A reciprocal test of perceptions of teaching quality and approaches to learning: A longitudinal examination of teaching-learning connections.

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ABSTRACT

Biggs' Presage-Process-Product (3P) model provides a flexible model for testing hypotheses about intra-psychic and contextual effects on student learning processes and outcomes; however, few empirical studies have effectively tested the longitudinal and reciprocal effects implied by the model. The current study provides an empirical test of theorized reciprocal relationships operating over time implied by the 3P model between perceived teaching quality and approaches to learning. The current study examines a longitudinal sample of Japanese university students (*n*=1348; female=404) from 18 degree programs. Data from a reciprocal latent model were analysed using structural equation modeling. Modeling identified significant reciprocal effects between teaching quality and deep approaches to learning. Deep (positively) and surface (negatively) predicted annualised GPA (moderate and large effects respectively). Consistent with a systems theory perspective on teaching and learning, longitudinal results supported hypothesised reciprocal relationships between perceptions of teaching quality and approaches. Implications for theory and practice are discussed.

Student learning research within higher education has matured during the past decade. The burgeoning nature of this field is marked by its salient transition from exploratory to confirmatory studies, employing and testing *a priori* models such as Biggs' 3P model (Presage, Process, Product; Biggs, 1978, 1985, 1993).

==================Figure 1 ABOUT HERE=========================

This growing body of research has employed increasingly sophisticated analytical approaches such as path analysis (Richardson, 2006) and structural equation modelling (Ginns, Martin, & Papworth, 2013), thereby testing longstanding theoretical connections between teaching and learning (e.g., Richardson, 2006). In addition to the growing sophistication of the field, recent meta-analyses (e.g., Richardson, Abraham, & Bond, 2012; Schneider & Preckel, 2017) have signaled both the current state of the field and important directions for future research: "Further prospective studies testing multivariate models with large samples are needed. Ideally, these would include applicants (before arrival) and first-year students followed up through their student careers." (p. 376). The current study aimed to build upon the above studies by employing sophisticated longitudinal modeling across one academic year at university. Thereby, we examined the predictive relationships between students' approaches to learning and their achievement, and tested the reciprocal relationships between teaching and learning suggested by the 3P model and supported by past cross-sectional research (Richardson, 2006).

The 3P model of student learning has played a substantial role within Student Learning Theory (i.e., a student-centred theory which includes approaches to learning and perceptions of the learning environment: SLT; Biggs, 2003; Ramsden, 2003) as a flexible model of the interface between motivation and processing, as well as the interaction between the students' perceptions of the learning environment, studying/learning behavior and learning outcomes. The model posits that students adopt qualitatively different approaches to their studies as a function of intra-personal presage factors (e.g. prior ability; socioeconomic status) and contextual presage factors (e.g. perceptions of the quality of teaching, as well as assessment and workload requirements). The intuitive appeal of the surface and deep approaches to learning dichotomy, and intrinsic connections between deep learning and students' integrated understanding has led to these concepts being used within many university instructors' curricular goals and day-to-day language (Pintrich, 2004). Institutions have also implemented SLT's model of the teaching-learning environment as a means of understanding the university experience in countries such as Australia (Barrie, Ginns, & Prosser, 2005; McKinnon, Walker, & Davis, 2000). Informed by systems theory, the 3P model incorporates the potential for feedback loops (see Figure), which by necessity operate over time. There are, however, relatively few longitudinal tests of the model, representing a major empirical gap in SLT. The current study aims to address this gap by employing a cross-lagged panel approach.

The current study was undertaken within the poorly understood context of Japanese higher education, which while perhaps the most mature system of higher education in Asia, is still working to clearly situate itself internationally. It is a context wherein student learning research might support ongoing national reforms aiming to improve the student experience. In the following sections we review the key components of SLT: approaches to learning and perceptions of the learning environment. This review is followed by a description of the 3P model and its organizing role for the model tested in the current study.

Student Learning Theory

Approaches to Learning. SLT arose initially from experimental research in Sweden during the 1970s. Ference Marton and Roger Säljö undertook a series of experiments which developed into a program of research into the interface between expected future output and how individuals processed text (beginning with Marton, 1975; Marton & Säljö, 1976a, 1976b). As the field of SLT matured, researchers began adapting these initial concepts to the context of adult learning (Biggs, 1978; Entwistle, Hanley, & Hounsell, 1979). The field began firmly seated in the psychological literature of the time, focusing on the cognitive processing of content. Over time, however, a steady conceptual shift led to a change in terminology (see Richardson, 2015), from processing, which is psychological in nature, to the commonly used concept of approaches to learning (Marton & Säljö, 1984). The latter is a construct representing how intention and processing together interact with the demands and support that the learning environment is perceived as providing. Approaches to learning are commonly operationalised as deep and surface approaches. Deep approaches are often described as the intention to learn the material for its own sake and processing that seeks connections and is elaborative. Surface approaches on the other hand, are often described as the pairing of intentions such as aiming to do the minimum necessary for future assessment, with cognitive processing that is explicitly focused on memorizing discrete chunks of information.

The Learning Environment. While initial experimental research applied relatively simple manipulations of the learning environment to gauge their effect on learner processing (Marton, 1975; Marton & Säljö, 1976a, 1976b), later qualitative and then quantitative research went on to construct a detailed model of how students perceive university departmental learning environments (Entwistle & Ramsden, 1983; Ramsden, 1979; Ramsden & Entwistle, 1981). The first inventory arising from this research programme was the Course Perception Questionnaire (Entwistle & Ramsden, 1983; Ramsden & Entwistle, 1981) which, after considerable research and feedback from the field (e.g., Parsons, 1988), resulted in the Course Experience Questionnaire (Elphinstone, 1989; Ramsden, 1991). The Course Experience Questionnaire has been employed in part or in whole by researchers internationally (e.g., Bryne & Flood, 2003; Diseth, 2007; Ginns, Prosser, & Barrie, 2007; Law & Meyer, 2011; Fryer, Ginns & Walker, 2012; Fryer, Ginns & Walker, 2014) and been generally found to have reasonable reliability and construct validity. The Australian government currently employs portions of the Course Experience Questionnaire as an outcome measure of university students' tertiary experience (McKinnon et al., 2000).

Reviews of the literature employing the Course Experience Questionnaire (Lizzio, Wilson, & Simons, 2002; Wilson, Lizzio, & Ramsden, 1997) have suggested that the Good Teaching (Presage) and Generic Skills (e.g., generalised skills for teamwork, addressing difficult problems and developing plans; Product) constructs are key correlates of both deep and surface approaches to learning. The Good Teaching scale assesses key elements of students' instructional experiences: being motivated, receiving feedback, and explanations of materials. The Generic Skills scale assesses the degree to which students perceive that their analytical, team/individual and problem solving skills have improved over the course of the academic year. As such, these are essential variables for a panel study of the longitudinal main predictive connections, beginning with the learning environment (presage) predicting approaches learning (process), and both of these Ps predicting outcomes like Generic Skills development and achievement (product).

The 3P Model. Biggs' (1993) Presage, Process, Product model (adapted from Dunkin & Biddle, 1974) is a flexible framework for organizing and then testing student learning research questions. Presage variables are generally divided into two components, which are encompassed by the learning environment and the individual. The learning environment presage components are aspects such as assessment, workload, and teaching methods. The student-centered presage variables are relatively stable elements such as student characteristics: e.g., gender, personality, values, and motivational orientations students bring with them to an environment.

The Processing stage of the 3P model includes all of the strategies students employ to actually learn the content presented by the environment; approaches to learning are typically positioned at this stage. Finally, the Product stage includes the outcomes students achieve as a result of their learning. The 3P model is based on the idea that in addition to main predictive effects (direct and indirect) proceeding logically left to right (presage to process to product), feedback relationships exist between each stage of the model: outcomes affecting future process and presage variables, and process variables potentially affecting some presage variables (see Figure 1 in Biggs, 1993). While theoretically comprehensible, this complex reciprocal model has not yet been satisfactorily tested.

Modeling the relationship between the academic learning environment and learning strategies. From the experimental inception of Student Learning Theory (Marton & Säljö, 1976a, 1976b) and through its qualitative expansion to include students' broad perceptions of departmental learning environments (Entwistle & Ramsden, 1983; Ramsden & Entwistle, 1981) there has been an implicit understanding about the direction of the relationship between the strategies and environment. This is clearly presented in the title of Ramsden’s (1979) seminal paper “Effects of academic departments on students' approaches to studying”. Biggs’ (1993) 3P model suggested that the relationship is in fact bi-directional or reciprocal; that is, “variations in students’ perceptions of the academic environment can give rise to variations in their study behaviour, but … variations in their study behaviour can equally give rise to variations in their perceptions” (Richardson, 2006, p.870). While implied by Biggs’ (1993) 3P model, an empirical test of this reciprocal hypothesis was not undertaken, however, until Richardson’s (2006) detailed correlational investigation. Richardson employed path analysis to test the reciprocal nature of the relationship between the learning environment (Course Experience Questionnaire) and students’ approaches to learning (Approaches to Study Inventory/Revised Approaches to Study Inventory). Richardson’s results suggested that a small bi-directional, causal relationship was feasible between students’ perceptions of the learning environment and students’ learning strategies. Richardson therefore concluded that if student learning is to be enhanced then both students’ learning strategies and their perceptions of the academic learning environment should be addressed.

Despite the careful series of analyses undertaken by Richardson (2006), his conclusion must be interpreted with care, particularly because Richardson’s empirical test lacked one of the fundamental research design components necessary for drawing even preliminary causal conclusions: temporal ordering of constructs (Tracz, 1992). In addition to this limitation, all variables employed by Richardson were mean-based rather than latent. Mean-based or observed variables treat each survey item as equally contributing to the construct measured, whereas latent variables formed through Structural Equation Model-based measurement allow each survey item to accurately contribute to the construct. Pedhazur (1982) suggested that error-free variables are necessary for tests of non-recursive models.

More recent studies have examining the presage-process connections (e.g., Platow, Mavor & Grace, 2013), process-product relationships (e.g, Clinton, 2014; Yonkers, 2011), and all 3Ps (Karagiannopoulou, & Milienos, 2015). While highlighting the importance of 3P connections, these studies have not filled this gap in our understanding regarding the reciprocal longitudinal connections the 3P model was founded on.

Students from countries with a Confucian historical background. Considerable research has been undertaken in and near Hong Kong investigating what has come to be called the “Asian Learner” (for an extensive discussion see Watkins & Biggs, 2001). The crux of this issue lies in findings from many qualitative and quantitative studies suggesting that some Chinese students attempts to memorise and understand may be linked (e.g., Kember & Gow, 1990). This idea is counter to early conceptions of surface and deep approaches as being orthogonal. In a qualitative study conducted with Mainland Chinese students Marton, Wen, and Wong (2005) provided a concise explanation, stating that students used memorisation and understanding in tandem. While students could parse the two ideas, they also perceived them as one strategy.

Recent quantitative research employing parts of the CEQ and Study Process Questionnaire in the context of Hong Kong (Webster, Chan, Prosser, & Watkins, 2009) and the complete CEQ and R-SPQ-2F in mainland China (Yin, Wang & Han, 2015) have highlighted an interesting and seemingly related phenonmenom. Results from both studies suggest that Good Teaching positively predicted aspects of students’ surface approaches to learning. This is contrary to considerable similar research undertaken within Western tertiary institutions (e.g., Lizzio, Wilson, & Simons, 2002).

Quantitative findings from research in Japan (Fryer et al, 2012, 2014, 2016; Fryer, 2013, 2017) observed positive correlations between surface and deep approach measures, suggesting that some aspects of the "Asian Learner" phenomenon may extend to Japan. However, a strict empirical test of the relationships between key elements of the learning environment and students' approaches to learning is necessary to integrate with past research and meaningfully push the discussion forward.

The current study. To support a longitudinal test of core elements of the 3P model, the current study tested auto- and cross-lagged predictive effects between perceptions of teaching quality and surface/deep approaches to learning (Time-1) as predicting the same constructs nine months in the future (Time-2). In addition, the predictive effect of these three variables on year-end Generic skills (Time-1 to Time-2), while accounting for Time-1 Generic skills was also tested. Finally, the predictive effect of all Time-2 variables on students' annualised Grade Point Average (GPA) was also examined. The Good Teaching and Generic Skills components of the CEQ were selected for use in the current study for three reasons. The first is that these represent important presage and product components of the 3P model (for a similar use of these constructs see Wilson, & Fowler, 2005). The second reason is specific to Good Teaching, which has been demonstrated to explain the bulk of the variance in factor analyses of the CEQ and have a substantial amount of shared variance with students' approaches to learning (Wilson, Lizzio and Ramsden, 1997). The third reason is due to the robust (latent) construct validity that only these two constructs (from the CEQ) demonstrate. In the case of latent modelling (rather than path analysis with mean-based variables), as we pursue in the current study, robust convergent and divergent construct validity is essential (see Fryer, Ginns & Walker, 2013).

We propose that longitudinal modeling of this kind is essential to test properly the complex direct and reciprocal feedback relationships the 3P model predicts unfold over time. These relationships were estimated using latent variables in a cross-lagged simultaneous regression model (Huck, Cormier, & Bounds, 1974).

Aims and Hypothesis

The chief aim of the current study was to examine the validity of longstanding theory and empirical research into the relationship between students' perceptions of the learning environment, their approaches to learning, and two key outcomes: Generic Skills and annualized GPA. The current study aimed to build upon previous cross-sectional and longitudinal studies primarily modeling observed variables by employing a longitudinal, latent panel design across two waves of approaches to learning and perceptions of the learning environment data (Times 1 and 2) and learning outcomes for the same academic year.

This study hypothesized that students' perceptions of teaching quality, after accounting for prior approaches to learning, would predict future approaches to learning (Hypothesis 1; Richardson, 2006). Reciprocally, approaches to learning were expected to predict future perceptions of teaching quality (Hypothesis 2; Richardson, 2006). The possibility of reciprocal relationships between perceptions of the teaching environment and approaches to learning can thus be assessed by examining the relative magnitude of "diagonal" pathways in the cross-lagged model, i.e., in Figure 1, pathways across Time 1 to Time 2 for Deep/Surface Approaches to Good Teaching, and from Good Teaching to Deep/Surface Approaches across the same period. Statistically reliable diagonal pathways of similar magnitude would provide evidence of a reciprocal relationship between perceptions of the teaching environment and approaches to learning. Approaches to learning were also expected to predict both future Generic Skills at Time-2 (Hypothesis 3; Wilson, Lizzio & Ramsden, 1997) and Annualized GPA at the end of the Year (Hypothesis 4; Wilson, Lizzio & Ramsden, 1997). Students' perceptions of teaching quality were expected to have a separate positive effect on Generic Skills at Time 2 (Hypothesis 5; Wilson, Lizzio & Ramsden, 1997) and Annualized GPA at the end of the Year (Hypothesis 6; Wilson, Lizzio & Ramsden, 1997). Figure 2 presents the hypothesised auto- (a variable predicting itself in the future) and cross-lagged (a variable predicting a different variable in the future) effects described in this section.

=====================Figure 2 ABOUT HERE===========================

Methods

Sample

The sample for the current study consisted of first-year and second-year students *n* = 1348 (female = 404, male = 944) studying within 18 degree programs at one private mid-sized (approximately 10,000 students) university in Western Japan. Participating students were informed of the larger research project during an orientation for university classes. Students were then invited to complete a survey during a compulsory foundation course at two times during one academic year. A cover sheet described the purpose of the survey within the larger project, explained that participation was voluntary, and noted that the survey results were unrelated to course grade.

Instrument

Scales from two previously validated SLT instruments were employed (Fryer et al., 2012; Fryer, 2013). Trigwell and Ashwin's (2006) approaches to study instrument, adapted from the Approaches to Study Inventory (Entwistle & Tait, 1995), was modified and piloted for use in the current study. Initially, translation and back-translation were undertaken followed by small-scale piloting with focus-group feedback from students. Finally, large-scale piloting resulted in a 10-item measure of deep (five items) and surface (five items) approaches to learning. The highest loading item from each scale is presented in Table 1.

=======================TABLE 1 ABOUT HERE========================

The learning environment was measured by two scales from the Course Experience Questionnaire (Elphinstone, 1989; Ramsden, 1991). Responses to the Good Teaching scale consistently account for a substantial amount of variance within students' approaches to learning (e.g. Richardson, 2005, 2010), while Generic Skills are a measure of what students feel they have gained from the university experience. These two self-report measures of students' perceptions of the learning environment represent presage and product components for the current study's model.

Grade Point Average

While the latent measure of students' perceptions of generic skills gained during an academic year at university are useful, these self-reported outcomes should be balanced with observed outcomes of student learning. Perhaps the most widely recognised outcome variable of a university education is Grade Point Average (GPA). Richardson et al.'s (2012) meta-analysis of correlates of GPA in higher education found small meta-analytic correlations between approaches and GPA (deep approach: r = .14, 95% CI .09 ─ .18; surface approach: r = -.18, 95% CI -.25 ─ -.10), providing benchmarks for the current study. Annualised GPA for the academic year was obtained from the university's registrar for the students involved in the current study and is included in modeling along with Generic Skills as a learning outcome. GPA is the average of all grades from that academic year, and ranges from 0 to 4.33.

Approaches to Modeling and Analysis

The research design for the current study aimed to assess a model of relations between presage, process and product variables unfolding over time. To achieve this aim, longitudinal data were analyzed employing latent simultaneous regression. M*plus* 7.0 (Muthén & Muthén, 1998-2013) was employed for all structural equation modeling. The Maximum Likelihood Robust (MLR) estimator, which is robust to non-normality (Boomsma & Hoogland, 2001), was selected for analysis of the covariance matrix (the default matrix for analyses performed by M*plus*). The finalized data set for the current study had less than 2% missing data at each time point. Missing data were coded and then accounted for by Full Information Maximum Likelihood estimation within M*plus*. The "cluster" command within M*plus* was employed to account for the nested nature of the data: participating students studied within 18 different degree programs across seven faculties. Scale reliability was assessed with Raykov's Rho (Raykov, 1997). Raykov's Rho has been demonstrated to be a more accurate assessment of reliability for scales with a non-homogenous set of items (Raykov, 1998). This is particularly relevant for present study, which seeks measure broad concepts such as teaching quality and generic skills, and approaches to learning which are a pairing of intention and processing.

Model fit was assessed based on Root Mean Square Error of Approximation (RMSEA; Browne & Cudeck, 1993) with values < .08 and < .05 held to indicate acceptable and good fit respectively, and the Confirmatory Fit Index (CFI) with values > .90 and > .95 held to indicate acceptable and good fit respectively (Marsh, Balla, & McDonald, 1988). Beta (β) coefficients were used for the interpretation of structural equation modeling results from the current study. We followed Keith's (2015) suggested guidelines for interpretation of beta coefficients in research on influences on learning, betas below 0.05 are interpreted as “too small to be considered meaningful”; those above 0.05 are considered “small but meaningful”; those above 0.10 are considered “medium”; and those above 0.25 are considered “large”.

In order to establish the discriminant validity of all variables, latent analyses began with a confirmatory factor analysis of all variables modeled. For all latent modelling, identical items (Time-1/Time-2) and constructs measured at the same times were allowed to co-vary. Following configural modelling, a test of invariance for the longitudinal variables was undertaken. For this test of invariance, comparisons of CFI and RMSEA (Time 1 and Time 2) were relied upon to assess the adequacy of the invariance between the two time points (Marsh, Nagengast, & Morin, 2013). Under this approach to invariance testing, the assumption of invariance is tenable if CFI does not change more than .01 and the RMSEA increases by less than .015 for the invariant model (Chen, 2007).

Following these initial tests, a cross-lagged panel approach to modeling was undertaken as it is the most effective means of exploiting the time-based precedence of variables made possible by the current study’s prospective research design. Latent variables were modelled based on latent variable-item pairings tested in the above-mentioned confirmatory factor analysis; path coefficients are thus purged of measurement error in latent factors. Huck, Cormier, and Bounds (1974) argue cross-lagged panel analysis is a powerful tool for examining “natural sequences” (p.374), thereby supporting understanding of the potential causal connections between constructs modelled. For both the mass confirmatory factor analysis and the latent simultaneous model test, error covariances were modeled for identical items across waves of data and between surface and deep approaches to learning, as well as Generic Skills and Good Teaching cross-sectionally at each Time 1 and Time 2..

Results

The results for the current study are reviewed in three parts: descriptive (Table 3), correlational (Table 3), and finally simultaneous regression modeling (Figure 3). Our findings indicate that on average, students entered university chiefly relying on surface approaches to learning and the pattern persisted across the year-long study in the current context. At Time-1 (after 4 weeks at university) students generally perceive the quality of teaching to be high but these perceptions dropped through to Time-2 (4.01- 3.86, $p < .01$, t-value = -6.88, d =-.19). Students' perceptions of the generic skills gained from at university similarly drop significantly between Time-1 and Time-2 (3.92 - 3.75, $p < .01$, t-value =-8.41, d = -.23). The reliability for all latent variables, except surface approaches to learning (Time-1 and Time-2) was acceptable (i.e., > .70; Devellis, 2012). Surface approaches to learning have a history of poor reliability, which J. T. E. Richardson (1994) has attributed to the differences between deep and surface approaches to learning. Richardson suggests that deep approaches to learning are similar across cultures, as this approach simply describes an individual engaging in course content with the purpose of understanding. Surface approaches to learning, however, are a type of engagement that reflects the expectations/demands of the learning environment, which is culturally specific.

The mass Confirmatory Factor Analysis (configural test) of all modeled variables resulted in acceptable fit and the test of invariance for the longitudinal variables resulted in fit which was within the invariance criteria outlined previously. The fit results are presented in Table 2 for easy comparison.

=======================TABLE 2 ABOUT HERE===================

The correlation matrix, means and standard deviations for all latent and observed variables are presented in Table 3.

=======================TABLE 3 ABOUT HERE====================

While inconsistent with Western conceptions of approaches to learning, the pattern of relationships observed between surface and deep approaches to learning is consistent with past research in the context of Japan (r = .30; Fryer et al., 2012) and in high schools in Hong Kong (r = .33; Kember, Biggs, & Leung, 2004). Despite this somewhat unusual pattern of positive relationships between surface and deep approaches to learning, their respective relationships with Good Teaching and Generic Skills indicate that deep approaches to learning are clearly aligned with perceptions of quality teaching and the acquisition of generic skills. Surface approaches to learning also exhibited significant, but very small relationships with both variables. Consistent with Richardson et al. (2012), relatively small positive and negative relationships with achievement were observed for deep and surface approaches respectively.

Fit for the hypothesised structural model was acceptable given its complex nature (Table 2). The resulting model is presented with all tested effects in Figure 3. The relationships presented in Figure 3 are generally consistent with the correlational results. As expected, large auto-lagged effects were observed between Times 1-2. Cross-lagged results indicated that Good Teaching (Time 1) had significant positive effects on Time 2 deep approaches to learning (Hypothesis 1; β = .13). Deep approaches (Time 1) predicted Good Teaching at Time 2

(Hypothesis 2; β = .11). Across Time 1 to Time 2, surface and deep approaches (Time 1) predicted Generic Skills (Time 2; β = -.12, β = .13 respectively; Hypothesis 3). Finally, first-year GPA was significantly predicted by surface approaches and deep approaches to learning at Time 2 (Hypothesis 4; β = -.30, β = .21).

The variance explained in deep approaches to learning, surface approaches to learning, Good Teaching and Generic skills was moderate at Time 2 (R^2 = .37, .28, .23, and .37 respectively). The combined variance in GPA explained by the model was small (R^2 = .10).

====================Figure 3 ABOUT HERE=====================

Discussion

The current study examined the latent longitudinal predictive effects of approaches to learning and perceptions of teaching quality on future Generic Skills and GPA. Good Teaching predicted future deep approaches but failed to predict Time 2 surface approaches to learning (Hypothesis 1). Reciprocal effects from approaches to learning to Good Teaching were observed from Time 1 deep approaches to learning to Time 2 Good Teaching (Hypothesis 2). From Times 1-2, deep approaches to learning significantly predicted Generic Skills (Hypothesis 3). Students' approaches to learning positively (deep) and negatively (surface) predicted GPA (Hypothesis 4). Good Teaching was the only Time-1 variable not to significantly predict future Generic Skills (Hypothesis 5). Good teaching failed to significantly predict GPA (Hypothesis 6).

Theoretical implications

Reciprocal relationships. Consistent with past theory (Biggs, 1993) and cross-sectional empirical findings (e.g., Richardson, 2006), the predicted reciprocal relationships were found between Time 1 Good Teaching and Time 2 Deep approach, and Time 1 Deep Approach and Time 2 Good Teaching. Both pathways were of similar magnitude (β = .13 vs. β = .11, respectively). While the magnitude of reciprocal pathways between Good Teaching and Surface approach were similar (T1 Good Teaching $\rightarrow$ T2 Surface approaches, β = .06; T1 Surface approaches $\rightarrow$ T2 Good Teaching, β = .07), these pathways were not statistically reliable, restricting interpretation of this set of results. The pattern of significant relationships involving Good Teaching and Deep approach nonetheless indicates that the reciprocal relationships hypothesised within the 3P model hold for these variables. While the replication of the current modeling within a similarly stringent design and analysis is crucial, these preliminary results support the systems theory approach to theoretically modeling effects within a learning environment.

Future Deep Approaches: Perceptions of teaching quality and prior approaches to learning. Modelling in the current study indicated that while the quality of the teaching that students experience is important for future learning strategies, students' prior strategies are also powerful predictors. Students already pursuing a deep approach are more likely to continue to pursue it. Furthermore, despite the positive correlation between the two approaches, increased surface approaches predicted decreased deep approaches nine months in the future. Clearly students employ both approaches and in this context using more of one is related to an increased use of the other, at least cross-sectionally. Extended use of surface approaches, however, has a deleterious effect on students' pursuit of deep understanding. In the current study, the reverse effect, however, was not significant suggesting that deep approaches today do not support less surface approaches in the future.

Predicting outcomes. Deep and surface approaches to learning predicted GPA; and consistent with theory, the predictive effects were strongly contrastive. As with past meta-analyses (Richardson et al., 2012; Watkins, 2001), approaches to learning were small to medium correlates of GPA. Consistent with suggestions by researchers in this field (e.g., Pandey & Zimitat, 2007), the smaller predictive effect of deep approaches to learning for GPA in this context might be the result of poor alignment between the assessment structures and the nature of deep learning.

After accounting for initial generic skills development (Time-1), year-end self-reported generic skills were predicted by both surface (negatively) and deep (positively) approaches with small effects. These finding support the longstanding conception that the quality of student learning is a significant predictor of outcomes beyond straightforward course achievement.

Applied Implications

The role and support of deep approaches to learning. Despite the consistent positive relationships between deep and surface approaches to learning at each time point, their lagged outcomes contrasted strongly, as theory and past empirical research would suggest (Marton & Säljö, 1984). In the current context, deep approaches to learning was a medium predictor of GPA and small predictor of self-reported Generic Skills outcomes. While GPA might be our best observed outcome of higher education, strong analytical, teamwork/individual and problem solving skills are also important for modern societies (e.g., Australia; HEC, 1992), including Japan. In addition to the importance of teaching quality for promoting deep approaches to learning, students' surface approaches to learning were also an important factor. While it seems natural that a student pursuing surface approaches is less likely to be pursuing deep approaches, to our knowledge, this relationship has not been noted. Contrary to the Asian Learner concept, which suggests the two approaches might be used cooperatively or in tandem (e.g. Marton, Wen & Wong, 2005), in the current context, surface approaches negatively predicted future deep approaches. Together these findings suggest that rather than seeking to induce deep approaches, trying to reduce surface approaches might be a clear way forward on the issue of improving both learning and outcomes. A recent longitudinal person-centered study has suggested that in some cases, the current quantity of students' self-reported surface approaches is a good indicator of movement to a more adaptive (greater deep and less surface approaches to learning) subgroup of students in the future (Fryer, 2016).

Limitations and Future directions

Despite the current study's longitudinal research design, the relationships investigated in this study were correlational, limiting clear causal implications. In addition, this study was undertaken at one Japanese university and the results may be idiosyncratic to either Japan or the institution. Replications of this study in other contexts (Japan and internationally) should employ the same latent, longitudinal design.

A further limitation to the current study is that it has employed students' self-reported approaches to learning, rather than students' actual approaches to learning. The gap between the two must be taken into consideration when interpreting the results from this and all studies based on self-reported variables.

While not the focus of the current study, our results highlights the limitations of research utilising the 3P generally, and approaches to learning specifically, to explain student achievement. As with any regression-based research findings, and particularly those resulting in low variance explained, the constructs not modelled present a gap in our understanding. Future studies in this area might consider including constructs identified in recent meta-analysis as being particularly strong correlates of achievement during higher education (e.g., Schneider & Preckel, 2017).

Finally, the longitudinal relationship between surface approaches and deep approaches deserves more attention. The potential danger of students' current surface approaches to learning for future deep approaches to learning has not to our knowledge been highlighted by the SLT literature to this point. We therefore suggest further research in this area. We suggest the use of intensive longitudinal latent designs to test the current findings and then to better examine the possible long-term implications. We also suggest further research in the broader Asian context utilising the 3P model as an organisational framework for latent longitudinal studies.

Conclusions

This study employed a panel research design to provide a longitudinal test of SLT's 3P model, focusing the relationship between perceptions of teaching quality and learning strategies. Our findings suggest that after accounting for prior variance, a reciprocal relationship between approaches to learning and teaching quality was significant. Despite the "Asian Learner"-like relationships between deep and surface approaches to learning, these approaches had clear adaptive (predicting higher achievement and more Generic Skills acquisition) and maladaptive (predicting lower achievement and fewer Generic Skills acquisition) effects consistent with past Western theory and research. Two findings which were signals of concern and hope respectively in the current study are as follows: 1) increased surface approaches, in addition its negative (large) predictive effect for achievement, predicted decreased deep learning; 2) increased deep approaches positively (medium) predicted perceptions of teaching quality, Generic Skills and GPA. These findings point towards the danger of surface approaches, beyond diminished learning outcomes, and towards the essential role of deep learning for outcomes and the learning experience. In conclusion, the current study's longitudinal validation of the hypothesised reciprocal relationship between teaching quality and approaches to learning supports Richardson's (2006) suggestion that if we are to improve the quality of student learning, that the learning environment and students' strategies must be addressed together.

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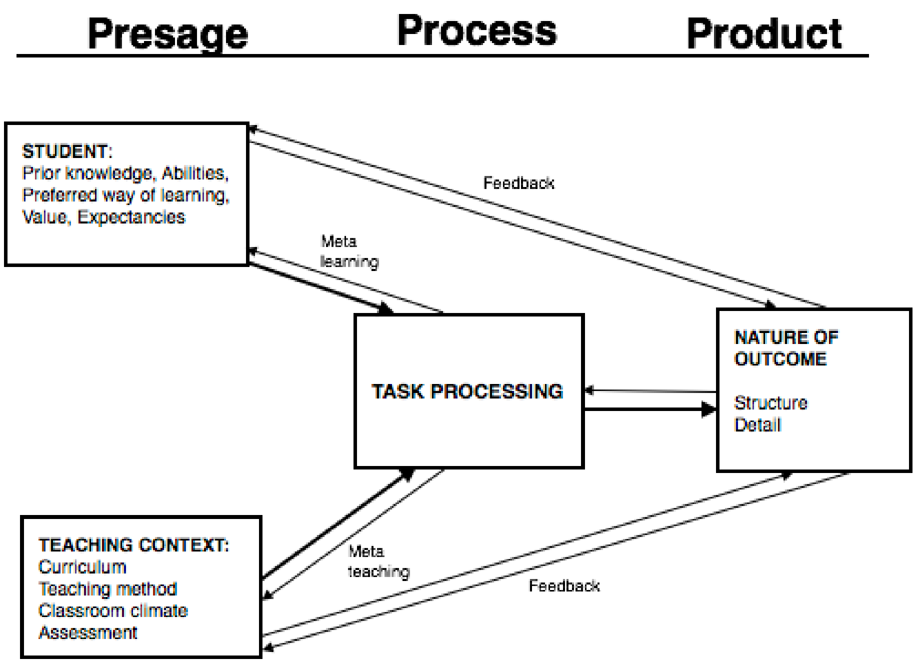

Figure 1. Presage, Process, Product Model from Biggs (1993)

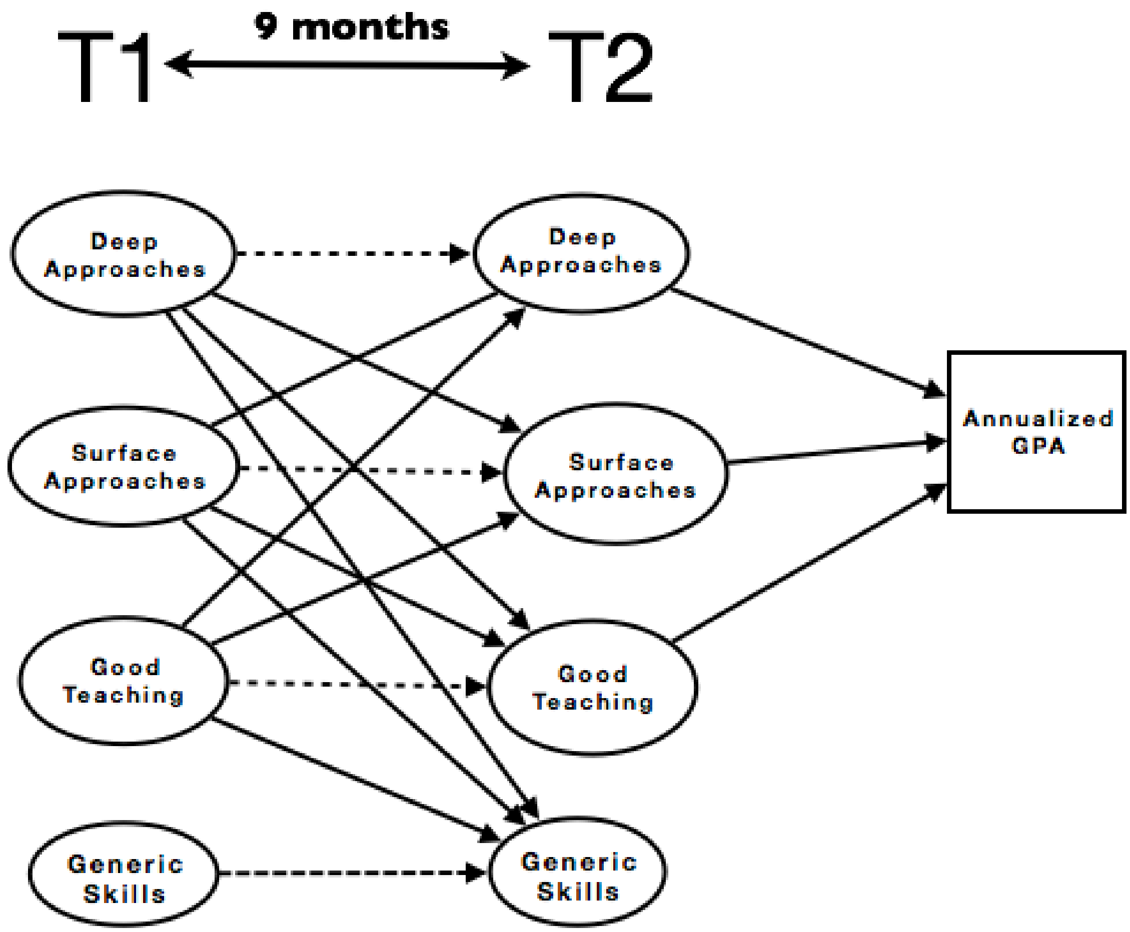

Figure 2. Hypothetical Panel Structural Equation Model

Table 1.
Highest Loading Item for each Scale

Scale	The two highest loading item
Good Teaching	1) Staff here put a lot of time into commenting on students' work 2) The teaching staff of this course motivate students to do their best work
Generic Skills	1) My courses have helped me to develop my problem-solving skills 2) My courses have sharpened my analytic skills
Deep Approaches to Learning	1) Ideas in course books or articles often set me off on long chains of thoughts of my own 2) When I am working on a new topic, I try to see how all the ideas fit together
Surface Approaches to Learning	1) I often worry about whether I'll ever be able to cope with the work properly 2) I concentrate on learning just those bits of information I have to know to pass

Table 2.
Configural, Invariance and Longitudinal Model Test Results

	CFI	RMSEA	90% C.I.	χ^2
Configural Model	.93	.034	.032-.036	1833.690
Invariance Model	.93	.033	.032-.035	1850.273
Longitudinal Model	.93	.034	.032-.036	1862.489

Table 3.
Correlations, Means, Standard Deviations, and Raykov's Rho for all Variables Modeled

	Surface Approaches T-1	Deep Approaches T-1	Generic Skills T-1	Good Teaching T-1	Surface Approaches T-2	Deep Approaches T-2	Generic Skills T-2	Good Teaching T-2
Surface Approaches T-1								
Deep Approaches T-1	.36**							
Generic Skills T-1	.11*	.59**						
Good Teaching T-1	.11**	.40**	.84**					
Surface Approaches T-2	.56**	.16**	.06	.11**				
Deep Approaches T-2	.07**	.57**	.40**	.33**	.35**			
Generic Skills T-2	-.05	.37**	.53**	.46**	.12**	.66**		
Good Teaching T-2	-.05	.37**	.53**	.46**	.12**	.66**	.81**	
GPA	-.07*	.14**	.13**	.10**	-.23**	.11**	.12**	.06**
Raykov's Rho	.64	.78	.79	.87	.65	.81	.85	.89
Mean	3.88	3.53	3.92	4.01	3.82	3.48	3.75	3.86
SD	.64	.65	.67	.69	.68	.69	.72	.80

Note: ** = $p < .01$, * = $p < .05$. SA_T1/T2 = Surface Approaches Time 1/2; DA_T1/T2 = Deep Approaches Time 1/2; GT_T1/T2 = Good Teaching Time 1/2; GS_T1/T2 = Generic Skills Time 1/2; GPA = Grade Point Average Year 1

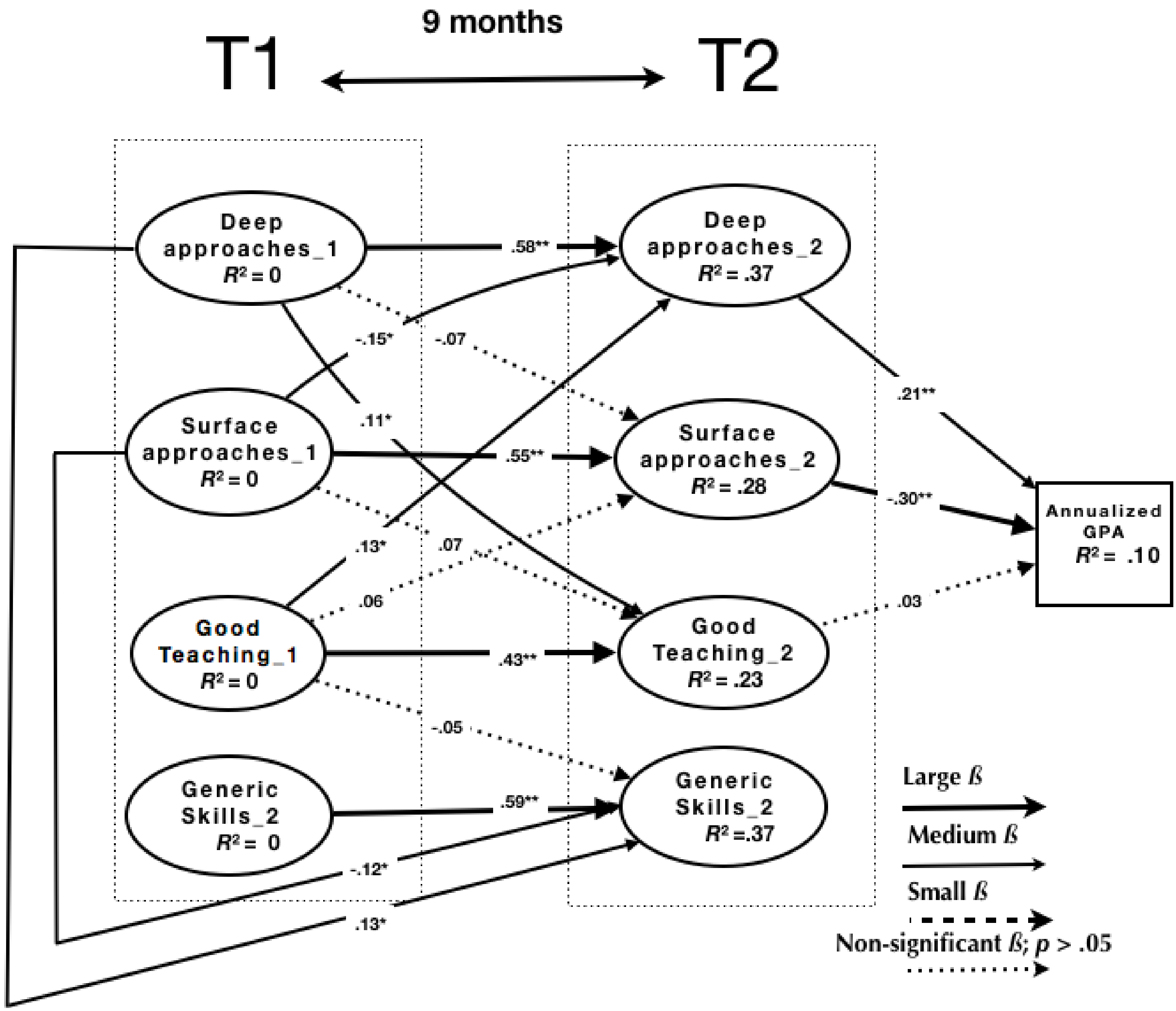

Figure 3. Finalized Panel Model.
Note: Significant β's (** = $p < .01$, * = $p < .05$). No small effects were present in the final model.