the reverse or feedback pathways from Product to Presage, and display the feedback model as Figure 4. Again the $\chi 2/df$ ratio (1.75) and the Bollen-Stine p (> 0.066), validate excellent model fit. The RMSEA, RMR, CFI, GFI, AGFI, and TLI values all support excellent fit (Cunningham, 2008; Hair, et al., 2010).

Here, we find the learning feedback pathways to learning experience and from learning experience to blended mode delivery are stronger than their respective forward pathways, and the learning experience to student factor paths to be equivalent. This indicates that under blended mode instruction strong interactions between the learning systems constructs occurs and that the student learns strongly via experiences encountered, skills acquired and via their commitments and inputs to the learning process. It further indicated that teaching remains a vital ingredient in maximizing this participatory students learning mode.

Discussion

As all paths shown in Figures 3 and 4 are both standardized and significant ($p < 0.01$), and all have solid loadings, we now combine both, and present the four Biggs 3P teaching and learning model constructs as a combined blended mode model (complete with feedback paths) as shown in Figure 5. This comparison of the Biggs 3P Presage-Process-Product feedback pathways shows complexities surrounding the student learning processes. Under blended mode delivery we do not have a causal unidirectional teaching to student learning system as is typified by traditional face-to-face learning models. Under blended mode teaching a complex mix of significant two-way student related interactions emerges. This demonstrates learning occurs through contributions and cross-mixes emerging from the interactions and feedback between all four constructs.

Thus the student learns in blended learning environment via their input (brought to the learning arena) student factors, the teaching (instructional) mode engaged, the learning experiences encountered under this institution's teaching mode processes, and by the application of the learning skills (products) the student acquires during the learning process. Hence, it is possible to deliver greater learning, knowledge and skills transfer outcomes by better preparing the student with quality experiences most suitable for learning situation to be experienced, and to vary the type of teaching and learning interactions, along with the degree of learning engagement experiences to be encountered.

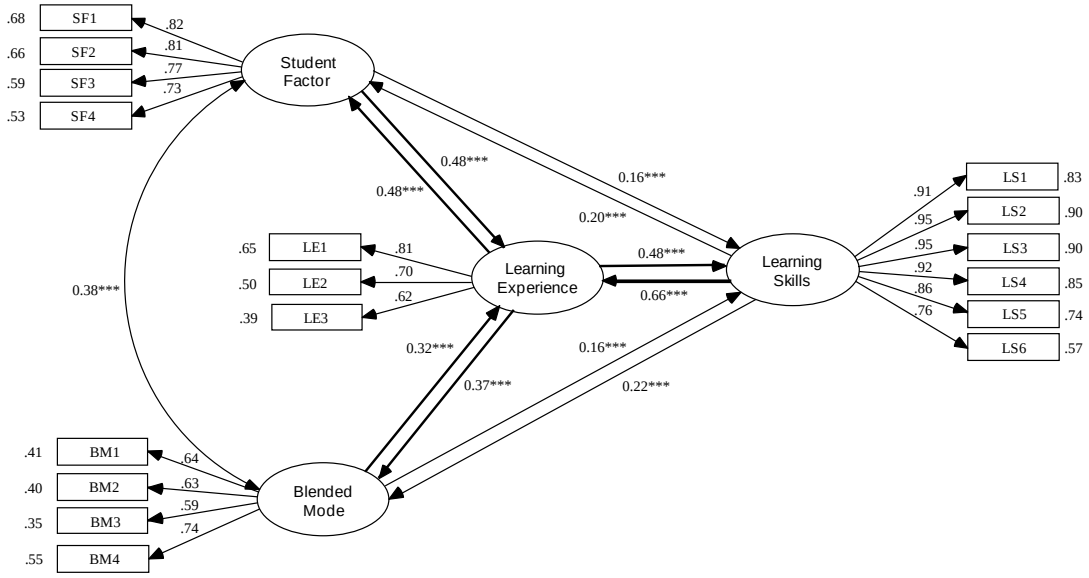

Figure 5. Forward and feedback model comparisons of Biggs 3P Presage-Process-Product

Implications of research

Current Theoretical Implications

Teaching and learning are interconnected systems. Where the student brings a high skills set of past-learned components into the learning environment higher levels of learning experiences and learning outcomes may be pursued. These can be further enhanced when blended learning approaches are engaged instead of traditional face-to-face approaches as per Hamilton and Tee's (2010) study. The Biggs 3P approach shows that higher levels of instructional engagement also deliver higher learning experiences and greater levels of learning outcomes.

Current Practical Implications

Currently learning outcomes are used by tertiary institutions to build learning programs into sets of course deliverables. This Biggs 3P study shows teaching and learning outcomes should be built upon all four constructs, and not be measured from a simple learning outcomes perspective.

Future Measurement Aspects

This Biggs approach is teaching and learning institution and business-unit specific. Teaching mode variations (traditional blended and flexible) can be assessed within an institution, and then compared to determine the net (and component) student learning effects. This can be used to build smarter, focused, institution-wide teaching delivery approaches. It can also be used to tackle gender differences in learning. For example, the data set of Figures 2 to 4 may be split into male students and female students and then separate SEM solutions may be generated. These results are tabulated as comparisons in Table 3.

Table 3 Biggs 3P presage-process-product gender comparisons

Pathways			Model Std Regression Wts		
			Full	Male	Female
Forward or Feedback Pathway			**(*p<0.05**	****p<0.01**	*****p<0.000)**
Blended Mode	→	Learning Experience	.32***	.35**	.37***
Blended Mode	←	Learning Experience	.37***	.43**	.34**
Student Factor	→	Learning Experience	.48***	.32**	.53***
Student Factor	←	Learning Experience	.48***	.42**	.48***
Learning Experience	→	Learning Skills	.48***	.48***	.49***
Learning Experience	←	Learning Skills	.66***	.64***	.68***
Blended Mode	→	Learning Skills	.16**	.16*	.15*
Blended Mode	←	Learning Skills	.22**	.22*	.22*
Student Factor	→	Learning Skills	.16**	.14*	.18*
Student Factor	←	Learning Skills	.20**	.23*	.20*
Covariance Pathway					
Student Factor	↔	Blended Mode	.38***	.61***	.25***

Both gender SEM solutions display excellent model fit (Table 4). This further validates the above combined feedback model of Figure 4. The blended mode gender-specific approach shows lower levels of male input skills (Student Factors) and higher instructor dependence or covariance (when compare to females in the same year level). This implies first year males

bring less input skills to this blended learning system. Hence, teachers seeking to maximize overall cohort learning can deploy additional (and engaging) skills-catch-up learning experiences - thereby compensating for this male input inadequacy, and so move future male learning more in-line with the capabilities of first year females.

Table 4 Biggs 3P presage-process-product gender fit

Gender	SEM Biggs Groups	Chi Sq/df	Bollen-Stine p	CFI	RMSEA	RMR	TLI
Male	Presage to Product	1.33	0.71	0.96	0.06	0.06	0.96
	Product to Presage	1.40	0.63	0.96	0.06	0.06	0.96
Female	Presage to Product	1.56	0.24	0.96	0.06	0.06	0.96
	Product to Presage	1.56	0.24	0.96	0.06	0.07	0.96

Hence, the teacher must be integrally aware of the differing needs of these two groups and should have the capabilities to vary the blended learning instructional approaches and to appropriately interactively engage with both gender cohorts. For example, the teacher may seek to maximize gender-specific student learning by building mixes of deep and surface interactive learning experiences whilst also ensuring the learning outcomes suite grows each student's knowledge, skills, capabilities and learned behaviors. Furthermore, teachers may vary their instructional approaches offering different blended learning instruments (or situations), and even extended approaches by offering flexible learning alternatives. Researches may evaluate such ideas and may also apply these across differing tertiary undergraduate or postgraduate year levels.

Future Theoretical Aspects

We believe the different learning modes outlined herein do vary the degrees of student learning experiences and learning outcomes. The above SEM approach offers great scope for institutions to analyze their teaching and learning systems, and then to improving their net-student learning strategies. There is considerable scope for additional research within each learning mode. Here the addition of latest on-line simulations, gaming and virtual reality avatar instructional situations may be assessed. Such approaches may offer new understanding that can then be embedded to support learning – even learning across distance or into international locations.

Future Management Aspects

Movement towards higher levels of blended or flexible learning requires different management approaches. Here vastly expanded data capture (along with business intelligence assessment systems) is useful in gauging and then possibly optimizing learning situations. The student's prior knowledge, input learning parameters, capabilities and gender must be determined. These can then be targeted with appropriately-selected teaching mode delivery systems – specifically chosen to maximize student interactive learning experiences whilst also delivering the student knowledge, skills, capabilities and behavioral outcomes most appropriate to their future needs.

A tertiary institution targeting prudent financial constraints may choose to establish common modularized program units across the early years of a three or four year degree, and then bolt-on higher-level, highly-targeted, interactive learning capabilities in the latter years of the degree program. These final year offerings are necessarily less pre-defined in nature, and are more expensive to deliver, and so are concentrated into those moving towards degree

completion and then into their chosen workforce arena.

Our research indicates the future directions of tertiary teaching and learning systems will increasingly become more interactive and more student-determined. This implies management must accept a role in providing greater student and teacher support and in offering their teachers the resources they will require to generate and retain educational leadership.

Conclusion

This first year tertiary student SEM approach builds understanding of blended learning The Biggs's 3P teaching and learning systems model displays significant two way interactions between each of its presage, process, and product constructs and validates this Biggs approach as a dynamic interactive learning system. The student learning processes occurs through teacher contributions, mixed with learning interactions and feedback systems. Greater learning, knowledge and skills transfer is possible when students are suitably pre-prepared/pre-skilled for the ensuing learning experiences and the variety of teaching/learning interactions to be encountered.

SEM elucidates that first year tertiary students under blended learning environments perceive their student learning outcomes to be delivered as an integrated, continuous feedback teaching and learning system. This teaching and learning mix likely varies under differing combinations of (or even components within) the instructional mode approaches adopted. As separate first year tertiary student groups, males and females each display differences in their respective blended teaching mode outcomes, and so should be taught using different approaches with first year males experiencing a more teacher-engaging interaction, and females experiencing higher skills engaging learning.

SEM also offers researchers a way to expand their knowledge and understanding of the teaching and learning nexus, and to further understand both student-perceived learning experiences and learning outcomes. Studies deploying highly interactive learning experience devices such as simulations, games and virtual world avatar instruction along with virtual reality learning tools may be tested under this approach and if deemed appropriate, then selectively added to the tertiary institution's competitive, value adding, teaching strategy.

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