Short and long(er)-term returns of self-efficacy's latent growth: Class attendance and longitudinal impact on knowledge, proximal and distal interest.

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Data is available on reasonable request but will take time as permission from the institution will be necessary first.

The short and long(er)-term dividends of self-efficacy's latent growth rate: Attendance, knowledge gain, and domain interest outcomes across two academic years

Abstract

The broad relationship between students' self-efficacy and interest has been highlighted for decades. This, along with the inherently developmental nature of learning, calls for a more thorough examination of the way fluctuations in students' self-efficacy influence their interest in learning within a single course over an academic year and beyond. The present study investigated how the latent growth of students' self-efficacy beliefs over time influenced their interest in a particular subject area, both short-term (3 weeks) and long-term (47 weeks). Data were collected at eight intervals: four times for self-efficacy within one academic year and three times for domain interest during the following academic year, primarily through weekly e-learning activities at a Japanese university. Attendance over three academic semesters, standardized achievement over one academic year (with prior knowledge control), and domain interest were modelled as outcomes in a latent structural equation model that encompassed a latent curve for self-efficacy beliefs throughout the course of study. The distinct contributions of both the baseline and the growth rate of self-efficacy beliefs to the variance in students' domain interest over the short and longer term were confirmed by the study. Over the course of two academic years, it was found that the growth rate of self-efficacy, relative to its baseline, became increasingly more important for key learning outcomes such as students' domain interest.

Introduction

For over four decades, self-efficacy (i.e., the belief in one's ability to be successful in a task/activity; Bandura, 1993; Schunk & DiBenedetto, 2021) and interest (i.e., a desire to re-engage with an object; Renninger & Hidi, 2015) have been theorised as being closely linked sources of student persistence (Bandura & Schunk, 1981). In an educational context, persistence refers to enduring student engagement and re-engagement in learning tasks over a meaningful period of time. The paired importance of self-efficacy and interest for student learning has recently been empirically strengthened by their reciprocal relationship across time (e.g., Authors, 2019; Nuutila et al., 2020), with self-efficacy hypothesised as supporting the sustenance and growth of students' interest in a specific object (Hidi & Ainley, 2008). The precise mechanisms for these contributions have only recently become the focus of empirical research.

Over the past four decades, research examining how self-efficacy impacts interest has grown from early cross-sectional correlative (Schunk & Bandura, 1980) to more recent longitudinal (Authors, 2019; Nuutila et al., 2020) studies. Acknowledging the dynamic nature of these interconnected individual differences (i.e., increasing/decreasing as well as qualitatively developing with learning experiences), educational researchers have begun to move beyond static longitudinal models. Researchers have begun to apply latent growth designs (requiring longitudinal data [with at least three, preferably four or more data points] with reasonable measurement invariance). Such designs are essential for separating the contributions of baseline and change components to outcomes, and might indicate more precisely how the interconnections between interest and self-efficacy play out across learning experiences in the short and longer-term. Early, related research (Kosovich et al., 2017) pointed to idiosyncratic roles for motivations and ability-beliefs' baseline and change components within learning outcomes. Recent research has confirmed the differential role of self-efficacy latent growth components and has pointed to the importance of baseline for

achievement, but change for future interest (Authors, 2022; Nuutila et al., 2021). These initial findings have signaled the potential for latent growth designs to explain the role of students' self-efficacy within their learning outcomes. Rigorous replications and longitudinal designs that clarify longer-term implications for students (i.e., beyond students' current course or subject study context) are critical to building on this potential.

The present study therefore built directly on two recent studies pairing interest and self-efficacy within latent growth research designs in tertiary (Authors, 2022) and primary (Nuutila et al., 2021) education. Both studies were carried out over comparatively brief periods (Authors, 12 weeks; Nuutila et al., a single class session), and focused solely on immediate interest outcomes. Moreover, both of these studies utilized marginal data for latent curve analysis (i.e., the minimum of three time points), which limited their ability to evaluate potentially more complex growth trajectories such as quadratic patterns (Hancock, et al., 2018). Both studies suggested differential roles and relationships for self-efficacy baseline and change rate within formal educational settings, underscoring the critical importance of each factor. This perspective has not yet been the focus of substantial theoretical exploration.

The present study was designed to extend our understanding of how students' self-efficacy for a course of study can contribute to their interest in a subject domain in the short, medium, and longer-term. To this end, this study examined how baseline self-efficacy and its rate of change, measured at four points over an academic year, independently contributed to interest at three subsequent stages: the end of that year, after an additional semester, and after a full subsequent academic year.

To ensure the findings of this study have practical implications in education, it modelled important observable variables as additional learning outcomes. These were: a. average course attendance, one of the strongest predictors of academic achievement (Credé et al., 2010), and b. cross-lagged standardised achievement, providing an unbiased assessment

of prior and developing abilities. To these ends, this study examined baseline/change for self-efficacy (for a course of study) and how they relate to students' interest the subject domain in the short (3 weeks), medium (16 weeks) and longer term (47 weeks). The study was conducted over two years within the demanding context of a compulsory, cross-faculty foreign language programme at a Japanese university, a setting known for its motivational challenges. To further strengthen the model test, the analysis controlled for a key demographic variable (gender) and relevant covariates from the learning experience (prior knowledge and utility-value).

Background

Self-efficacy (i.e., Bandura, 1977, 2011) and interest (Four-Phase Model of Interest Development; Hidi & Renninger, 2006; Renninger & Hidi, 2022) are two important individual differences that are hypothesised to contribute to student persistence. Self-efficacy is hypothesised as supporting students through difficult tasks, feeding learning experiences back through to students' engagement choices, acting as a self-regulatory process during and between proximal tasks. Interest in contrast is hypothesised as potentially developing across engagements with a topic/object from in-moment (situational) to a sustained desire to re-engage (personal). Interest therefore has implications for individual tasks but, potentially, across a lifetime of engagement in a topic/object. Separately and (potentially) synergistically, these can be critical sources of student choice and persistence.

Persistence is especially critical in situations where students lack choice about the initiation of learning and feel less invested in the learning process (Vallerand & Losier, 1999). Much of formal education consists of compulsory subjects. Even in ostensibly elective environments like tertiary education, much of what students engage with is in fact compulsory for progression to future courses and/or graduation. It is important therefore to understand how interest is supported. Specifically, in light of the reciprocal connections

highlighted by recent research, how self-efficacy (an important source of short-term, context specific persistence) might support short and longer-term interest is an important area for research.

The Central Role of Ability-Beliefs Within Learning

Ability-beliefs (or perceptions of control) are a crucial source of motivation, with established links to the environment broadly (Model of Reciprocal Determinism; Bandura, 1993) and to formal education specifically (i.e., Self-System of Motivational Model of Development [SSDM]; Skinner, 1995). Both models posit at least triadic reciprocal linkages between intra-individual factors, environmental factors, and behaviour/outcomes. SSDM provides theoretical linkages for educative artefacts (e.g., instruction and curricula) specific to classrooms. Both models demonstrate how environmental and intra-individual factors can motivate individuals. Maehr and Meyer (1997) defined motivation as that which has explanatory power for initiation, direction, persistence, intensity, and quality of learning behavior. While self-efficacy is theoretically aligned with persistence behaviors specifically (Bandura, 1993), research in formal education has also found self-efficacy to be a critical covariate of achievement (e.g., Schneider & Preckel, 2017).

Self-efficacy's Definition, Function, and Implications

Bandura (1977) posited that self-efficacy is an intra-individual belief that one has the ability to be successful in a specific task. Bandura (1993) differentiates self-efficacy from expectancy beliefs (e.g., expectancy-value; Feather, 1982) by suggesting that in addition to believing that one will achieve a successful outcome, believing that one has the necessary capacity is critical. Self-efficacy is theorized to support learning by carrying a student through the challenges and failures that are inherent to the learning process.

Interest and its Development

Interest, as noted, is defined as a desire to re-engage with a specific object (e.g., an activity, such as a sport, or a subject, such as math). As conceptualized by the Four-Phase

Model of Interest Development (Hidi & Renninger, 2006; Renninger & Hidi, 2022), interest is a multi-dimensional construct that can develop along with progressively greater engagement with an object. The four-phase model describes interest as potentially developing aacross stages: a. *triggered situational interest* is associated with externally driven changes in affect; b. *maintained situational interest* is associated with increased external support of value for an object; c. *emerging individual interest* is associated with a small but growing self-generated desire to re-engage with an object; and d. *well-developed individual interest* is associated with an increasingly sustainable self-generated desire to re-engage with an object over longer time periods, potentially even in the absence of external support. Across these stages, interest develops from a chiefly affective construct to a multi-dimensional construct that includes substantial elements of value and epistemological components.

Interest and its Covariates within Learning

Interest is both a central source of motivation for learning outcomes (Renninger & Hidi, 2022; Schiefele et al., 1992) and a critical outcome of the learning process (Harackiewicz et al., 2016). While the environment can drive short-term learning to some degree, an internal source of motivation is essential for students to be successful in most fields of study. In addition to being perhaps the most intensely researched source of student interest (Authors, 2022), value for an object has been identified as an integral aspect of interest development (Hidi & Renninger, 2006). A growing number of utility-value interventions have applied this principle to demonstrate that helping students develop a connection to a subject of study can boost interest (e.g., Hulleman et al., 2010; Hulleman & Harackiewicz, 2021). Utility-value is critical for interest development. This is in part due to its role within experiences of involvement and identification in topics/objects (Brown et al., 2015; Priniski et al., 2018), both of which are integral parts of the hypothesised four-phase interest developmental process (Renninger & Hidi, 2022). Longitudinal models integrating

dynamic measurement have suggested that, while initial value is indeed important, ability-beliefs (e.g., expectancy) might be the more important lever for enhancing interest as a learning outcome (Kosovich et al., 2017). Kosovich et al. found that rate of change in expectancy, but not utility-value, predicted increases in future interest.

Buttressing the importance of ability-beliefs' role within interest development, both theory (Hidi & Ainley, 2008; Hidi et al., 2006) and empirical evidence (Authors, 2019; Nuutila et al., 2020) support robust reciprocal linkages between interest and self-efficacy across time. Furthermore, interest and self-efficacy have each been found to predict knowledge gains at both situational (Authors 2021) and at course-level grain sizes (Authors, 2019; Nuutila et al., 2020). Therefore, self-efficacy and interest are essential individual differences that, together and reciprocally, stimulate and sustain learning.

Understanding how this pair of individual differences inter-relate and co-function across time is an important question—one that cannot be effectively addressed through experimental research. Even longitudinal-panel SEM incurs limitations in integrating changes across time. However, latent curve analysis provides accurate measurement of the individual contributions of baseline (intercept) and change (slope) components of self-efficacy towards outcomes (i.e., short-/mid-/longer-term interest).

Latent Curve Research with Self-efficacy and Interest

Scant research has tested the implications of latent curve analysis for students' ability-beliefs generally, let alone more specifically for self-efficacy. Much research in this area has historically been undertaken within the very loosely conceptualised *expectancy* component of expectancy-value theory (Feather, 1982). Researchers employing expectancy-value theory commonly use self-concept (Jacobs et al., 2002), self-efficacy (Bong, 2001), and sometimes expectancy (Kosovich et al., 2017) to frame students' ability (expectancy) beliefs. Latent curve analyses of student ability-beliefs across multiple grade levels have indicated that

ability-beliefs, similar to value, tend to decline across the formal education experience (Jacobs et al., 2002). A latent curve analysis of paired curves for expectancy and utility-value (Kosovich et al., 2017) has suggested that with respect to interest as an outcome, expectancy is the more important individual difference. Latent curve modelling with self-efficacy specifically, has indicated consistent predictions for knowledge (Nuutila et al., 2021) and interest (Authors 2022) outcomes.

Research surrounding the development of interest has mostly been short-term in nature, often conducted across a single learning experience (e.g., Rotgans & Schmidt, 2014), a semester (Authors., 2016), or an academic year (Authors, 2019). Understanding how self-efficacy feeds into interest, across both short and longer spans of learning, is therefore central to expanding our understanding of interest and its development. To this end, separating the baseline and change rate of self-efficacy is essential for enhancing our understanding of dynamic learning systems across courses, semesters and educational years within formal education.

Important Controls for Modelling Individual Differences in Education

Controlling for important covariates is essential for the validity of structural equation modelling results. First, dependent variables of concern should be modelled longitudinally (i.e., pre-post achievement and interest in the current study). Second, covariates with established predictive relationships for the core dependent variables (i.e., students' interest in the domain for the current study), where possible, should also be controlled for. Three important controls meet these criteria: utility-value, gender, and prior knowledge.

Utility-value's central contribution to interest development has been reviewed to this point, both theoretically, as a component within the four-phase model (Renninger & Hidi, 2015) and powerful area for interventions in students' academic interest (e.g., Harackiewicz et al., 2016). At a broader scale, utility-value has long been hypothesized to interact with

expectancy (which self-efficacy is related to) during the decision-making process (Atkinson, 1957; Feather, 1982). Decision making plays an increasingly important role throughout the tertiary education experience, as evidenced by factors such as course attendance (modelled in this study as a dependent observed variable; see Authors, 2018), selection of courses (Harackiewicz et al., 2012), and ultimately, career decisions (Rozek et al., 2017).

Two additional sources of control for SEMs of individual differences, both of which are widely recognised as critical in academic contexts, are gender (Voyer & Voyer, 2014) and prior knowledge (Dochy, 1992; Tobias, 1994). Gender is a persistent factor within a broad array of motivational (Meece et al., 2009; Voyer & Voyer, 2014), belief (Duckworth et al., 2019), and cognitive (Voyer & Voyer, 1995) factors within formal education generally. As a final note, including these controls is consistent with longitudinal structural equation modelling research in this area (e.g., Authors, 2019, 2022; Grigg et al., 2018; Kosovich et al., 2017; Nuutila et al., 2018, 2021).

Observed Outcomes

Key observed outcomes were included in the present modelling to reinforce and extend the model test: a. Knowledge gains across the first course of the study (longitudinal, standardized tests of English). Prior and future knowledge has robust theoretical (Bandura, 1993; Feather, 1982; Hidi & Renninger, 2006; Renninger & Hidi, 2022) and empirical (Authors, 2019; Hulleman et al., 2017) connections to self-efficacy, utility-value, and domain interest; b. Average course attendance across the two language courses examined in this study. Course attendance is an important learning outcome because of its exceptionally strong relationship with achievement outcomes (Credé et al., 2010), and is an observed (rather than latent) measure of engagement in higher education. Course attendance has empirical linkages to interest and value (Priniski et al., 2018), suggesting that these individual differences are integral to students' course participation choices. There is also evidence from research in

higher education that attendance is predicted by both students' ability-beliefs and perceptions of task-value (Authors, 2017).

The Current Study

This study longitudinally tested the implications of course-specific self-efficacy baseline (intercept) and rate of change (slope), modelled from four measurements across the first two semesters of a two-year course of foreign language study. The primary outcomes were students' individual interest in learning English as a foreign language (Domain interest) across the short- (near the end of two academic semesters), mid- (beginning of the third semester, the next academic year) and longer-term (near the end of the fourth and final academic semester) (see Figure 1). This test was undertaken while simultaneously controlling for: a. prior utility-value for the course subject (measured before the course of study), b. the longitudinal growth of course knowledge across the first academic year of the study, and c. the students' gender. Students' average course attendance was modelled as an additional observed dependent variable to better situate the implications and connections between the latent constructs.

Aims

The current study set out to extend our current understanding of the longitudinal relationship between self-efficacy growth and interest. To this end, three research questions and accompanying hypotheses were set and tested. The first two questions addressed essential controls for understanding the self-efficacy baseline and growth, while the third examined their contribution to Domain interest in the future, knowledge gains, and course attendance.

First, what is the predictive relationship of prior utility-value for future self-efficacy (intercept and slope), gains in knowledge, and interest (at each of three future measurements) (Research Question 1; RQ1)?

Hypothesis 1(H1): Utility-value was expected to (statistically) significantly positively predict future Domain interest (H1a; Hulleman et al., 2017), self-efficacy intercept (H1b; Authors, 2019), average course attendance (H1c; Priniski et al., 2018), but not knowledge gains (H1d; Hulleman et al., 2017). Insufficient longitudinal evidence exists to hypothesize direct prediction beyond the first interest measurement. Similarly, insufficient theory and empirical research exists to hypothesize clearly about the connection of utility-value to future self-efficacy's rate of change. Hypotheses were not set for these tests.

Second, what is the role of prior knowledge within future self-efficacy (intercept and slope) and interest (Research Question 2; RQ2)?

Hypothesis 2 (H2): Prior knowledge was expected to (statistically) significantly predict future self-efficacy intercept (H2a; Bandura, 1993), Domain interest (H2b; Hidi & Renninger, 2006), and course attendance (H2c; Authors, 2017). Insufficient evidence exists to confidently hypothesize about the longitudinal connections between prior knowledge and change in self-efficacy, and mid- or longer-term interest.

Third, what is the role of self-efficacy (intercept and slope) within knowledge gains, class attendance, and short-, mid-, and long-term interest (Research Question 3; RQ3)? Hypothesis 3 (H3): Past theory (Hidi & Ainley, 2008) and empirical studies, both static-panel SEM (Authors, 2019) and latent curve (Kosovich et al., 2017), support the expectation of robust longitudinal connections from self-efficacy (slope and intercept) for imminent future Domain interest (H3a). However, there is little evidence supporting direct (statistically significant) connections from self-efficacy to

mid- and long-term interest measures. Therefore, these connections remain open questions. Some empirical support exists for ability-beliefs supporting class attendance (Authors, 2017; H3b).

Methods

Participants

First-year students (*n*=390, Female=88; gender composition consistent with the institution where this study took place) from seven faculties at a private university in western Japan participated in this two-year study. The study was conducted within a compulsory cross-faculty foreign language programme, divided into four semester-long course sections during students' initial two years at the university. This arrangement for English as a Foreign Language courses is standard throughout Japan. Similar compulsory foreign language programmes are common across East Asia (e.g., Korea, Taiwan, Mainland China). Each course section employed identical teaching materials (textbooks, vocabulary; Author., 2010), standardized tests (Stewart et al., 2012, 2013), and weekly e-learning assignments (Bovee et al., 2011). Sections consisted of 25-35 students. Classes were 90 minutes long, held twice a week (60 weeks over two years). Students completed weekly homework assignments, taking approximately 90 minutes. Classes focused on the structured development of reading, writing, speaking, and listening, aiming for students to achieve sufficient proficiency for using English in the workplace.

Students were invited to join the study in their first year via online surveys administered within their weekly online assignments. However, only students who had completed the full two-year programme, and agreed to continue participating in the research in the latter half of their second year were included in the study. Consistent with research practices at the institution, the educational centre reviewed and granted ethical permission to

proceed with the study. All procedures performed in the study involving human participants were undertaken in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants.

Procedures

Data were gathered over the span of two academic years, encompassing the entire duration of the students' compulsory language courses. The initial data collection was in the form of a standardized placement test used to assign students to level-appropriate courses. The utility-value survey was completed at the same time as the prior knowledge placement test (T1), which was one week before classes started. By collecting this data before students began their classes, we ensured that these control variables were not influenced by their course experiences. Self-efficacy data were collected online, following e-learning assignments across the students' first academic year. Data were collected at intervals designed to strategically track the development of students' self-efficacy throughout the academic year at key educational time points. Four data points on self-efficacy were collected to ensure that a clear trajectory of potential change could be estimated, permitting the assessment of quadratic trends if the linear fit was found to be inadequate. Data collection was limited to weeks 2 through 11 of each 15-week semester, a period when all students engaged in e-learning assignments as a component of their language courses. The initial measure of self-efficacy was completed following the first four weeks of e-learning assignments in the first semester (T2). The second self-efficacy measure coincided with the completion of the students' final e-learning assignment of the first semester (T3), conducted six weeks after the first measure. The third self-efficacy measure was completed at the end of the second semester’s first week (T4). The fourth and final measure was completed after the last e-learning assignment, nine weeks subsequent to the third measure (T5).

The initial measure of interest was obtained three weeks after the last e-learning assignment, concurrently with a standardised test administered to all students at the conclusion of the first year's classes (T6). The two follow-up measures were collected after e-learning assignments in the second year of the study (T7 and T8). See Figure 1 for a concise overview of the data collection timetable.

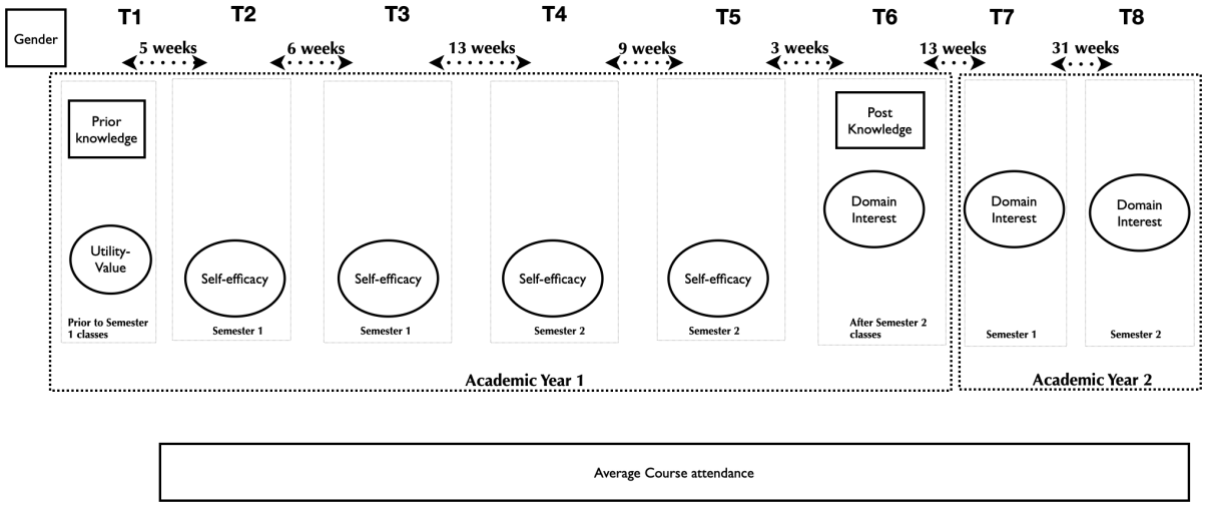


Figure 1. Research Design

Measures

The standardized tests used for modelling prior and post knowledge were 30-minute standardized multiple choice reading tests (Stewart et al., 2012). The Patterns of Adaptive Learning (Midgley et al., 2000) self-efficacy scale (e.g., "I can do almost all the work in this class if I don't give up") was used to capture students' course self-efficacy regarding their current course. Utility-value was measured using a three-item utility-value scale (Hulleman et al., 2010) at the level of their current course: e.g., "Learning English in this course is related

to my life this year." All scales were translated and back-translated by both a native and non-native bilingual researcher. Inconsistencies were resolved through discussion (Brislin, 1980). These scales have since been used in several studies in Japanese teaching and learning settings, consistently demonstrating strong construct validity and reliability (e.g., Author., 2016, 2019).

Interest was assessed at the domain level, focusing on students' interest in learning English as a Foreign Language. The scale for Domain interest included three items (e.g., “I think that English is always interesting”; translated here from its original Japanese form; Ichihara & Arai, 2004).

Attendance was modelled as students' average attendance in two connected courses across the two years of the study in a coordinated programme of English as a foreign language. Full scales are presented in English in the Appendix (Table 3).

Analysis

Analyses proceeded in three stages. First, the various datasets were joined and reviewed for errors. Missing data (6.4%) were addressed by the Robust Expected Maximum Likelihood imputation procedures native to JMP 14.1 (SAS, 2020). The imputed dataset was used to conduct further analyses to address this study's research questions.

At the second stage, descriptive statistics (means, standard deviations, and scale reliability), and pairwise correlations were calculated. ANOVA's (Bonferroni corrected) were conducted for the longitudinal variables as a foundation for the latent variable analysis. This was undertaken to ascertain statistically significant mean differences across the study (no hypotheses set). After reviewing these results, structural equation modeling tested the structural validity and invariance of longitudinal latent variables.

The adequacy of all structural equation models (configural, invariance testing, unconditional self-efficacy, full conditional structural model) were determined based on four

established indexes: Root Mean Square Error of Approximation (RMSEA) with values <.08/.05 indicating acceptable/good fit (Browne & Cudeck, 1992), Standard Root Mean Square Residual (SRMR) with values <.08 indicating good fit, and Tucker Lewis Index/Comparative Fit Index (TLI/CFI) with values >.90/.95 indicating acceptable and good fit respectively (Marsh et al., 1988). A power analysis was undertaken and determined that the sample size was adequate for the structure of the full conditional model (five latent variables, and 18 observed variables) and to detect small to moderate effects (at the .80 power level, and .05 significance level; Soper, 2024).

A full configural confirmatory factor analysis was conducted for latent variables, followed by invariance testing for self-efficacy and Domain interest. Invariance testing was conducted in three stages: configural, then metric, and scalar invariance were tested across time. Based on Chen (2007), the assumption of invariance is tenable if CFI decreases by no more than .01 and the RMSEA increases by no more than .015 for the invariant model.

The nested quality of the data (students in different classes within the coordinated programme described) was accounted for within the structural equation modelling by using cluster-robust standard errors (i.e., individual classes of students were treated as a cluster) with M*plus 7.1* (Muthén & Muthén, 1998-2019).

At the final stage, the structural equation model was tested. Initially, the unconditional self-efficacy latent curve was tested. For latent curve slope tests, and subsequent SEM, the four data points were fixed at 0, 1, 3.1, 4.6 (scaled to timing of data collection) to define a linear growth model. This test was followed by a fully-forward test (i.e., all prior variables predicting all future variables with no paths removed to improve fit) of the full structural model (Figure 2). The test of this structural model addressed the research questions and tested the presented hypotheses.

Standardised regression coefficients (βs) were utilised to estimate the effects of variables across time. For testing connections between variables which were cross-lagged (such as between interest and achievement), Orth et al. (2022) suggested that .03/.07/.12 be benchmarks β values for small/medium/large effect sizes. For non-cross-lagged effects (e.g., attendance), Keith's (2015) guidelines for estimating effect size in educational research were used: small/medium/large effects were estimated based on $|\beta| \geq .05/.10/.25$ respectively.

Results

Following imputation of the dataset, means and standard deviations were calculated for all variables. Cronbach's Alpha was then calculated for latent variables, presenting acceptable reliability (>.70; Devellis, 2012). Pairwise correlations for all modelled variables were consistent with theory and past empirical research that utilized similar constructs (Table 1).

	Utility-value T1	Prior Knowledge T1	Self-efficacy T2	Self-efficacy T3	Self-efficacy T4	Self-efficacy T5	Domain Interest T6	Post Knowledge T6	Domain Interest T7	Domain Interest T8	Gender	Average Course Attendance
Utility-value T1												
Prior Knowledge T1	.18**											
Self-efficacy T2	.19**	.13*										
Self-efficacy T3	.24**	.10	.48**									
Self-efficacy T4	.11*	.06	.37**	.36**								
Self-efficacy T5	.09	.06	.31**	.20**	.56**							
Domain Interest T6	.34**	.10	.26**	.21**	.39**	.40**						
Post Knowledge T6	.12*	.52**	.12*	.12*	.09	.05	.21**					
Domain Interest T7	.30**	.02	.39**	.43**	.45**	.34**	.46**	.04				
Domain Interest T8	.21**	-.01	.28**	.19**	.46**	.40**	.37**	.06	.46**			
Gender	-.19**	-.15**	-.01	-.01	.04	.01	-.02	-.06	-.03	-.02		
Average Course Attendance	-.03	.13*	.19**	.23**	.12*	.06	.13*	.09	.12*	-.01	.05	
Mean	4.51	45.02	4.28	4.22	4.19	4.23	3.34	54.34	3.93	4.20		10.95
Std Dev	.90	9.38	1.21	1.22	1.28	1.18	.97	8.33	1.31	1.43		1.21
Cronbach's Alpha	.91		.87	.90	.91	.87	.86		.79	.85		

notes: * $p < .05$; ** $p < .01$

Table 1. Pairwise correlations, Means, Standard Deviations, Cronbach's Alpha

Graphs presenting the changes in self-efficacy and Domain interest are presented in Figure 3-4 (supplementary file). Repeated ANOVAs for self-efficacy and Domain interest across the study resulted in non-significant and significant mean differences respectively across time: a. There was no statistically significant effect of time on self-efficacy $F(3,387)=.64$, $p=.59$ (T2=4.28, T3=4.122, T4=4.19, T5=4.23); b. There was a statistically significant effect of time on domain interest $F(2,388)=86.55$, $p<.001$, $\eta_p^2=.31$ (T6=3.34, T7=3.93, T8=4.20).

The configural CFA test resulted in good fit. Subsequent invariance tests for both self-efficacy and interest indicated that the assumption of invariance was tenable. Conditional/unconditional tests of the self-efficacy latent curve suggested that the pairing of intercept and slope (i.e., linear model) presented adequate fit. See Table 2 for all model fit related results.

Table 2. Fit for Structural Equation Models

	Configural CFA (Latent Variables)	Full SEM	Self-efficacy Latent Curve Configural test	Self-efficacy Latent Curve Metric Invariance	Self-efficacy Latent Curve Scalar invariance test	Domain Interest Configural test	Domain Interest Metric Invariance test	Domain Interest Scalar Invariance test	Self-efficacy Latent curve Intercept only	Self-efficacy Latent curve Intercept and Slope
CFI	.97	.97	.98	.98	.96	.99	.98	.98	.91	.97
TLI	.97	.96	.97	.97	.96	.97	.96	.96	.94	.96
RMSEA	.03	.038	.036	.034	.043	.047	.055	.058	.102	.076
Chi-Square(df)	578.303 (428)	233.314 (148)	200.903(134)	214.322 (147)	270.466 (158)	27.966(15)	41.057 (19)	50.601 (22)	40.611 (8)	16.338 (5)
SRMR	.04	.047	.037	.041	.045	.023	.043	.048	.079	.052

notes: Invariance (metric and scalar) for self-efficacy (four data points) and domain interest (three data points) are presented. Fit for unconditional and conditional latent curves for self-efficacy are presented.

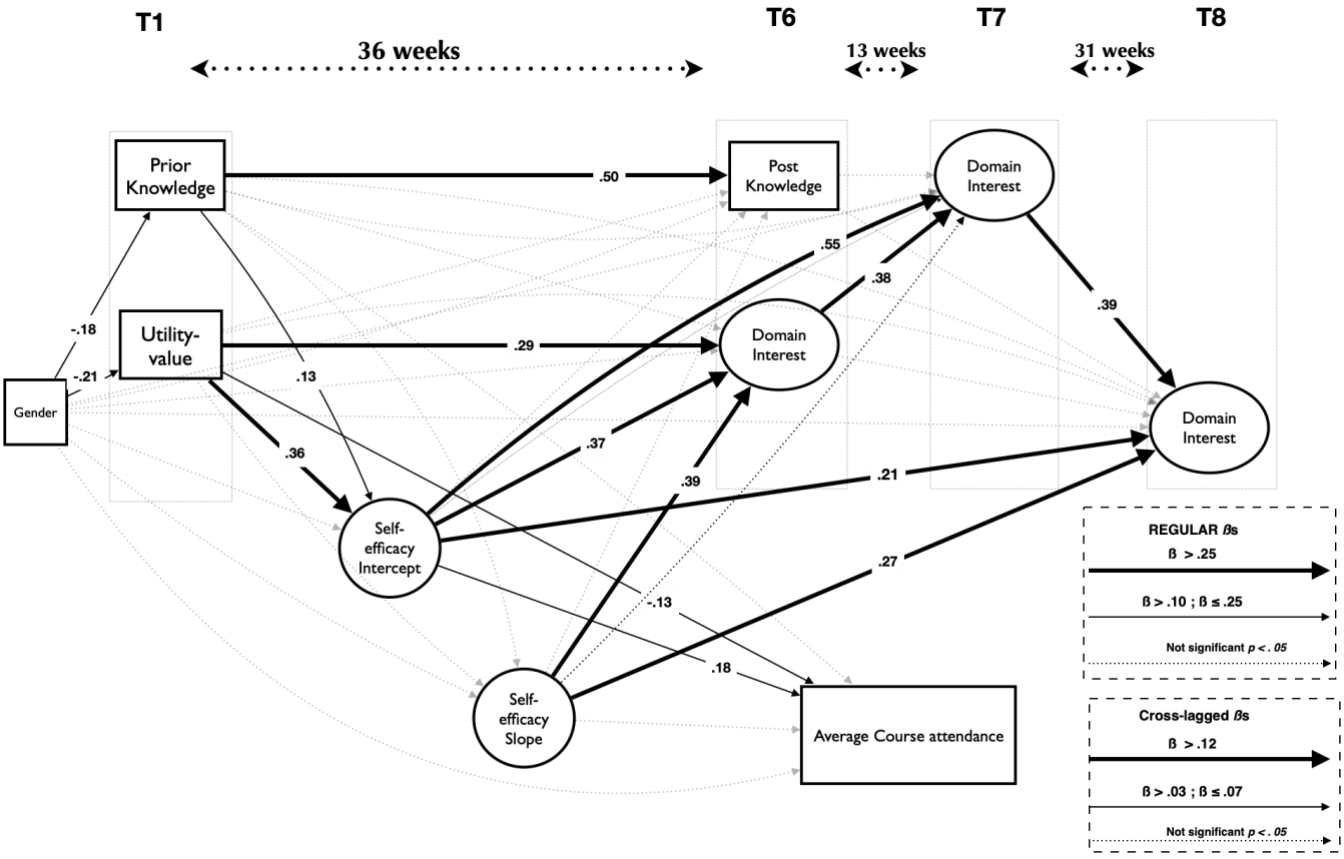
Table 2. Fit for Structural Equation Models

The fully-forward structural model fit the data well (Table 2). Final fully-forward modelling results are presented in Figure 2. Reviewing the results, utility-value (RQ1) presented: a) a large relationship with T6 domain interest (β=.29) but no direct relationships

with later interest measurements (H1a); b. a large relationship with self-efficacy intercept (β=.36) but not slope (H1b); c. a moderate negative relationship with average course attendance (β=-.13; H1c), and no statistically significant relationship with post knowledge (H1d).

Prior knowledge (RQ2), presented a large auto-lagged relationship (β=.50), and a medium relationship with self-efficacy intercept (β=.13) but not slope (H2a). Prior and post knowledge (standardized reading test) failed to predict both future domain interest (H2b) and course attendance (H2c).

Self-efficacy (RQ3; H3a), both intercept and slope, presented large relationships with T6 domain interest (β=.37 and β=.39 respectively); only intercept predicted (β=.55) mid-term domain interest (T7); both intercept (β=.21) and slope (β=.27) predicted long-term interest (T8). Self-efficacy intercept (β=.18), but not slope, predicted course attendance (H3b).



note: All prior variables modelled as predicting all future variables with no paths deleted to improve fit. All solid lines represent statistically significant *ßs* *p<.05.* Gender: Female = 0 , Male = 1 A full list of ßs (including those that were not statistically significant) are presented in the appendices in Table 4.

Figure 2. Fully-Forward Structural Equation Model

Discussion

This study aimed to expand our understanding of how self-efficacy contributed to interest across two academic years in two connected compulsory "English as a Foreign Language" course sections. Due to its longstanding theoretical and extensive empirical relationship with both self-efficacy and interest, the role of prior utility-value was controlled for within self-efficacy's latent growth and short-/mid-/longer-term interest. As established covariates of student motivation more broadly, gender and prior knowledge were also controlled for. Average attendance in the two course sections across the two academic years was included and modelled as an additional observed measure of student engagement.

Research Questions and Hypotheses

As expected, utility-value was an important predictor of self-efficacy (intercept) and domain interest (but only in the short-term). However, failing to support H1, utility-value did not predict knowledge gain across the first academic year of the study. Unexpectedly, utility-value presented a negative relationship with class attendance: i.e., students who reported higher value for the subject before the courses started, attended fewer classes across the two years of study.

Of the hypothesized connections including knowledge (prior and end of year one), only one cross-lagged significant relationship was supported: prior knowledge to self-efficacy intercept.

As hypothesized, baseline and change rate for self-efficacy differentially predicted future interest after the first academic year, with time being the critical factor for the difference. Both were meaningful predictors of short-term interest (3 weeks), while only baseline was a large predictor for mid-term interest (16 weeks). In a subtle reversal, the rate of change in self-efficacy emerged as the stronger predictor (relative to the baseline) for sustaining longer-term interest over a period of 47 weeks. Self-efficacy baseline, but not change rate, predicted students' average class attendance. Neither aspect of self-efficacy latent curve components made a significant contribution to post knowledge gains after accounting for prior knowledge.

Implications for Theory

Results from this study support an important role for initial utility-value within students' reasons for persisting in a course of study. Utility-value's strong connections to baseline self-efficacy and short-term interest support the growing body of utility-value intervention research (Hulleman et al., 2010, 2017). Results also suggest that utility-value had no longer-term direct impact on interest or the rate of self-efficacy growth, which points to

the limitations of utility-value interventions. Clearly, thinking that something is important or worthwhile will only take a student so far.

Furthermore, the results suggest that utility-value's direct support for interest fades over time. Self-efficacy, both baseline and growth rate, might step in and become increasingly important in regards to this supportive relationship. Both self-efficacy components (baseline and change rate) were robust predictors of interest across the three measures modelled. Their differential predictions after the first measure of interest (T6) suggest a potential new avenue for theorizing about how static and change-related measures of key individual differences might affect the learning process. Baseline self-efficacy was important for students' interest in the domain in the short- and mid-term, but not the longer term. Current theory for most individual differences, including self-efficacy, is not well situated to explain why rate of change is important for a students' longer-term interest. Given the longitudinal controls for key individual differences in the current study, it is safe to suggest that the course experiences driving the rate of change are important to the support of enduring interest. What exactly these course experiences might be, remains an open question.

Attendance is one of the strongest covariates of learning outcomes (see Credé et al., 2010; Schneider & Preckel, 2017). The relationship between attendance and the investigated individual differences is still only weakly understood, and the current study exposes just how complicated such relationships might be. Previous research (Author, 2017; Priniski et al., 2018), basic expectancy-value theory (Feather, 1982), and common sense suggest that individual differences—like prior knowledge, value for the domain, and ability-beliefs about course performance—are all likely to be factors that influence students' decision of whether to attend class. The current study revealed that students with higher self-efficacy for the course, but not initial value for the content, exhibited higher attendance rates. This result contradicts expectancy-value theorized interactions regarding this choice. Two preliminary

reasons might partially explain these findings. Students' initial valuation of the expected course content may not have been well aligned to the actual taught content: for example, students expected to be taught practical English but received a more academic and structured experience. In contrast, students who started with a low valuation might have felt pleasantly surprised by the course content, resulting in higher attendance rates. A regression to the mean (see Barnett, 2004) might also explain part of these theoretically contrary findings.

Implications for practice

The initial state (i.e., their readiness) of students upon entering a new learning environment plays a critical role in their success. How much they know (prior knowledge), their confidence in their ability to succeed (self-efficacy), their value for the content under study (utility-value), and likely many other individual factors need to be considered from two main perspectives. First, teachers and schools should strive to ensure that students start off with the most adaptive beliefs and motivations possible. For example, to ensure students' knowledge is at an appropriate fundamental level, students could receive tutoring in early grades. For both knowledge and ability-beliefs development, a programme of formative testing is a straightforward means of providing support. For utility-value, teachers can take the time to explain the importance of the course content and provide activities that help students gradually develop a personal connection to the subject matter (see Brophy, 2009; Harackiewicz et al., 2016). All of these strategies have to start early in students' education and be consistent across years and subjects. Other strategies that might be tried early in university courses to jump-start these individual differences are: a. early affordances for mastery experiences (self-efficacy; Bandura, 1977; Schunk & DiBenedetto, 2021); b. a writing assignment in the first class which encourages students to make personal connections to course contents (utility-value; Hulleman et al., 2010, 2017); c. a pre-test, administered

either before class (online) or during the first class, that impresses upon students the course expectations and encourages them to close any gaps in prior knowledge early on.

The current study's results demonstrate that the manner in which students' self-efficacy changes across an academic year can have implications, at least through to the following academic year and perhaps beyond. This suggests that self-efficacy needs to be constantly nurtured. While Bandura's suggestions for supporting self-efficacy (vicariously, verbally, through personal mastery experiences, and physical sensations; Bandura, 1977) are a useful foundation for understanding how experiences might be translated into self-efficacy, they provide minimal direction for broad curricular or instructional strategies. However, perceived control theory (Skinner, 1995)—a type of capacity belief (Schunk, 1995) within the broader concept of perceived control beliefs (Skinner, 1996)—can be drawn upon for additional direction since it is integrated into how teachers, students, and classrooms work (Author, 2023). Perceived control theory describes how structure in the learning environment can support students in developing robust perceptions of control over the course material. Structure is best described as those parts of the curricula and instruction that afford students a clear sense of curricular and teacher expectations as well as useful information about students' progress. Thus, structure is simply a key element of good quality teaching (e.g., Author, 2020) which can support adaptive ability-beliefs and motivations (e.g., Author, 2019).

Students who report higher self-efficacy at the start of a course are more likely to attend classes. Perceived control theory (Skinner, 1995) offers some direction, suggesting that the more students understand course expectations (independent study, lecture/tutorial/lab procedures, and assessment), and the better aligned the course is (course aims, teaching/learning, and assessment), the stronger students' self-efficacy is likely to become (Author, 2023).

Limitations and Future Directions

While this study builds on and extends previous studies (Author, 2021, 2022) and other burgeoning recent research in this area (Kosovich et al., 2017; Nuutila et al., 2020, 2021), external validity rests on further replication in a broader array of contexts. Relationships between variables approaching statistical significance may warrant additional tests for replicability (including gender on self-efficacy intercept: β=.09, p=.12; and prior knowledge on average course attendance: β=.13, p=.07). Future studies should consider including a variety of achievement measures to clarify whether standardized achievement measures in the current study impacted the results presented.

Conclusions

The current study focused on testing longitudinal relationships between students' baseline (intercept) and change rate (slope) in self-efficacy with future short-/mid-/longer-term interest. The components of self-efficacy were complementary and differential in their relationship with interest–depending on timing. These findings indicate that formal education should attend to both baseline and growth of self-efficacy. Self-efficacy is one of the strongest latent correlates of achievement in higher education (Schneider & Preckel, 2017); robust connections to both course attendance and a short-/mid-/long-term interest in the domain of study compound self-efficacy's critical role in the learning process. Curriculum developers and classroom educators alike need to take seriously actions that support self-efficacy, both prior to and during courses. An abundance of relevant theory and a burgeoning body of intervention-based methods stands ready to be applied.

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Appendix

Domain interest
I think that English is always interesting.
I know that English arouses my curiosity.
I like to learn new English topics.
Course Self-efficacy
I'm certain I can master the skills taught in class this year.
I'm certain I can figure out how to do the most difficult class work.
Even if the work is hard, I can learn it.
I can do even the hardest work in this class if I try.
I can do almost all the work in class if I don't give up.
Course Utility-Value
Learning English in this course is related to my life this year.
English I learn at university in this course will be useful this year.
Learning English this course is personally meaningful.

note: English translations from Japanese

Table 3. Survey items

	Prior Knowledge T1	Utility-value T1	Self-efficacy Intercept	Self-efficacy Slope	Post Knowledge T6	Domain Interest T6	Domain Interest T7	Domain Interest T8	Average Course Attendance
Gender	-.18**(.06)	-.21**(.04)	.09(.06)	.01(.15)	.02(.05)	.03(.05)	-.05(.05)	-.03(.05)	.04(.06)
Prior Knowledge T1			.13*(.05)	-.06(.09)	.50**(.08)	.04(.08)	-.03(.06)	-.07(.05)	.13(.07)
Utility-value T1			.36**(.08)	-.15(.14)	-.03(.06)	.29**(.07)	.03(.09)	.05(.09)	-.13*(.06)
Self-efficacy Intercept					.09(.06)	.37**(.07)	.55**(.08)	.21*(.10)	.18**(.06)
Self-efficacy Slope					-.07(.09)	.39**(.12)	-.03(.20)	.27*(.14)	-.08(.17)
Post Knowledge T6							-.14(.08)	.06(.07)	
Domain Interest T6							.38**(.12)	.07(.14)	
Domain Interest T7								.38**(.13)	

notes: * $p < .05$; ** $p < .01$

Table 4. Full list of all ßs for fully-forward model. Standard errors are presented in brackets. Row variable predicts Column variable.