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Academic self-concept, perceptions of the learning environment, engagement, and learning outcomes of university students: relationships and causal ordering

Jian-Peng Guo[1] **· Ling-Yan Yang**[2] **· Juan Zhang**[3] **· Ya-Juan Gan**[4]

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Abstract
Two studies were conducted to examine the relationships among university students' academic self-concept, perceptions of the learning environment, engagement, and learning outcomes (academic achievement, generic skills development, and learning satisfaction). Study 1 ($N = 1{,}502$) adopted a cross-sectional design and supported a model showing that engagement mediated the effects of academic self-concept and perceptions of the learning environment on generic skills development and learning satisfaction. It was also found that academic self-concept directly predicted academic achievement and generic skills and that perceptions of the learning environment directly predicted learning satisfaction. Study 2 ($N = 2{,}069$) adopted a longitudinal design involving three waves of data collection with a 1-year interval (freshman, sophomore, junior). The results of study 2 replicated the findings of study 1 and supported a reciprocal effects model showing that prior academic achievement predicted subsequent self-concept which in turn determined future achievement even with prior achievement partialed out. These findings contribute to developing a finer-grained model of higher education student learning.

Keywords Academic self-concept · Perception of the learning environment · Course experience · Engagement · Learning outcome

✉ Ling-Yan Yang
yanglingyan@xmu.edu.cn

Jian-Peng Guo
guojp@xmu.edu.cn

Juan Zhang
zhangjuanzj714@163.com

Ya-Juan Gan
ganyajuan@xmu.edu.cn

Extended author information available on the last page of the article

Introduction

Learning is a complex human activity and has been the focus of extensive research over many decades. Within this field, student learning in higher education is one of the most widely studied topics in the higher education literature. The search for factors influencing college students' learning outcomes has been a major endeavor of higher education researchers for many years. These factors are commonly categorized as either personal/psychological factors (e.g., student age, intelligence, personality, prior experience) or relational/contextual factors (e.g., perceived quality of teaching and assessment, perceived workload, approaches to learning, engagement) (Kornilova et al., 2009; Pascarella & Terenzini, 2005; Trigwell et al., 2013). Numerous studies have been conducted to investigate the independent effects of these individual factors on learning in relative isolation. Few studies, however, have attempted to examine their interrelationships and interactive effects on learning outcomes to determine a causal model of higher education learning (Drew & Watkins, 1998; Trigwell et al., 2013; Zeegers, 2004; Zhou et al., 2015).

Three distinct strands of student learning have been developed to explain how students learn in higher education, namely approaches to learning (SAL; Biggs, 1993), self-regulated learning (SRL; Pintrich & Zusho, 2007), and student engagement (Coates, 2007). Plenty of research has shown the importance of these factors in predicting learning. However, this research has been implemented independently by separate communities of researchers, which limits its theoretical and practical value (Zusho, 2017). Given that there is a considerable amount of overlap across these strands (Wolters & Taylor, 2012; Zusho, 2017), it is possible and necessary to integrate these traditions and to explore the joint effects of these important predictors on learning. Guo (2018) synthesized the SAL and engagement research to simultaneously examine the joint effects of perceptions of the learning environment and engagement on university students' academic achievement, generic skills, and learning satisfaction. The results showed that student engagement mediates the relationship between perceptions of the learning environment and learning outcomes. Two limitations, however, existed in that study. First, psychological factors were not included in the model of the study, which limited its effectiveness in explaining college learning, especially for the outcome of academic achievement. Second, the study adopted a cross-sectional design, which constrained the capacity of interpreting causal relationships between the variables in the model.

The main objective of the current study is therefore to address these limitations in a comprehensive manner. By including academic self-concept as an important predicting factor of learning, this study aims to investigate the effects of academic self-concept, perceptions of the learning environment, and student engagement on learning outcomes. It is hypothesized that academic self-concept predicts perceptions of the learning environment and student engagement, which, in turn, predict learning outcomes. By adopting a longitudinal design involving three waves of data collection, this study explores the causal relationship between academic self-concept and academic achievement, and a reciprocal effects model is hypothesized. This model integrates a set of individual and environmental factors and is expected to contribute to developing a finer-grained model about higher education student learning.

College students' perceptions of the learning environment, engagement, and learning

Ever since Marton and Saljo (1976a, 1976b) first identified the concepts of deep and surface approaches to learning, a new research tradition arose by using means of quantitative self-reported instruments to measure students' approaches to learning (SAL) and to explore the relationship between SAL and other learning variables. Within this field, Biggs is often credited with developing the presage-process-product (3P) model of general learning to account for the learning process in higher education. Three sets of variables were differentiated in this model. Presage factors exist prior to the time of learning and mainly refer both to student personal factors (e.g., prior knowledge, ability, personality) and to the institutional context (e.g., assessment, teaching methods, climate), process concerns the students' approaches to learning, and product is about to the learning outcome. The presage personal and situational factors interact with each other to determine how students process a particular task, which in turn mediates the types of outcomes achieved. The presage factors can also directly predict learning outcomes. The relationships between these factors can be interactive and reciprocal. As Biggs et al. (2001) maintained, "student factors, teaching context, on-task approaches to learning, and the learning outcomes, mutually interact, forming a dynamic system" (p. 135).

Central to the SAL research and the 3P model is the phenomenographic view of learning, which interprets learning from a relational and perceptual perspective, rather than a cognitive stance of mental construction (Guo et al., 2012; Marton & Booth, 1997). As a consequence, approaches to learning are not treated as learners' stable psychological traits but are instead affected by the simultaneous effects of the learner, the task, and the context within which the task is being experienced (Baeten et al., 2010; Entwistle & McCune, 2004). Among these factors, student perception of the learning environment is considered a key element. As many researchers have claimed, it is students' perceptions of the learning environment that influence their learning approaches, rather than the objective context in and of itself (Asikainen & Gijbels, 2017; Entwistle, 1991; Entwistle & McCune, 2004). Students' positive perceptions of their learning environment are associated with the adoption of deep learning approaches and negative perceptions are associated with the adoption of surface approaches (Diseth, 2007; Lizzio et al., 2002). Furthermore, researchers have simultaneously investigated the relationships among perceptions of the learning environment, approaches to learning, and learning outcomes, and have generally found the mediating effects of learning approaches on the relationship between the presage and product variables (e.g., Diseth, 2007; Diseth et al., 2010; Lizzio et al., 2002; Trigwell et al., 2013). For instance, Guo et al. (2017) found that students' perceptions influence their course satisfaction and generic skills development both directly and indirectly through their approaches to learning.

There is another popular tradition focusing on student engagement and its effects on higher education learning. The value of engagement in higher education learning has been recognized by most researchers. Decades of research have consistently reported the connection between student engagement and college outcomes (for reviews, see Bowen, 1977; Pascarella & Terenzini, 2005). However, engagement is a complex and multifaceted metaconstruct and there is debate regarding its exact nature (Kahu, 2013; Zepke, 2014). As Skinner et al. (2008) conclude, the key problem is a lack of clear distinction between indicators and facilitators of engagement. Indicators concern the inside features that belong to engagement, whereas facilitators are outside factors that impact the construct. It is widely agreed that engagement consists of behavioral, cognitive, and affective indicators (Fredricks et al., 2004). Behavioral engagement refers to positive conduct, participation, efforts, attention, and persistence. Cognitive engagement focuses on students' use of deep learning strategies, self-regulated learning, motivation, and expectations. Affective engagement is defined in terms of enjoyment, enthusiasm, interest in the task, sense of belonging, reactions to, and relationships with others that encourage much learning. With respect to the facilitators, Skinner et al. (2008)

suggest context and self as facilitators which predict engagement and outcomes. Kahu (2013) differentiates the state of engagement from its antecedents and consequences in her model and define psychosocial (e.g., motivation, self, support, teaching) and structural (e.g., culture, curriculum, family, life load) factors as antecedents.

Although conducted independently by separate researchers, the SAL and engagement research share a considerable amount of overlap. Zusho (2017) summarized their similarities in terms of learning assumption, learning process, constitutive structure, and measurement. For instance, both models of SAL and student engagement specify that student learning is influenced by both personal and contextual factors, consider students as active participants in the learning process, use the survey as a common method for measurement, and recognize the constructs of cognition, affect, and behavior. As Wolters and Taylor (2012) pointed out, it is common to find that researchers of one perspective use terminology from another perceptive. Zusho (2017) thus suggested linking these models of student learning both theoretically and practically.

It seems appropriate to consider engagement as a process factor and include it in the 3P model. As researchers (Kahu, 2013; Skinner et al., 2008) suggested, engagement is a process variable that mediates the relationship between the antecedents and the consequences. In addition, engagement is a broader construct in that SAL mainly refers to the cognitive dimension of engagement. Therefore, we suggest replacing approaches to learning with engagement as the key process variable in the 3P model and exploring the relationship among perceptions of the learning environment, engagement, and learning outcomes. As Yin and Ke (2017) argued, there is little attempt to examine the relationship between students' perception of their learning environment and engagement in higher education literature. Their study revealed a significant relationship between students' course experience and engagement. Guo (2018) explored the relationships among senior students' perceptions of the learning environment, engagement, and learning outcomes. The results showed that engagement mediates the relationship between perceptions and learning outcomes of generic skills and satisfaction. Students' academic achievement, however, was found to be uncorrelated with their perceptions and engagement. As Guo (2018) claimed, important variables contributing to academic achievement were missing in the study and students' personal factors such as academic self-concept should be included in future studies to investigate their relationship with academic achievement and other learning factors in the model.

Academic self-concept and learning

Self-concept is defined as "a person's self-perceptions formed through experience with and interpretations of one's environment" (Marsh & O'Mara, 2008, p.534). As one of the oldest and most important constructs in research, scholars commonly agree on the hierarchical and multifaceted nature of self-concept comprising academic and nonacademic components (Marsh, 2007; Shavelson et al., 1976). A vast body of literature has shown that academic self-concept is not only one of the most important educational goals but also leads to other desirable personal or educational outcomes, such as better academic achievement, higher engagement, intrinsic motivation, reduced test anxiety, and longer educational attainment (see Marsh, 2007, for a review; Skinner et al., 2008).

Researchers are particularly interested in the causal ordering of academic self-concept and academic achievement, i.e., differentiating the cause from the outcome. Three models have been proposed to explain this relationship. The self-enhancement model suggests that academic self-concept determines subsequent achievement, while the skill development model suggests a reversed relationship between the two variables. A third model is called the reciprocal effects model (REM) proposed by Marsh and colleagues, which suggests that the relationships between academic self-concept and academic achievement are reciprocal and mutually reinforcing rather than one-way and causal. Strong empirical evidence has been shown to support the reciprocal effects model over the other two models (Huang, 2011; Marsh & O'Mara, 2008).

Although numerous studies have been conducted in the academic self-concept domain and have generated many research findings, most studies have focused on elementary school children and adolescents (Cokley, 2000; Guay et al., 2003; Reynolds, 1988). In higher education, there are studies addressing the role of academic self-concept in college learning. For instance, some researchers have reported the correlations between academic self-concept and academic achievement (e.g., Cokley, 2000; Kornilova et al., 2009). Drew and Watkins (1998) found that students' academic self-concept indirectly predicts their academic achievement through the deep approach to learning. Zhou et al. (2015) reported that faculty interaction and homework involvement positively predicted GPA through their academic self-concept. However, there is little attempt to simultaneously examine the relationship among academic self-concept, perceptions of the learning environment, student engagement, and learning outcomes. In addition, the reciprocal relationships between academic self-concept and academic achievement found in K-12 students have not been verified in college students. As a population that is vastly different from adolescents in many aspects, it is necessary to examine the reciprocal effects in a higher education context.

The present study

In view of the limitations of the existing literature discussed above, the main purpose of the present study was to explore the relationships among students' academic self-concept, perceptions of the learning environment, engagement, and learning outcomes. Specifically, two studies were carried out to address these limitations.

Study 1 adopted a cross-sectional design to examine the relationship among these variables on 1,502 Chinese senior students. According to the 3P model reviewed above, students' perceptions of the learning environment are influenced by the characteristics of the student and the context. Therefore, being an important individual attribute, academic self-concept was included in the model as a presage personal factor which predicts perceptions of the learning environment. Student engagement was considered a process variable. Regarding the product variables, students' academic achievement, generic skills development, and learning satisfaction were used as indicators of learning outcomes. Hence, as Fig. 1 depicts, it was

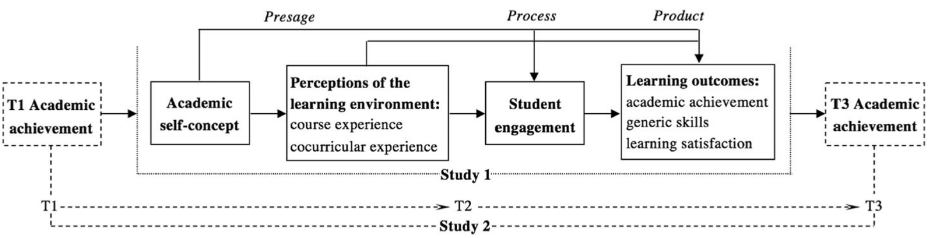

Fig. 1 The hypothesized causal sequence of research variables for the theoretical model

hypothesized in study 1 that academic self-concept directly predicts perceptions of the learning environment that predict engagement, which, in turn, predicts learning outcomes.

Based on the results of study 1, study 2 further adopted a longitudinal design to explore the causal relationship between academic self-concept and academic achievement in 2,069 university students. Data were collected at three-time points with a 1-year interval: the GPA of the first semester of freshman year (time-1, T1); students' academic self-concept, perceptions of the learning environment, engagement, generic skills, and learning satisfaction measured at the end of the first semester of sophomore year (time-2, T2); and the GPA of the first semester of junior year time-3, T3). In accordance with the reciprocal effects model proposed by Marsh and O'Mara (2008), it was hypothesized in study 2 that T1 academic achievement predicts subsequent T2 academic self-concept which in turn predicts subsequent T3 academic achievement.

Study 1

Methods

Participants

The participants were 1,502 seniors from a full-time research-intensive university in mainland China, with a mean age of 22.36 years (range 18.59–27.43, SD = .82). All 4,886 seniors at this university were invited to participate in the survey in the month before graduation. The participants were required to use their university ID and password to log on to an online system containing inventories of this study. Only after answering all the questions required could the participants click the "submit" button to finish the survey. They were allowed as much time as they needed to complete the inventories, and they typically required 15 min. Their participation was voluntary and they were allowed to quit the study anytime. All data were saved anonymously and kept confidential. Of the sample, approximately 52.3% were males, and 47.7% were females. With respect to discipline, approximately 28.5% of participants were humanities/social science majors, and 71.5% were science/engineering majors. The gender and discipline distribution of the sample was generally in line with the overall senior population at the university.

Measures

Except for academic achievement, which was measured by student's cumulative GPA and obtained from university records, other variables were measured by inventories. The academic self-concept inventory was a short version adapted from Damme et al. (2002). Other inventories were developed by Guo and colleagues (Guo, 2018; Guo et al., 2017; Guo & Ji, 2019), which are based on Chinese culture and can better evaluate Chinese university students' learning with good reliability and validity.

Academic self-concept A five-item academic self-concept inventory was used to measure students' evaluations of their general academic ability. An example item is "I think that I am good at learning." Items are rated on a 1 (strongly disagree) to 5 (strongly agree) scale.

Course experience An eight-item course experience inventory was used to measure students' perceptions of the quality of teaching. Two scales were extracted from this inventory, including *good teaching* ("The teacher often encourages us to share our ideas") and *teaching organization* ("The teacher is well prepared for the course"). Items are rated on a 1 (strongly disagree) to 5 (strongly agree) scale.

Cocurricular experience A 12-item cocurricular experience inventory was developed to assess students' perceptions of the university's campus environment. Two scales were extracted from this inventory, including *university resources* ("The university has sufficient learning space and public area") and *university support* ("The university provides support for social interaction"). Items are rated on a 1 (strongly disagree) to 5 (strongly agree) scale. The course experience inventory focused on students' in-class learning experience, and the cocurricular experience inventory focused on students' out-of-class learning experience, both of which consisted of their perceptions of the learning environment.

Student engagement A 36-item inventory was developed to measure student engagement. Six scales were extracted from this inventory, including *course study* ("I carefully take notes in class"), *student-faculty interaction* ("I discuss my study plan with a faculty member"), *peer interaction* ("I work with other students on course projects or assignments"), *extracurricular activity* ("I participate in research projects"), *deep learning approach* ("When studying, I often try to generate my own opinions"), and *university belonging* ("I think I belong to the university"). Items are rated on a 1 (never) to 5 (very often) scale.

Academic achievement Academic achievement was measured by calculating students' cumulative GPA from their first year to their last year at university using a 4-point scale. Students' GPA scores were available from official university records.

Generic skill developments An eight-item scale was developed to assess students' generic skills development. An example item is "The development of my oral communication skills". Items are rated on a 1 (very poor) to 5 (excellent) scale.

Learning satisfaction A 12-item learning satisfaction scale was used to measure students' satisfaction with their collegiate experience. An example item is "My satisfaction with scholarship system". Items are rated on a 1 (very unsatisfied) to 5 (very satisfied) scale.

Data analysis

In the first stage, confirmatory factor analyses (CFA) were used to assess the reliability and validity of the measurement models using Amos 17.0. In the second stage, the hypothesized relationships between constructs were examined using structural equation modeling (SEM). Gender, major, race, and parental education were entered into the model to control for the effects of demographics on outcome measures.

The internal consistency of each construct was investigated using Cronbach's alpha and composite reliability (CR). Tests for convergent and discriminant validity were performed to assure the validity of the scales. Convergent validity is confirmed when indicator factor loadings are statistically significant and exceed the acceptable value of .5 on their corresponding constructs and when the average variances extracted (AVEs) for constructs are larger than .5. Discriminant validity is assured by the square root of the AVEs being greater than the interconstruct correlations (Fornell & Larcker, 1981).

The goodness-of-fit of the CFA and SEM models were evaluated using a number of indices. In addition to the chi-square statistic, the root mean square error of approximation (RMSEA), the confirmatory fit index (CFI), and the non-normed fit index (NNFI) were used as model fit indices in the study. According to the SEM literature (Marsh et al., 1988; Schreiber et al., 2006), data fit is excellent when RMSEA is less than .06, and NNFI and CFI are greater than .95, and data fit is acceptable when RMSEA is less than .08, and NNFI and CFI are greater than .90. We also performed Harman's single-factor test to assess the common method bias since we used a single questionnaire method to collect data for all the measures in this study (Podsakoff et al., 2003).

Results

Descriptive statistics, correlations, and confirmatory factor analyses

Table 1 summarizes the descriptive statistics and the correlation matrix. The results showed that students generally had a positive academic self-concept, perceptions of the learning environment, engagement, and learning outcomes. The scores on university belonging ($M = 4.44$ and SD = .59), university resource ($M = 4.37$ and SD = .67), university support ($M = 4.31$ and SD = .60), learning satisfaction ($M = 4.31$ and SD = .60), teaching organization ($M = 4.23$ and SD = .61), and course study ($M = 4.22$ and SD = .64) were obviously higher than those of other scales. In contrast, there was still room for some scales to be improved. For instance, student-faculty interaction ($M =$ 3.40 and SD = 1.05), extracurricular activity ($M = 3.56$ and SD = .95), generic skills development ($M = 3.81$ and SD = .76), and academic self-concept ($M = 3.84$ and SD = .68) had much lower scores than those of other scales. It could be concluded that students have higher perceptions of the learning environment than of themselves, and they spend more time on coursework than on interpersonal interactions and extracurricular activities.

The correlation matrix in Table 1 shows the expected significant correlations between subscales. Academic self-concept, course experience, cocurricular experience, engagement, generic skills development and learning satisfaction had moderate and positive correlations with each other (r ranging from .24 to .70, $p < .001$). The correlations between university GPA and the other factors were generally weak (r ranging from .01 to .25 with a mean of .07).

We examined factor structures of the measures by conducting a CFA comprising 14 factors: 13 first-order latent factors and one observed factor of GPA. This measurement model fit the data well: $x^2[3,138] = 12{,}505.45$, $p < .001$, RMSEA = .05, CFI = .91, NNFI = .90. All of the factor loadings were greater than .60, and the t value revealed significance at the .001 level. The AVEs of all constructs were over .50. The square root of the AVEs was greater than the intercorrelations, indicating acceptable discriminant validity. Table 1 also shows that the values of Cronbach's α coefficients and the composite reliability for all scales were no less than .80, indicating that all of the subscales reached an acceptable level of internal consistency (Fornell & Larcker, 1981). In sum, the above reliability and validity of the data coefficient suggest that the measurement was acceptable.

Table 1 Correlation matrix, reliabilities, validities, and descriptive statistics ($N = 1{,}502$)

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Cronbach's a	CR	AVE	CFA Loadings range (mean)
1. Academic self-concept	(.72)														.83	.84	.52	.64–.81 (.72)
2. Good teaching	.41	(.81)													.88	.88	.65	.70–.88 (.81)
3. Teaching organization	.40	.66	(.86)												.92	.92	.74	.77–.92 (.86)
4. University resource	.24	.35	.42	(.78)											.86	.86	.61	.73–.81 (.78)
5. University support	.38	.55	.57	.65	(.77)										.92	.92	.60	.70–.83 (.77)
6. Course study	.45	.44	.44	.26	.39	(.75)									.82	.84	.57	.61–.89 (.75)
7. Student-faculty interaction	.58	.51	.42	.26	.41	.50	(.89)								.96	.96	.79	.79–.93 (.89)
8. Peer interaction	.43	.50	.46	.39	.45	.49	.59	(.80)							.87	.88	.64	.70–.89 (.80)
9. Extracurricular activity	.55	.42	.36	.24	.39	.43	.70	.59	(.73)						.82	.82	.53	.62–.79 (.72)
10. Deep learning approach	.64	.57	.54	.30	.50	.66	.68	.60	.61	(.83)					.96	.97	.69	.70–.84 (.78)
11. University belonging	.43	.43	.51	.41	.55	.43	.35	.48	.37	.55	(.81)				.88	.88	.65	.71–.87 (.81)
12. University GPA	.11	− .01[a]	− .02[a]	− .16	− .10	.25	− .01[a]	− .02[a]	.01[a]	.09	.03[a]	-			-	-	-	-
13. Generic skills	.60	.47	.42	.30	.45	.44	.62	.52	.62	.69	.44	− .05[b]	(.71)		.89	.89	.51	.60–.78 (.71)
14. Learning satisfaction	.46	.55	.63	.52	.70	.46	.48	.52	.43	.58	.63	− .06[b]	.54	(.85)	.95	.97	.73	.70–.87 (.78)
Mean	3.84	4.10	4.23	4.37	4.31	4.22	3.40	4.02	3.56	4.06	4.44	3.19	3.81	4.31				
SD	.68	.71	.61	67	.60	.64	1.05	.76	.95	.67	.59	.41	.76	.60				

Note. Mean values for scales are total scores divided by number of items. Possible mean range between 1 and 5 for scales, 0 and 4 for GPA. Lower triangular matrix of columns in the correlation between variables, and the diagonal line is the square roots of average variance extracted (AVE)

[a] $p > .05$

[b] $p < .05$, others $p < .001$ (2-tailed)

Harman's single-factor test (Podsakoff et al., 2003) was performed to assess the common method bias. The single-factor model with all manifest variables produced poor fit indices ($x^2[3,163] = 50,850.67$, $p < .001$,RMSEA = .10, CFI = .52, NNFI = .51). Its fit was significantly worse than the fit of the measurement model ($\Delta\chi^2$ [25] = 38,345.22, $p < .01$). Therefore, common method variance should not be a severe problem in this study.

SEM analysis

SEM was applied to investigate the hypothesized relationship among students' academic self-concept, perceptions of the learning environment, engagement, and learning outcomes in accordance with the theoretical assumptions described in the "Introduction" section. In order to produce a more parsimonious model, items in subscales were summed to obtain the scores of subscales, which were then accounted for by a single latent higher-order factor respectively. As a result, good teaching and teaching organization were accounted for by a latent course experience factor; university resource and university support were accounted for by a latent cocurricular experience factor; and course study, student-faculty interaction, peer interaction, extracurricular activity, deep learning approach, and university belonging were accounted for by a latent student engagement factor. In addition to the three first-order latent factors of academic self-concept, generic skills, and learning satisfaction, there were totally six latent factors and one observed factor (i.e., GPA) in the model.

This model had acceptable fit indices ($x^2[704] = 4,050.25$, $p < .001$,RMSEA = .06, CFI = .91, NNFI = .90). As shown in Fig. 2, with respect to direct relationships among course experience, cocurricular experience, engagement, and learning outcomes, students' engagement positively predicted their generic skills development ($\beta = .68$, $p < .001$) and learning satisfaction ($\beta = .29$, $p < .001$). Course experience positively predicted engagement ($\beta = .41$, $p < .001$) and learning satisfaction ($\beta = .23$, $p < .001$). Engagement and course experience did not predict university GPA (ps > .05). Cocurricular experience positively predicted engagement ($\beta = .13$, $p < .001$) and learning satisfaction ($\beta = .41$, $p < .001$) but negatively predicted GPA ($\beta = -.20$, $p < .001$). Regarding the indirect effects, student engagement mediated the relationship between course experience and generic skills development ($\beta = .28$, 95% CI: .22–.35, $p < .001$), course experience and learning satisfaction ($\beta = .12$, 95% CI: .08–.17,

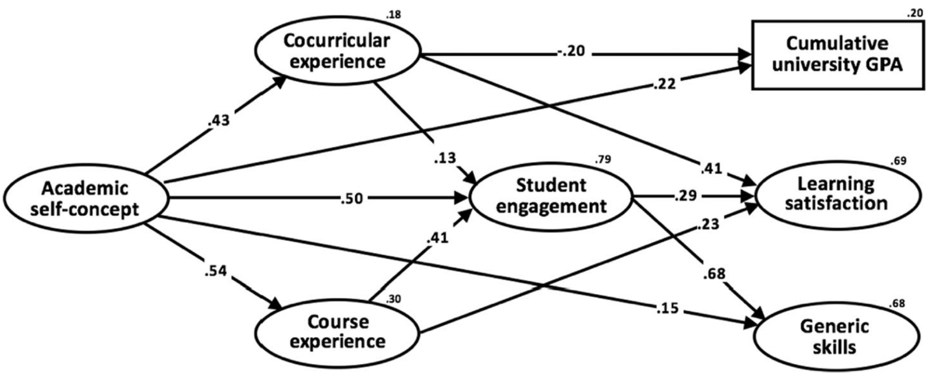

Fig. 2 Standardized structural relations among variables ($N = 1,502$). All of the paths with standardized coefficients are statistically significant at the .001 level. Controlled demographic variables are omitted in the figure to maintain the clarity of the model

$p < .001$), cocurricular experience and generic skills development ($\beta = .09$, 95% CI: .04–.15, $p < .001$), and cocurricular experience and learning satisfaction ($\beta = .04$, 95% CI: .02–.07, $p < .001$).

With respect to the effects of academic self-concept on other learning variables, academic self-concept positively predicted course experience ($\beta = .54$, $p < .001$), cocurricular experience ($\beta = .43$, $p < .001$), engagement ($\beta = .50$, $p < .001$), university GPA ($\beta = .22$, $p < .001$), and generic skills ($\beta = .15$, $p < .001$). In addition to those direct effects, students' academic self-concept also indirectly predicted engagement ($\beta = .28$, 95% CI: .25–.32, $p < .001$), university GPA ($\beta = -.08$, 95% CI: − .11–.06, $p < .001$), generic skills development ($\beta = .53$, 95% CI: .46–.61, $p < .001$), and satisfaction ($\beta = .53$, 95% CI: .48–.57, $p < .001$).

Bootstrapping procedures were used to test the significance of the above indirect effects of the mediators. The bootstrapping involved resampling the data multiple 2,000 times in this study. The 95% bootstrapped confidence interval (CI) of all the above mediating effects did not include zero, indicating the significance of the indirect effects. The variance accounted for by the predictor variables in this model was $R^2 = .30$ for course experience, $R^2 = .18$ for cocurricular experience, $R^2 = .79$ for student engagement, $R^2 = .20$ for university GPA, $R^2 = .68$ for generic skills development, and $R^2 = .69$ for learning satisfaction.

We performed a group path analysis by imposing a gender equality constraint on the path estimates. The goodness-of-fit for the constrained models was found to be as good as that for the unconstrained models (x^2 = 72.87, $p < .05$; ΔIFI = .002, ΔNFI = .002, ΔRFI = −.003, ΔTLI = − .003), indicating that the effect estimates did not differ by gender.

Discussion

As expected, the results of the present study showed that academic self-concept, perceptions of the learning environment, engagement, and learning outcomes are positively correlated with each other, which is in line with previous studies (e.g., Diseth et al., 2010; Guo et al., 2017; Marsh, 2007; Zepke, 2014). The SEM analyses further revealed the structural relationship among these variables. The mediating effects of student engagement on the relationship between academic self-concept, perceptions of the learning environment, and learning outcomes were confirmed by the path model.

The SEM results indicated that student engagement mediates the relationship between perceptions of the learning environment and learning outcomes of generic skills and learning satisfaction, which is consistent with the findings of Guo (2018). Students who perceive a positive learning environment tend to devote more effort to learning, which will have better generic skills development and satisfaction. Course experience and cocurricular experience also directly predict learning satisfaction. Academic achievement was not predicted by course experience and engagement but was negatively predicted by cocurricular experience.

The major purpose of study 1 was to investigate the role of academic self-concept in college learning. It is encouraging to confirm that academic self-concept has significant positive effects on perceptions of the learning environment, engagement, and three types of learning outcomes either directly or indirectly. Students who evaluate themselves as having a higher academic ability are more likely to report positive in-class and out-of-class learning experiences and thus engage more in learning, which ultimately leads to better academic achievement, generic skills development, and learning satisfaction. The relationship between academic self-concept and academic achievement is particularly significant compared to the model in Guo's (2018) study which had a limitation in explaining the variance of academic achievement. Together, these findings support the effectiveness of the model in study 1 in accounting for college student learning.

Although the results of study 1 support the important role of academic self-concept in college learning, still unknown is the causal ordering between academic self-concept and academic achievement due to the nature of the cross-sectional design of study 1. Thus, the question of whether prior self-concept determines subsequent academic achievement or vice versa is explored in study 2.

Study 2

Methods

Participants and data collection

Study 2 involved three waves of data collection with a 1-year interval between each measurement time as suggested by Marsh and Yeung (1997). The longitudinal sample comprises 2,069 out of 4,667 university students from the same university as that used in study 1. All variables examined in study 1 were measured in T2 using the same inventories and method. In addition, students' GPA was collected at T1 and T3. The reason for choosing the three-time slots for data collection is that most credits are completed during the first 3 years of university. The mean age of the participants was 20.26 years (SD = .76) at T2.

Data analysis

CFA was first conducted to assess the reliability and validity of the inventories. The SEM was then used to examine the causal ordering of academic self-concept and academic achievement by adding the T1 GPA and the T3 GPA into the path model of study 1. In addition to investigating the relationship among academic self-concept, perceptions of the learning environment, engagement, and learning outcomes, study 2 can further examine the effect of T1 academic achievement on the subsequent T2 academic self-concept, as well as the effect of T2 academic self-concept on the subsequent T3 academic achievement. Gender, major, race, and parental education were entered into the model to control for the effects of demographics on outcome measures.

Results

Descriptive statistics, correlations, and confirmatory factor analyses

As shown in Table 2, the scores on the variables in study 2 were generally lower than the scores found in study 1, indicating that students improved as their grade level increased. The sequence of factor ratings was the same as that found in study 1. All subscales were significantly and positively correlated with each other at a moderate level (r ranging from .19 to .70, $p < .001$). The correlations between GPA (T1 and T3) and the other factors were generally weak (r ranging from .01 to .26 with a mean of .08). CFA of the measurement model showed an acceptable fit to the data ($x^2[3,206] = 13,169.78$, $p < .001$,RMSEA = .04, CFI = .91,

Table 2 Correlation matrix, reliabilities, validities, and descriptive statistics ($N = 2{,}069$)

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Cronbach's *a*	CR	AVE	CFA Loadings range (mean)
1. Academic self-concept	(.71)															.81	.81	.50	.62–.75 (.68)
2. Good teaching	.35	(.74)														.82	.83	.55	.62–.83 (.74)
3. Teaching organization	.33	.59	(.80)													.87	.87	.64	.69–.86 (.80)
4. University resource	.21	.35	.43	(.73)												.82	.82	.53	.68–.77 (.73)
5. University support	.31	.50	.56	.65	(.74)											.91	.91	.55	.69–.77 (.74)
6. Course study	.43	.39	.35	.19	.31	(.71)										.77	.79	.50	.52–.86 (.69)
7. Student-faculty interaction	.54	.44	.34	.23	.36	.43	(.87)									.94	.95	.76	.75–.92 (.87)
8. Peer interaction	.37	.45	.38	.30	.43	.42	.54	(.78)								.85	.86	.61	.68–.86 (.78)
9. Extracurricular activity	.48	.35	.27	.21	.31	.36	.70	.53	(.71)							.82	.80	.51	.58–.79 (.71)
10. Deep learning approach	.63	.49	.43	.27	.43	.62	.65	.56	.55	(.77)						.94	.95	.59	.64–.80 (.73)
11. University belonging	.36	.40	.46	.45	.55	.34	.32	.49	.33	.48	(.77)					.85	.85	.59	.68–.82 (.76)
12. T1 GPA	.11	.02[a]	− .01[a]	− .15	− .07	.24	.02[a]	.04[a]	.01[a]	.13	− .01[a]		-			-	-	-	-
13. T3 GPA	.17	.05[b]	.02[a]	− .13	− .08	.26	.05[b]	.07	.02[a]	.15	.02[a]	.58	-			-	-	-	-
14. Generic skills	.57	.43	.36	.28	.41	.38	.59	.50	.57	.62	.43	− .01[a]	.00[a]	(.71)		.88	.88	.50	.56–.77 (.69)
15. Learning satisfaction	.34	.50	.57	.53	.69	.37	.38	.46	.35	.46	.65	− .05[b]	− .06	.46	(.80)	.93	.95	.64	.65–.83 (.73)
Mean	3.44	3.88	4.07	4.16	4.13	4.07	2.84	3.75	3.03	3.76	4.19	3.11	3.30	3.31	4.09				
SD	.68	.70	.59	.73	.63	.66	1.04	.79	.95	.68	.62	.42	.51	.79	.60				

Note. Mean values for scales are total scores divided by number of items. Possible mean range between 1 and 5 for scales, 0 and 4 for GPA. Lower triangular matrix of columns is the correlation between variables, and the diagonal line is the square roots of average variance extracted (AVE)

[a] $p > .05$

[b] $p < .05$, others $p < .001$ (2-tailed)

NNFI = .91). Values in Table 2 also show acceptable reliability, convergent, and discriminant validity of all constructs.

SEM analysis

The model depicted in Fig. 3 was fitted to determine the hypothesized relationship among students' academic self-concept, perceptions of the learning environment, engagement, and learning outcomes. This model had acceptable fit indices ($x^2[705] = 4{,}642.39$, $p < .001$,RMSEA = .05, CFI = .91, NNFI = .90). As shown in Fig. 3, with respect to the relationships among variables investigated at T2, the SEM analysis generated a similar pattern as that in study 1. Academic self-concept and perceptions of the learning environment indirectly predicted generic skills and learning satisfaction through student engagement. Course experience and cocurricular experience also directly predicted learning satisfaction. Academic self-concept directly predicted perceptions of the learning environment, engagement, and generic skills. All direct and indirect effects were significant at .001 level.

With respect to the longitudinal data, the path model showed that T1 academic achievement positively predicted T2 academic self-concept ($\beta = .13$, $p < .001$) and T3 academic achievement ($\beta = .49$, $p < .001$). T2 academic self-concept positively predicted T3 academic achievement ($\beta = .18$, $p < .001$) and T2 cocurricular experience negatively predicted T3 academic achievement ($\beta = -.11$, $p < .001$).

The variance accounted for by the predictor variables in this model was $R^2 = .02$ for academic self-concept, $R^2 = .23$ for course experience, $R^2 = .13$ for cocurricular experience, $R^2 = .77$ for student engagement, $R^2 = .40$ for T3 GPA, $R^2 = .65$ for generic skills development, and $R^2 = .66$ for learning satisfaction. A group path analysis was performed by imposing a gender equality constraint on the path estimates. The results showed that the effect estimates did not differ by gender ($x^2 = 119.99$, $p < .05$; ΔIFI = .003, ΔNFI = .003, ΔRFI = − .001, ΔTLI = − .002).

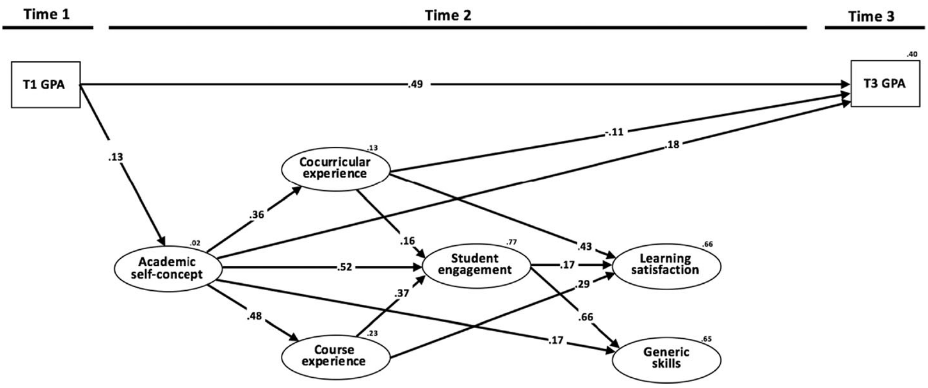

Fig. 3 Standardized structural relations among variables ($N = 2{,}069$). All of the paths with standardized coefficients are statistically significant at the .001 level. Controlled demographic variables are omitted in the figure to maintain the clarity of the model

Discussion

The results of study 2 first confirmed the findings reported in study 1. The descriptive results of the two studies showed that university students generally have a positive academic self-concept, perceptions, engagement, and learning outcomes. But, their self-perceptions, interpersonal interactions, and extracurricular activities score lower than other variables. The comparison of the results of study 1 and study 2 showed that students improve from sophomore year to senior year. This outcome supports the added value of the university experience on student learning as discussed by researchers (Pascarella & Terenzini, 2005; Zhou et al., 2015).

Results of study 2 also corroborate the findings of study 1 in that student engagement mediates the relationship between academic self-concept, perceptions of the learning environment, and learning outcomes. Specifically, academic self-concept is found to predict perceptions of the learning environment, engagement, and learning outcomes both directly and indirectly. The important role of engagement and academic self-concept in college learning is supported by the results of study 1 and study 2.

The main purpose of study 2 was to examine the causal ordering of academic self-concept and academic achievement. The results support a reciprocal effect model, showing that prior academic achievement predicts subsequent self-concept, which in turn determines future achievement even with prior achievement partialed out. In addition, the size of the effect of prior academic self-concept on subsequent academic achievement ($\beta = .18$) was larger than the size of the effect of prior achievement on subsequent self-concept ($\beta = .13$). T1 academic achievement explained only a small amount of the variance in T2 academic self-concept ($R^2 = .02$). This outcome suggests that the causal predominance of self-concept over achievement in college students and thus supports the consideration of academic self-concept as a presage variable in the model of the present study.

General discussion

The present study simultaneously examined the effects of academic self-concept, perceptions of the learning environment, and engagement on different types of learning outcomes in higher education. By integrating a set of personal and contextual factors into the learning models, the results of this study enable the different research perspectives to be woven together and facilitate a shared understanding regarding how university students learn and how to enhance their learning.

The SEM results in study 1 and study 2 generated the same pattern regarding the relationship among academic self-concept, perceptions of the learning environment, engagement, and learning outcomes, which is also consistent with Guo's (2018) findings. It is compatible to integrate SAL and engagement in one model, which suggests engagement as a key process factor mediating the effects of presage factors (academic self-concept and perceptions) on product factors (generic skills and satisfaction). Engagement is influenced by the complex interplay between the student and the context. Particularly, it is not the objective context but the way students perceive it that influences engagement. Students who believe they are good at learning and have sufficient support are likely to engage more in learning, which leads to greater generic skills and satisfaction. The results not only confirm the important role of engagement in learning as suggested by previous research (Coates, 2007;

Fredricks et al., 2004) but also address the distinction between antecedents, engagement, and consequences considered as the dominant limitations of current engagement research (Kahu, 2013; Skinner et al., 2008).

The models also support the importance of academic self-concept in college learning as did by previous studies (e.g., Kornilova et al., 2009; Zhou et al., 2015). Academic self-concept has considerable effects on each factor in the model. Students who have a higher evaluation of their own academic ability are likely to report a positive learning experience, to devote more time and effort to learning, and to gain more from college. In particular, academic self-concept is the only factor that positively contributes to the students' academic achievement measured by their GPA. As hypothesized, including the variable of academic self-concept in the model can significantly increase its power of explaining learning in higher education. Much of the focus has been on the individual and contextual characteristics that influence the process of learning. Little attention has been paid to students' motivational and affective factors such as self-concept, which requires more studies in the future.

It is important to recognize the reciprocal relationships between academic self-concept and academic achievement in university students. Not only does academic self-concept predict academic achievement but also prior academic achievement benefits subsequent self-concept. Both types of effects are statistically significant and important. Previous studies have provided good support for the reciprocal effects model for elementary school children (Guay et al., 2003; Skaalvik & Hagtvet, 1990) and adolescents (see Marsh & Yeung, 1997 for a review). This study extends this model to the sample of university students, which contributes to fully understanding the relationship from a developmental perspective.

Some results related to academic achievement, however, are inconsistent with the findings of previous studies and need to be discussed. It is surprising to find the negative effect of cocurricular experience on academic achievement in both study 1 and study 2. It seems that the out-of-class support and resource provided by the university would occupy too much students' time and energy and thus decreases their academic performance. Nevertheless, the in-class course experience and engagement were shown to have no effects on academic achievement either. This finding is in line with Guo's (2018) study but is different from studies showing the positive link between course experience, engagement, and academic achievement (e.g., Kuh et al., 2008; Lee, 2014; Lizzio et al., 2002). As Guo (2018) argued, one explanation for such inconsistency might lie in the fact that constructs in these studies are conceptualized and measured differently. Engagement in the current study was measured broadly from cognitive, behavioral, and affective dimensions. This is compared to studies focusing on behavioral indicators of time, effort, and participation in learning activities (Diseth et al., 2010; Kuh et al., 2008; Lee, 2014). For instance, Diseth (2007) measured effort by only one item asking students for time spent on study activities. This is evident by the significant correlations between GPA and the subscales of course study and the deep learning approach in the current study (see Tables 1 and 2). In addition, academic achievement in the study was measured by students' GPA of 4 years (study 1) or one semester (study 2), whereas Diseth et al. (2010) used course grade and Lee (2014) used reading literacy to measure academic achievement. Although the reasoning might help to explain the inconsistent findings, the insignificant or weak correlations between GPA and other variables in the model remind us to consider the following questions: What does GPA really measure in nature? Does GPA focus on disciplinary knowledge and memorization or reflect skills and abilities? What is the relationship between knowledge and ability? Answers to these questions can definitely contribute to the discussion of these results.

Implications for practice

The findings of the present study have important practical implications for educators. First, it is necessary to understand higher education learning from a relational perspective. To promote learning outcomes, it is important for educators to create a learning environment where students have positive in-class and out-of-class learning experiences and are willing to devote more time and effort to academic-related activities. Students with positive learning experiences are more likely to engage more in learning, which ultimately leads to greater generic skills development and learning satisfaction. Given that students spend less time on interpersonal interactions and extracurricular activities, more resources, and programs should be deployed to increase students' involvement in activities such as collaborating with peers, working with faculty, participating in an academic competition, and taking part in a student society, etc.

Second, the present findings reveal the important role of academic self-concept in college learning. Academic self-concept predicts perceptions of the learning environment, engagement, academic achievement, generic skills development, and learning satisfaction. Thus, institutions are advised to place greater emphasis on students' self-concept. It is plausible for teachers and professors alike to design classroom activities that would aid in enhancing university students' academic self-concept. In particular, the causal ordering of academic self-concept and academic achievement was confirmed in that high self-concept leads to high academic performance and vice versa, thereby forming a positive gain spiral. Students who begin their study with high academic confidence become gradually more confident and successful as they progress through university. Therefore, it is recommended to integrate self-enhancement and skill development models and to simultaneously improve both self-concept and academic achievement. Otherwise, as Marsh (2007) claimed, the effectiveness of intervention may be negligible and not long lasting if only self-concept or performance is enhanced.

Limitations and directions for future research

There are several limitations that need to be addressed and directions for future research that need to be pointed out. First, although the study indicated the effects of academic self-concept on perceptions of the learning environment, engagement, and learning outcomes, only a limited amount of variance in academic achievement was explained. More critical variables such as high school performance (Richardson et al., 2012) need to be examined in future studies. Furthermore, academic self-concept was considered from a domain-general perspective without considering its domain-specific nature, which might underestimate its relationship with academic achievement. As Marsh and Yeung (1997) claimed, domain-specific academic self-concept has a stronger relationship with academic achievement than general academic self-concept. Researchers are thus encouraged to investigate the relationships among the variables of the present study in specific academic subjects.

Second, study 2 used a longitudinal design and supported the reciprocal effect of academic self-concept and academic achievement. However, academic self-concept was measured only once. The relationship among T1 academic self-concept, T2 GPA, and T3 academic self-concept is unknown. Future studies could measure academic self-concept at different time points, which would better test the causal ordering of academic self-concept and academic achievement. In addition, academic self-concept, perceptions of the learning environment, engagement, and learning outcomes were measured within the same time point in both study 1 and study 2. Given the lack of temporal precedence among variables, the predictive paths in the current study should be interpreted with caution. Alternative models can be tested to investigate the predicting effects of perceptions of the learning environment and engagement on academic self-concept. It is particularly suggested that researchers measure variables in this study at different time points and explore their causal orderings in future studies.

Third, except for academic achievement, which was measured by an objective GPA, other variables were measured by students' self-reported questionnaires. Although the validity of self-reported measurement has been acknowledged by researchers (Douglass et al., 2012), they are only indirect indicators of student learning and may produce upwardly biased ratings (Hill & Betz, 2005). Particularly, students' participation in the data collection process was encouraged by the Academic Affairs Office of the university, which might have created additional pressure for students to report their true thoughts, although the participation was voluntary and anonymous. Hence, caution must be exercised in the interpretation of the results.

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Affiliations

Jian-Peng Guo[1] • **Ling-Yan Yang**[2] • **Juan Zhang**[3] • **Ya-Juan Gan**[4]

[1] Institute of Education, Xiamen University, Xiamen, China

[2] School of Sociology and Anthropology, Xiamen University, Xiamen, China

[3] Institute of Education, Tsinghua University, Beijing, China

[4] Academic Affairs Office, Xiamen University, Xiamen, China