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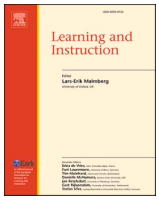

How does interest in a course interact with course learning?

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A B S T R A C T

Background: The present study modeled how students' interest in a course of study changes and how those changes fit into their broader course experiences.
Aims: The present study modelled the relationship between students' changing (latent growth curve) course interest, their readiness for learning (prior knowledge and interest), ongoing learning experiences (formative assessments) and important outcomes (post-course knowledge, self-efficacy, and interest).
Methods: Postgraduate students ($n = 415$) completed short surveys and formative assessments on six occasions across four weeks. Data were analysed within a latent structural equation model inclusive of a latent growth curve (course interest).
Results: Modelling pointed to the expected strong positive relationship between initial and growing course interest for latent outcomes (post interest and self-efficacy: $\beta = .26$-$.44$). At the same time, modelling revealed counterintuitive implications of prior knowledge for initial course interest ($\beta = -.12$) and pre-class learning formative assessment for course interest slope ($\beta = -.21$).
Conclusions: Course interest (initial and growing) is important for course outcomes, but it might be exceptionally sensitive to prior knowledge and initial learning fit based on early learning experiences.

1. Introduction

Learning is a developmental process. The obvious focus of most learning during formal education is the development of knowledge in a series of related but separate domains. Less obvious are the motivations and beliefs that support and sustain the amount and type of engagement necessary for knowledge development to continue across the months and years needed (Hattie & Donoghue, 2016). These are essential to the learning process and must develop alongside domain knowledge for learning to be sustainable (Alexander & Murphy, 2024; Renninger & Hidi, 2023). A central source of support for sustained learner engagement, which is modelled in a manner that addresses this specific issue, is interest (i.e., the desire to re-engage with an object; Four Phase Model of Interest Development; Hidi & Renninger, 2006; Renninger & Hidi, 2011, 2022). While interest is widely acknowledged by educators and researchers alike as critical to students' short and longer-term engagement, how interest develops in classrooms, buffeted as it is by the constraints and affordances unique to these environments (e.g., teachers, peers, curricula, and assessments) has been less often researched. Research during the past two decades has begun to address this broad question, focusing on students' interest in the classes and courses where learning takes place (Fryer et al., 2016, 2021; Häussler & Hoffmann, 2002; Hoffmann, 2002).

Longstanding and more recent theoretical (Clark, 2012; Renninger & Hidi, 2022b) and empirical (Shum & Fryer, 2023; Chen et al., 2016; Fryer et al., 2021; Niemivirta & Tapola, 2007; Nuutila et al., 2020, 2021; Rakoczy et al., 2019; Zhang et al., 2023) research has pointed towards a substantive and complex relationship between interest development and self-efficacy during formal education. These studies have suggested that this relationship might be moderated by prior knowledge and a range of other feedback elements intrinsic to formal education learning environments such as assessment. Hidi et al. (2007) has suggested connections that might underlie a model tying these components together: i.e., that interest can play a role in kickstarting engagement, which might feed self-efficacy through feedback (e.g., formative assessment), which can in turn support further interest.

Given its exceptional relationship with achievement (Hattie, 2023), its flexibility across learning contexts, and usefulness for a broad range of student profiles (Dunlosky & Rawson, 2015), formative assessment is an important source of feedback for students in any formal education context. Despite these consistent and generally strong relationships, the precise pathways by which formative assessment supports achievement is less clear. Furthermore, formative assessment's relationships with other critical components of the learning experience (e.g., self-efficacy and interest) have only nascent theory (e.g., Ainley et al., 2002; Hidi et al., 2007) and preliminary, robust (longitudinal; e.g., Nuutila et al., 2020) empirical

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support. Given the established power and flexibility of formative assessment (Dunlosky & Rawson, 2015; Irons & Elkington, 2021), a better understanding of its relationship with interest/self-efficacy may shed light on how formative assessment enhances learning outcomes and thereby how to further improve formative assessment interventions in classrooms.

The present study was designed to examine two critical developmental components of the learning experience. First, this study examined the relationship between formative assessment, the individual differences students bring with them to learning (e.g., prior knowledge and interest), and the latent and observed outcomes they carry with them between learning experiences (e.g., self-efficacy, interest, and achievement). Second, this study asked how students' interest in a course of study changed, how this change was supported by components of students' readiness for engaging (Renninger & Hidi, 2020) in something like a course (e.g., two components like prior knowledge and interest), and in turn supports learning in a course of study. To this end, students' course interest was modelled as a Latent Growth Curve, enabling relationships between initial levels and change in course interest components and course readiness, formative and important course outcomes to be tested.

2. Background

Learning at any level of formal education is an experience partially structured by expectations (Finn, 1972; Papageorge et al., 2020; Rubie-Davies, 2014) and feedback (Black and Wiliam, 1998a; Hattie & Gan, 2011). Expectations are set by curricula, the instructors, the individual students and/or parents. Feedback similarly can come from a wide variety of sources, but a critical source of feedback comes through assessment, both formative and summative (Hattie & Gan, 2011). Feedback through assessments can at the same time be critical mechanisms for simultaneously setting expectations for students. Formative assessment is clearly the more flexible (Dunlosky & Rawson, 2015), presenting strong meta-analytic relationships with students' achievement (Hattie, 2023). Relationships with other critical components of the learning process, such as self-efficacy and interest, have only preliminary theoretical (Hidi et al., 2007) and empirical (Fryer et al., 2021, 2023a; Nuutila et al., 2018, 2020) foundations. However, as feedback is central to the sustenance of self-efficacy (Bandura, 1993) and development of interest (Hidi & Renninger, 2006), formative assessment is well placed to be a strong source of support for both.

2.1. Interest development

Interest is a critical part of the learning process. The idea that we develop interest across experiences with an object has long been acknowledged (Krapp, 2007; Schiefele, 1991) and during the past few decades, been the topic of intense theoretical discussion (Ainley, 2006; Hidi, 1990; Renninger and Hidi, 2022a). A considerable portion of the interest research in education has come to focus on the Four Phase Model of Interest Development (Hidi & Renninger, 2006; Renninger & Hidi, 2011, 2022b).

2.1.1. The four phase model of interest development

The Four Phase Model of Interest Development describes interest as developing across a set of experiences with an object: a. *triggered situational interest* is a chiefly affective experience which is entirely reliant on the environment. Sustained engagement with the same object can lead to the second phase, b. *maintained situational interest* which is an increasingly multi-dimensional construct, but is still primarily affective and largely relying on the environment for sustenance, with increasing knowledge and value components. Transitioning from these stimulated to more internally sustained sources of motivation, c. *emerging individual interest* is the next potential phase, which includes affective elements, with increasingly substantial knowledge and value components. Across sufficient engagement with and increasing knowledge of an object, a strong personal connection can develop. With such experiences, interest can become a d. *well-developed individual interest,* which has the potential to act as a sustained source of motivation for driving re-engagement with its object, thereby supporting students in both knowledge and continued interest growth.

The four-phase model of interest development is a powerful means of describing the natural process of how experience can support the development of an individual's interest in any given object. Building on Hoffmann's (e.g., 2002) research in formal education, Fryer et al., (2016; 2021) demonstrated that in the constrained context of formal education, it is useful to consider three distinct levels in researching interest: task (an isolated, structured learning experience during class or independent study), course (a series of experiences, in a specific environment [i.e., curricula, instruction, and peers]) and the broader domain of study. Based on this research, course interest can therefore be conceptualised within the four-phase model as a combination of students' interest in the environment wherein the learning takes place and the actual content of the course. This provides a useful bridge between individual task experiences and longer-term domain interest which is focused on the area of study and consistent with later stages of the four-phase model of interest development (Fryer et al., 2016; 2020, 2021a). Supporting this suggested role, Fryer and Bovee (2021) demonstrated that Course interest is sensitive to course experiences, such as good and controlling teaching, and can be a substantive predictor of class attendance.

2.2. Self-efficacy and the model of reciprocal determinism

Students are motivated to learn for a wide variety of reasons in any given learning environment; many of these reasons are connected, often reciprocally, which can bring about virtuous circles. Interest and self-efficacy are one such example of a pair of individual differences which have both theoretical (Hidi et al., 2007; Renninger et al., 2024) and empirical (Chen et al., 2016; Fryer et al., 2016, 2019; Nuutila et al., 2018, 2020) reciprocal connections across time. Within this paired reciprocal model, self-efficacy, as part of social cognitive theory (Bandura, 1977, 1993), is reinforced by Bandura's model of reciprocal determinism (1978). This model describes how self-efficacy supports behavioural engagement which through feedback can then support self-efficacy. Bandura hypothesised four potential feedback pathways which could each act as a source of future self-efficacy for the task at hand: a. Mastery, b. Vicarious, c. Persuasive, d. Physiological.

2.3. Interest and self-efficacy in formal education

The development of students' interest during formal education faces many constraints and affordances that are less common or very rare across most day-to-day life experiences. With regard to these constraints, it is critical to remember that students have very little choice at any level of education (even at the postgraduate level), despite choice playing a critical role in the learning process (Bernacki et al., 2021). Students rarely choose their subjects/courses and have even less choice once the learning begins. Constraints such as time, peers, and instructors (i.e., assigned) could slow or potentially even prevent students' natural interest development. Similarly, poor quality teaching and learning experiences could limit the kinds of feedback social cognitive theory suggests (i.e., mastery, vicarious, persuasive, and physiological) are critical for self-efficacy to grow (Schunk & DiBenedetto, 2021).

It is important to note that formal education does offer a host of affordances which might support both steady development of interest and the growth of self-efficacy. Interest is supported by novel, personally relevant, and emotionally stimulating tasks at early stages, and then gradually more challenging tasks within increasing utility which support mastery and deeper learning (Renninger & Hidi, 2022). A combination of well-structured curricula and instruction which has a keen eye for students' individual differences can therefore play a meaningful role in

interest development. Similarly, classrooms which build in a wide variety of feedback experiences (mastery to physiological) can support self-efficacy in growing across days, weeks, semesters, and years of formal education (Kim and Bong, 2023).

Acknowledging some of the constraints and affordances of formal education should focus attention on how educators can expand on the latter. Specifically, several reviews and meta-analyses have shown how current educational tools are effective in supporting observed (e.g., achievement) and latent (e.g., motivation) learning outcomes (Hattie, 2023; Lee et al., 2020). Few educational tools pair a broader empirical base of support with simplicity than formative assessment (Hattie, 2023; Morris et al., 2021).

2.4. Formative assessment: cumulative evidence and integrative approaches-

Formative assessment has been described as "feedback in any assessment" (Black and Wiliam, 1998a, p. 53). Since the seminal reviews that brought attention to the field of formative assessment (Black and Wiliam, 1998a), there have been isolated researchers and research groups who have nudged the theoretical and empirical boundaries around formative assessment (Morris et al., 2021). Black and Wiliam (2009) made preliminary efforts to connect formative assessment with a broad range of motivational and cognitive psychological theories (for an early call see Perrenoud, 1998). They have called for more of this kind of effort (e.g., Black & Wiliam, 2018), and have urged higher education researchers/educators to learn from the rich body of research undertaken at earlier stages of education (Black & Wiliam, 2010). Leenknecht et al. (2021) and Dayal (2021) are deductive and inductive ways in which this discussion has been nudged forward recently: pointing to formative assessments' implications for the psychology that underlies student motivation and how it can be affected by teachers' experiences and subsequent instruction.

2.4.1. Meta-analytic evidence

During the past few decades there has been an abundance of reviews of the formative assessment literature from a broad range of perspectives (e.g., Bennett, 2011; Morris et al., 2021; Stanja et al., 2023; Wiliam, 2010). These reviews have been supplemented by meta-analytic evidence consistently confirming the strong relationship between formative assessment and student achievement (Hattie, 2023). With the initial groundswell of empirical research and reviews, a handful of practice-orientated papers and books were published seeking to apply the growing evidence to classrooms and schools. One such approach was to fully integrate formative assessment into teaching, often referred to as curriculum embedded formative assessment (Lee et al., 2020; Shavelson et al., 2008; Wilam, 2011).

2.5. Formative assessment and motivation to learn

Black & Wiliam's, (2010) expansive exploration of the relationship between formative assessment and psychological theories on why and how students learn, asked many important questions. It reaffirmed Perrenoud's (1998) early contention that if our understanding of formative assessment was to progress, that it must be seated within a broad and robust theoretical framework. If we focus on how formative assessment is supported by and reciprocally supports students' motivation to learn, social cognitive theory is a logical theory to apply. Social cognitive theory is focused squarely on feedback from the environment, this means that it can be applied to both explaining and potentially enhancing the contribution of formative assessments (i.e., a critical source of feedback during formal education) for future self-efficacy and self-efficacy's reciprocal role supporting formative assessment performance (examples of the latter: Fryer et al., 2021, Fryer, Bovee, & Nakao, 2022). Fryer and Leenknecht (2023) expanded Skinner's Self-System Model of Motivational Development (SSMMD; Skinner & Belmont, 1993) to include self-efficacy as one type of perceived control (Connell, 1985). By modelling self-efficacy as a type of perceived control (which it is widely acknowledged to be: e.g., Schunk, 1991; Skinner, 1996), connections from classroom experiences to self-efficacy become more straightforward. Essentially any aspect of the classroom that lends *structure* (i.e., information informing students about how they can be academically successful in a context; for a recent reviews see Patall et al., 2024; Skinner et al., 2022) to student's experience can provide support for their self-efficacy. Formative assessment is one important source of structure and therefore potentially an important support for self-efficacy. Self-efficacy's aforementioned reciprocal relationship with interest establishes a potential mediated path from formative assessment to the development of longer-term motivation to learn. In addition to the potential mediated contribution of formative assessment, the Four Phase Model describes increasing knowledge as a critical factor within interest and its development across learning experiences (Renninger et al., 2024).

3. Current study

The current study aimed to extend our understanding of the nature and role of the development of course interest within student learning experiences and outcomes. Specifically, this study aimed to connect the dynamic changes of interest in an introductory course on how to teach, with prior and ongoing learning experiences (prior knowledge/interest and formative tests) and key learning outcomes (knowledge, interest, and self-efficacy). This study builds on a burgeoning body of sophisticated longitudinal research presented to this point. This study extends this work by the present study's experience sampling design, application of a four-data point latent growth curve and mixed latent/observed variable design. By modelling latent change with concrete knowledge outcomes this study connects underlying learner development with the knowledge outcomes that are explicit focuses of education.

More broadly, this study aimed to build on longstanding evidence of the power and flexibility of formative assessment (Dunlosky & Rawson, 2015). Furthermore, this study sought to address calls for formative assessment to be aligned with substantive psychological theory, seeking to address how formative assessments' contribution to learning might be affected by and in turn affects the learning process and outcomes (e.g., Black & Wiliam, 2010). These dual aims were addressed through theoretically framing the study through the application of the four-phase model of interest development (within the constraints of formal education) and social cognitive theory (with a focus on teacher self-efficacy due to the course's focus on preparing students for imminent teaching as tutors). A micro-analytic (i.e., frequent, short, on task measurement) design was embedded into an eight module, 24-h course on teaching training for research postgraduate students. For participating students in the current study, the teaching training course was their first substantive theoretical and practical experience (i.e., practice teaching within the course) in teaching. This lack of experience and proximal aims of the course make it an ideal context to examine how course interest and self-efficacy are inter-related across time.

Participants completed formative assessments (multiple choice with answers provided at the end) and short surveys at the beginning and/or end of classes across the short course. The pre-post design controlled for prior knowledge (Tobias, 1994) and domain (teaching) interest (i.e., together conceptualised as components of students' readiness for learning; empirically tested as a control for interested and related outcomes by Fryer et al., 2021; theorised as a critical difference student engagement in "tasks, activities or assignments … " by Renninger & Hidi, 2020, p. 15), with the same variables being measured along with teaching self-efficacy as outcomes. Students' course interest was measured four times with the aim of capturing and modelling its longitudinal change across the course. In addition to prior Domain interest and Knowledge being modelled as important sources of control for the course interest growth, gender was included as a control. A substantial

body of research has confirmed the potential impact of gender on an individual's motivations to learning across an array of contexts (e.g., Voyer & Voyer, 2014). While the present research does not specifically address questions of gender, it is seen as an essential demographic factor to be controlled for.

To address the current study's aims of understanding the role and nature of the development of students' interest in a course, a longitudinal, quantitative research approach was pursued. Latent growth curve analysis is a well-established means of measuring construct change across time, with a minimum of four data points necessary to establish a robust curve (Duncan et al., 2006). To effectively test how factors support course interest growth across time and the implications of its change for important course outcomes, it was necessary to embed the latent growth curve in a simultaneous structural equation model. To address these needs, a longitudinal design (inclusive of four data points for course interest) with a substantial sample, was organised for the present study. Fig. 1 presents the overarching research design in detail. The participants, procedures, instruments, and analysis plan are presented in detail after the study's research questions and hypotheses.

4. Aims and research questions

The present research aimed to make two contributions to our understanding of student learning. Firstly, this study aimed to extend our understanding of how students' changing interest in a course of study interacts with other aspects of formal learning environments. Secondly, the current study was designed to test formative assessments' relationship with key psychological theories related to student learning: social cognitive theory and the four-phase model of interest development. Research questions and hypotheses are forthwith reviewed.

What are the predictive relationships from students' readiness for a course (i.e., prior domain interest and knowledge [Fryer et al., 2021]), initial and changing Course interest, to their formative assessment outcomes, and end-of-course measures of interest, self-efficacy, and knowledge (Research Question 1)? Prior domain interest (Hypothesis 1a) and prior knowledge (Hypothesis 1b) were each expected to positively predict initial and change in interest for the course of study (medium and large *ßs* respectively: Fryer & Ainley, 2019; Kosovich et al., 2017 and students' achievement on formative assessment (medium and small-nil respectively: Fryer et al., 2021). The same readiness components were expected to present large auto-lagged (Hypothesis 1c) and smaller cross-lagged *ßs* for the course outcomes modelled (Hypothesis 1d; Fryer et al., 2021). How are formative assessment outcomes related to one another, to initial and changing interest, and to post measures of interest, self-efficacy, and knowledge (Research Question 2)? As a start, formative assessment outcomes were expected to present large auto-lagged relations between and across the formative assessments employed (Hypothesis 2a; Fryer et al., 2021, Fryer & Shum, 2024). Initial formative assessments were expected to predict initial and change in course interest (Hypothesis 2b). Formative assessments were expected to positively predict (small to medium *ßs*) the post measures of interest and self-efficacy, and end-of-course knowledge (large *ß)* (Hypothesis 2c; Fryer et al., 2021; Nuutila et al., 2020).

Finally, what is the relationship between initial and patterns of changing course interest and outcomes such as domain (teaching) interest, self-efficacy for teaching, and end-of-course knowledge of teaching (Research Question 3)? Initial and increasing interest were expected to positively predict post domain interest, post self-efficacy, and end-of-course knowledge (Hypothesis 3; Fryer, Bovee, & Nakao, 2022; Niemivirta & Tapola, 2007; Nuutila et al., 2021).

5. Methods

5.1. Participants

The present study was conducted in a teaching course which was mandatory for research postgraduate students with teaching responsibilities during their studies. As students with previous teaching experience are exempted from the course, the students participating in the present study had no substantive prior experience teaching. The study was conducted in a comprehensive, publicly-funded, and research-intensive university in Hong Kong , where around 37% of the total student population are postgraduate students. Research postgraduate students from nine of the university's 10 faculties were enrolled. The overall participation in the study consisted of: $n = 451$ invited; $n = 435$ participated, Female = 236, Male = 185; Prefer not to say/Non-binary = 14. The faculty representation of the sample was roughly consistent with university's postgraduate student population. Students' specific demographics were not included in the ethics application for the current study and were not collected. However, based on the general demographics of the university, the majority of the students would be of Chinese ethnicity. The full programme of annual courses, from which

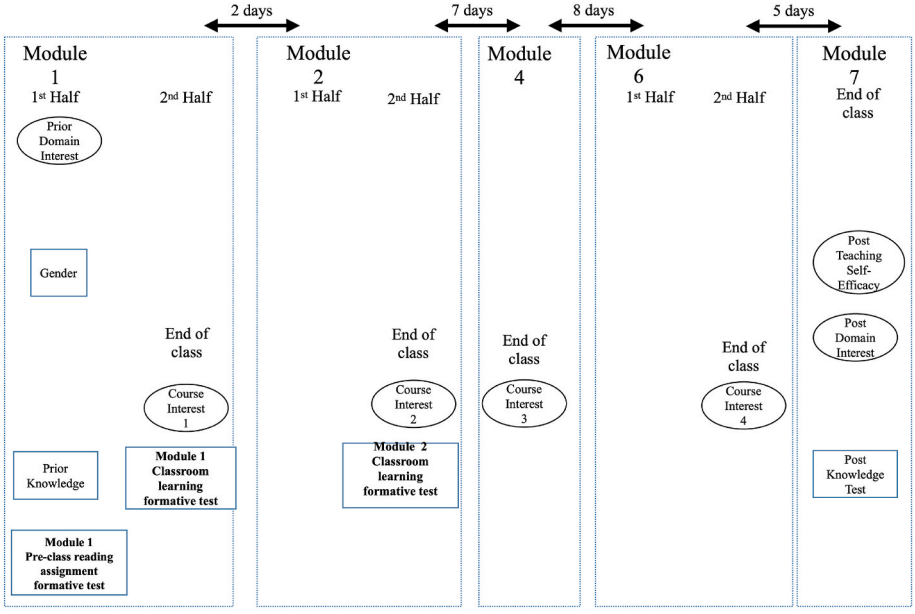

Fig. 1. Research design.

this study sampled, is made up of 14% MPhil and 86% Ph.D. students. Prior to conducting this study, ethical clearance was granted by the university's research ethics committee [Ethics# EA1608028].

5.2. Procedures

Participants completed all measurements during class time using their mobile phones. Participants scanned a QR code, leading to an online bespoke platform. In the first module, students registered on the platform, receiving an automatically generated anonymized code (e.g., 2ETQHLiGWWxe2De1u0eCnmT11zl), enabling anonymous longitudinal response collation across the course. Instructors explained the purpose and aims of the study and invited all students of the course to participate in the study. Consent was sought in the first half of the first module. Participants were told they could withdraw at any time with no negative consequences. There were no material nor grade benefits for participating in the study. Regardless of consent, students were encouraged to complete the formative assessments to receive feedback on their ongoing understanding in the course. Instructors provided students with about five to 10 min of class time to complete each test, and about 2 min to complete each survey at the beginning or end of the class (see Fig. 1). Immediately after the completion of the formative tests students received a score and full answers to review and reflect upon. Student could return to the tests, its results and answers at any time during the course.

5.3. Instruments

The scales employed in the current study were planned with attention to both parsimony and quality of measurement (e.g., reliability and construct validity; Kosovich et al., 2017): i.e., they were consistent with past studies in this area, in this context and were kept succinct for easy completion. All scales used in the present study had been successfully validated and used for a previous longitudinal study in the same context (Fryer et al., 2021). The domain interest measure drew upon a previously validated interest scale centring on perceived knowledge and previous efforts of voluntary re-engagement with the domain (e.g., "In your spare time, how often have you tried to learn about teaching?"; 3 items; Renninger & Schofield, 2014). The Course Interest Scale consisted of items measuring re-engagement and personal meaning (e.g., "I want to learn by taking courses like this. How does this statement match you?"; 3 items; Fryer et al., 2021, Shum et al., 2021; Hidi & Renninger, 2006). As the focus of the course context for this study was preparation for teaching as a university tutor, self-efficacy was measured with items from the Teacher's Sense of Self-Efficacy scale, focusing on one's perceived ability in skills that are trained in the course (e.g., "I can craft good questions for students. How does this statement match you?"; 4 items; Tschannen-Moran & Hoy, 2001). All three scales have demonstrated good validity previously in higher education contexts (Fryer et al., 2021, Shum et al., 2021). Domain interest was measured at the beginning and end of the course. Self-efficacy was measured at the end of the course as an outcome. Course interest was reported four times across the course. All items were reported from 1 to 6, ordinally, from nothing like me to exactly like me. The full set of items and labels are provided in the Appendix (see Table 5).

All tests consisted of only multiple-choice questions designed by the second and fourth authors, who were the course co-ordinators, and taught approximately 70% of the participants. They were best positioned to design formative assessments consistent with supporting students' understanding through feedback and the demands of the course. The prior knowledge and post-test measures were designed to broadly assess the content taught across the course. The pre-class reading assignment tests were based primarily on understanding of assigned short pre-class readings relevant to the module's content (taking about 15–20 min to complete). The in-class classroom learning test assessed students' understanding in the material taught in the module. Test items along with their multiple-choice options are provided in the Appendix, Table 4. The timing of the study's data collections is provided in Fig. 1.

Gender was included as a control variable in the current study. For correlation and regression analyses purposes, gender were modelled as Female (1) and Male (0). Given the lack of teaching experience across the participants, prior teaching experience was not included as a control variable.

5.4. Analyses

Prior to conducting analyses, missing data were calculated (12.5%) and assessed using Little's MCAR test ($p = 1.00$). Failing to reject the null hypothesis, (i.e., that the data is MCAR, that no patterns existed in the missing data) we proceeded with imputation of the dataset which was used for all further review and analyses. Missing data were addressed through REML imputation, employing JMP 14.01 (SAS, 2023) which is a widely recognised means of addressing reasonable amounts of MCAR data (Enders, 2022). With a complete dataset, descriptive statistics, pairwise correlations and Cronbach's alpha were calculated and reviewed. To address the study's research questions, a fully-forward cross-lagged panel structural equation modelling was tested. A fully-forward cross-lagged model is a model wherein a prior variable is modelled as predicting all future variables with no paths removed to enhance fit. Variables which were collected at the same time point were allowed to correlate with each other. Prior to this analysis three tests were undertaken with the longitudinal variables to ascertain construct validity: invariance testing for each of a. Course interest (four data points), b. Domain interest (two data points). Additional tests: c. full configural model test of all constructs (i.e., confirmatory factor analysis), and d. unconditional and conditional latent growth curve tests were undertaken.

The data for this study were nested in nature (i.e., students in 21 offerings of the same course using the same teaching materials taught by four instructors). Multi-level modelling was not considered appropriate because the number of level two clusters was insufficient to prevent potential bias (i.e., <50; Maas & Hox, 2005). To safeguard our results, we undertook a preliminary test to decide if our latent growth curve model needed to account for nesting of students in different course cohorts. We tested a conditional model with cluster-robust standard errors within M*plus* 7.4 (Muthén & Muthén, 2022) and compared it with the un-clustered data. For both analyses, intercept and slope parameters were statistically significant. As a result, the simpler approach was pursued and no adjustment for course cohort was undertaken.

Three fit indices were used to assess fit for all latent models tested: Tucker-Lewis Index/Comparative Fit Index (TLI/CFI) with values > .90/.95 indicating acceptable/good fit respectively (Marsh et al., 1988); Root Mean Square Error of Approximation (RMSEA), with values < .08/.05 indicating acceptable/good fit respectively (Browne & Cudeck, 1992).

Invariance testing was undertaken by comparing three models: Configural, Metric, and Scalar. CFI and RMSEA comparisons were used to assess the adequacy of the invariance across the study. The assumption of invariance is tenable if CFI does not decrease by more than .01 and the RMSEA increases no more than .015 for the more stringent model (Chen, 2007). Where full invariance was not possible, partial invariance was tested.

For cross-lagged standardised regressions (βs), Orth et al.'s (2022) recommendations are that .03 (small effect), .07 (medium effect), and .12 (large effect) are meaningful benchmarks for interpreting results. Keith's (2015) guidelines for estimating βs (not necessarily cross-lagged) in educational research are: $|\beta| \geq .05/.10/.25$ for small, medium. and large effects respectively.

6. Results

Prior to analyses which directly address this study's hypotheses, an

examination of the modelled constructs convergent/divergent validity, reliability, and longitudinal invariance is presented and reviewed.

6.1. Descriptive statistics and reliability

A review of the modelled constructs' pairwise correlations indicated relationships (Table 2) broadly consistent with recent (Fryer et al., 2021; Nuutila et al., 2020) and longstanding (Bandura & Schunk, 1981) empirical studies. Cronbach's alpha for all self-reported scales were well above accepted thresholds (>.70, Devellis, 2012).

6.2. Invariance, configural model, and unconditional latent growth curve tests

Longitudinal measurement invariance testing (configural, metric, and scalar) of course interest (four data points) indicated that invariance across the course of study was tenable. For domain interest (pre-post) partial metric invariance test suggested that partial invariance was tenable (Table 1). As for course interest, the unconditional model for both the latent growth curve and full configural model test presented reasonable fit based on the guidelines presented (Table 1). Average standardised slope (.625, $p < .001$), intercept (5.46, $p < .001$) and variance were consistent and statistically significant ($p < .05$) for both unconditional and conditional tests of the latent growth curve. The slope and intercept were negatively related but not statistically significant ($r = -.10$, $p = .27$) The configural confirmatory factor analysis model presented acceptable fit (see Table 1).

6.3. Configural model and fully-forward cross-lagged model test

An initial test of a configural model to establish convergent and divergent validity was undertaken first, fit indices and pairwise relations were reviewed. Reviews of these outcomes (Tables 1 and 2) suggested reasonable convergent (fit for CFI/TLI and RMSEA based on the afore mentioned heuristics) and divergent (pairwise correlations consistent with past research in this area). The test of the fully-forward model, presented in Fig. 2; presented acceptable fit based on the heuristics described in the analysis section (Table 1). Fig. 2 only presents statistically significant βs ($p < .05$), but show all regressions tested as dotted lines. All βs are presented in Table 3 in the appendices for the interested reader. The review of the model results will begin by addressing the contribution of students' readiness (prior domain interest and knowledge) for students' course experiences (Research Question 1), followed by formative assessments' βs for future formative assessment achievement, course interest (slope and intercept) and the course outcomes (Research Question 2), and concludes with course interest (slope and intercept) predictions for students' course outcomes (Research Question 3).

To answer Research Question 1 regarding the readiness components, prior domain interest was a medium positive predictor of course interest intercept ($\beta = .11$), and negative predictor of course interest slope ($\beta = -.12$) (Hypothesis 1a). The prior knowledge test was a large negative predictor of course interest intercept ($\beta = -.12$), and positive predictor of Module 2 formative assessment ($\beta = .08$) (Hypothesis 1b). Prior domain interest and prior knowledge presented large ($\beta = .49$) and medium ($\beta = .10$) auto-lagged predictions to end-of-course outcomes respectively (Hypothesis 1c). Finally, prior domain interest predicted post teaching self-efficacy ($\beta = .32$; Hypothesis 1d).

Regarding Research Question 2, the formative assessments presented three medium statistically significant auto-lagged predictions (.09, .11, and .21; Hypothesis 2a). Module 1 pre-class learning formative assessment presented large cross-lagged statistically significant βs for course interest slope ($\beta = -.21$; Hypothesis 6) and post knowledge test ($\beta = .17$; Hypothesis 7). Module 1 classroom learning f ormative assessment did not present any statistically significant cross-lagged βs (Hypotheses 2b & 2c). Module 2 formative assessment presented a large cross-lagged statistically significant βs to the post knowledge test ($\beta = .17$; Hypothesis 2c).

Addressing Research Question 3, Course interest components presented five statistically significant cross-lagged βs to the outcomes (Hypothesis 3): Course interest intercept presented two statistically significant large βs: post teaching self-efficacy ($\beta = .44$), post domain interest ($\beta = .43$) and negatively predicted the post-test ($\beta = -.13$). Course interest slope predicted post teaching self-efficacy ($\beta = .26$) and post Domain interest ($\beta = .27$).

7. Discussion

Theoretical focuses for the current study were to a. build on our understand how students' interest in a course developed and, controlling for their gender and readiness, test its longitudinal relationship with important course experiences and outcomes; b. test the interconnected nature and outcomes of formative assessments across a course of study.

7.1. Hypotheses-related findings

Students' readiness for the course (represented by prior interest and knowledge in the current study) presented many medium to large auto-lagged and cross-lagged βs with future learning and course outcomes (Hypothesis 1a). Prior knowledge's negative prediction of Course interest intercept and slope could have indicated poor fit of the introductory course for students with substantive prior experience teaching (Hypothesis 1a and 1b). As expected (Hypothesis 1c), medium to large βs were present for all auto-lagged tests. A cross-lagged prediction from prior domain interest to post teaching self-efficacy was confirmed (Hypothesis 1d). The lack of other significant cross-lagged connections might suggest inconsistencies between students' theoretical knowledge for teaching and motivation to teach (i.e., the act of teaching): that greater theoretical knowledge of teaching might not support increased motivation for teaching.

Both types of formative assessments presented medium to large auto and cross-lagged positive βs (Hypothesis 2a) confirming the connected, developmental growth of knowledge and feedback across a course of study. Only two of the formative assessments were timed sufficiently early to be meaningful predictors of initial and changing interest for the course, and only the Module 1 pre-class study test presented a statistically significant, large negative β for changing course interest (Hypothesis 2b). This might indicate that students who performed better on the first formative assessment were less likely to experience positive growth in their interest in the course (i.e., poor fit for the introductory course). The formative assessments' collective contribution to the outcomes of the study were constrained to two large βs for the post

Table 1
Configural, metric, and scalar invariance models tests for course and domain interest.

	Course interest invariance			Domain interest invariance			Full Model	
	Configural	Metric	Scalar	Configural	Metric (partial)	Scalar (partial)	Full Configural Model (CFA)	Full SEM Model
CFI	.996	.995	.993	.993	.989	.989	.960	.950
TLI	.990	.990	.988	.978	.971	.976	.930	.920
RMSEA	.046	.047	.052	.056	.064	.059	.060	.050
Chi-Square(df)	57.643(30)	70.800 (36)	87.502(40)	11.789 (5)	16.611(6)	17.560(7)	306.969 (125)	257.298(121)

Table 2
Pairwise correlations, descriptive statistics and reliability for modelled variables.

	Gender	Prior Domain Interest	Prior knowledge	Course Interest Intercept	Course Interest Slope	Module 1 pre class study Formative assessment	Module 1 in class study Formative assessment	Module 2 in class study Formative assessment	Post Domain Interest	Post Teacher Self-efficacy	Post Knowledge
Gender											
Prior Domain Interest	.11*										
Prior knowledge	.01	−.06									
Course Interest Intercept	−.02	.09	−.14*								
Course Interest Slope	.04	−.10	−.06	−.10							
Module 1 pre class study Formative assessment	−.06	−.03	.17**	.05	−.20						
Module 1 in class study Formative assessment	−.08	−.05	.07	−.02	−.08	.12*					
Module 2 in class study Formative assessment	−.01	−.08	.12**	−.09	−.08	.23**	.13**				
Post Domain Interest	.03	.50**	−.18**	.47**	.17	−.05	−.01	−.15**			
Post Teacher Self-efficacy	−.02	.32**	−.17**	.47**	.17**	−.01	.04	.09	.84**		
Post Knowledge	−.11	.13*	.16**	−.10	−.01	.23**	.14**	.24**	−.04	−.03	
Mean		2.56	1.28			1.69	2.74	2.10	4.09	4.35	1.88
Std Dev		.59	.61			.73	1.45	.64	.68	.63	1.04
Cronbach's Alpha		.78							.85	.93	

Note: *p < .05; **p < .01.

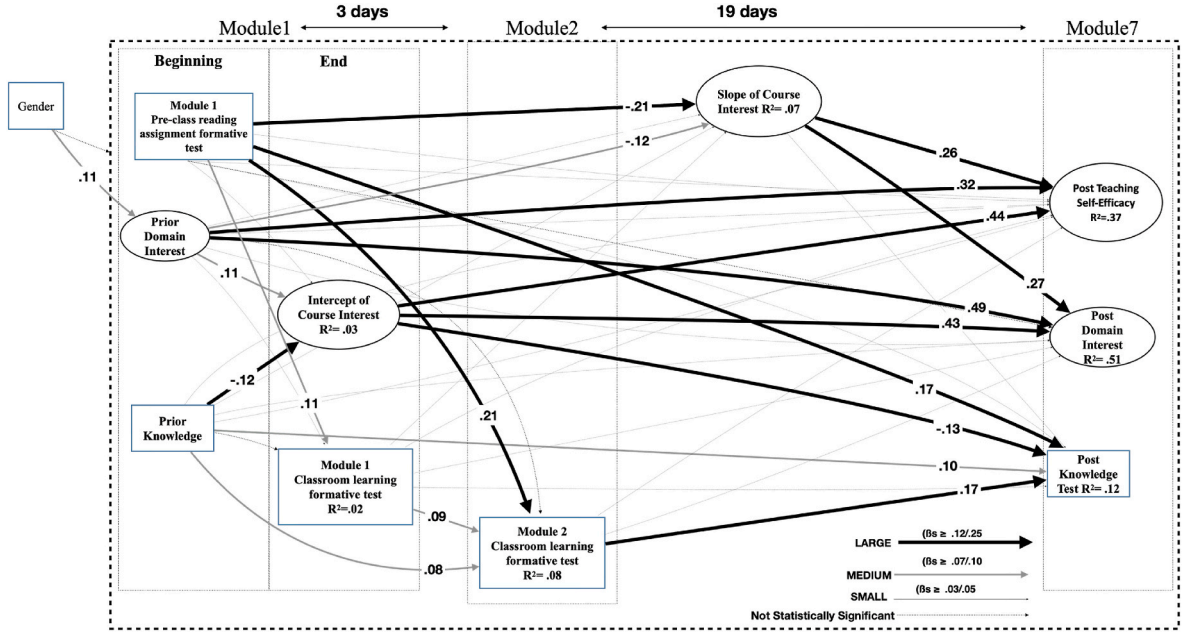

Fig. 2. Final Model for fully-forward cross-lagged model.
note: All solid lines present statistically significant *β*s ($p < .05$). Dotted lines present not statistically significant connections ($p > .05$).
*β*s ≥ cross-lagged/not cross-lagged.

knowledge test (Hypothesis 2c). This suggests that formative assessments were not statistically significant drivers of future motivation but did play a positive role in knowledge growth. Together, initial and changing course interest played substantive roles (statistically significant large cross-lagged *β*s) within the three outcomes modelled (Hypotheses 3). Initial course interest presented large predictions (*β*s) for post self-efficacy and interest, and presented the only, and negative *β* for the post knowledge test. Change in course interest demonstrated

strong connections to post self-efficacy and domain interest. This indicated that the greater the increase in Course interest, the greater the self-efficacy and Domain interest at the end of the course.

8. Theoretical implications

The theoretical focus for the current study was to better understand how students' interest in a course of study developed. To this end, controlling for students' gender and readiness, this study was designed to test the longitudinal relationship between course interest changes and important course readiness/experiences/outcomes (i.e., formative assessment, self-efficacy, and interest). With regard to predicting initial and changing course interest, only changing course interest was found to be statistically significantly (negatively) predicted by initial formative assessment. This might be an indication that students who initially found the course more challenging, were more likely to be interested as the course progressed. This inverse relationship, at the beginning of the course might reflect a cornerstone of both the four phase model of interest development (Renninger & Hidi, 2022) and the model of domain learning (Alexander, 2003). Both models stress that knowledge and interest can develop together across engagement with a domain: Lower initial knowledge therefore could indicate that there is greater room for growth in interest. These findings would appear to support the models' developmental implications.

An alternative explanation for the negative relationship between early achievement and growth of students' course interest could be the fact that the current study took place in an introductory course, with most students having no experience teaching (good fit for the course) and a small proportion having undertaken substantial teaching during their previous master's degrees (poor fit to the course). While Simonsmeier et al., (2022) suggested that in introductory learning contexts, like those in the current study, prior knowledge might not be a major factor, they might have been guilty of ignoring the potential negative motivational implications of excessive prior knowledge. Results from the current study indicate that prior knowledge can have a negative effect on students' motivation, with potential negative implications for subsequent engagement and learning outcomes. This challenges the notion that prior knowledge is always a good thing, corroborating prior studies showing significant heterogeneity in the effects of prior knowledge (Simonsmeier et al., 2022). In the case of the current study's course context, it might have been that students who came to the course with greater theoretical knowledge might have been less interested because of its introductory nature.

Addressing the study's broad aims, modelling pointed to the separate but substantial longitudinal roles that both initial and changing course interest can play within course-end domain interest and self-efficacy. Course interest has been theorised as a bridge between individual experiences and longer-term interest (Fryer et al., 2016, 2021). Consistent with other previous context based research (Nuutila et al., 2020; Rotgans & Schmidt, 2017), interest's process-oriented nature and sensitivity to instruction (a combination of interest in the domain and the environment) might underlie the contribution of changing course interest to longer term interest at the course's end.

There are at least two reasons for the strong connections between course interest and self-efficacy. The first being the longstanding theoretical (Hidi et al., 2007) and more recent empirical (Fryer & Ainley, 2019; Lee et al., 2024) indication of reciprocal linkages. In the context of the current study, course interest drives increasing engagement with the course which supports self-efficacy. This is because self-efficacy is reliant on personal (mastery and physical) and contextual (vicarious and encouragement) feedback (Bandura, 1978, 1993), which is made possible through consistent and meaningful course engagement.

The current study is one more piece of empirical evidence tying interest and self-efficacy together as tightly related sources of motivation in courses. These findings also highlight the importance of understanding how students' interest in a course of study can be supported both at the outset and in growing across the weeks and months is a critical question for educators.

9. Practical implications

As this and previous studies have suggested (Fryer et al., 2021; Tobias, 1994; Wade & Kidd, 2019), where a student starts plays a huge role within where they end up – across a broad array of outcomes. This means that both understanding this starting point and helping students start well should be essential parts of effective teaching (see Simonsmeier et al., 2022; Yan et al., 2024). Short pre-course formative assessments, paired with survey and open-ended questions can be an effective means of addressing the first issue and should be a part of curricula across the formal education spectrum. The second issue is more complicated given the complexity of boosting any of the readiness components modelled in the current study. It might be possible, however, to insert an informational nudge for interest through targeted short videos sent out to the students. Video nudges have proven to be experimentally effective for students with middling initial interest in other course contexts (Fryer et al., 2023a). Such videos might target the relevance of the course (interest; Renninger & Hidi, 2022a) or structure of curricula which can support perceptions of students' control over their course outcomes (self-efficacy; Fryer & Leenknecht, 2023).

Formative assessment is a well-established powerful and flexible instructional tool which is used by educators across formal education; yet, experimentation with it as an instructional tool is still relatively limited. When we consider all the different ways students learn in formal education and the myriad of outcomes students work towards, it seems reasonable for educators to be seeking to create a matching network of formative feedback. The very simple pairing of formative assessments for independent and classroom study in the present research was not innovative. In fact, it only seems fair that students receive feedback on something they are asked to undertake as part of the course. Thinking about formative feedback as something all students deserve regularly and figuring out how to do it sustainably should be a part of ongoing curricular design and revision. In addition to ongoing support, formative testing can play a role in assessing and potentially adjusting student learning fit to curricula. Generative AI, while raising many concerns for education, will make aspects of personalised learning much more realistic. Personalised learning with Generative AI support might consider how both knowledge and interest fit together.

Initial and changing interest in a course each play a substantive and overlapping role within students ongoing desire to re-engage with course contents. The question is how teachers build support for these into classroom and independent study. Recent theorising by Renninger and Hidi (2022a, 2022b, 2024), provide a few directions for addressing this issue in courses. The first is the potential role of strategic knowledge gaps to trigger latent interest and sustain it by encouraging information seeking. The second is by educators, and curricula more broadly, constantly creating opportunities for students to find and build on self-relevance for their studies. Relevance can both trigger and support the development of interest. The third is recognising that just as interest has been proposed as being reciprocally related to self-efficacy, it is likely a part of a much larger self-regulating system that supports learning in the short (across a course) and longer-term (lifelong). It is likely due in part to its physiological basis (Hidi, 2016; Renninger and Hidi, 2022b) and resulting universality, that interest is almost certainly central to this self-regulating system, making its growth critical for sustained learning (Renninger et al., 2024).

10. Limitations and future directions

As with all research undertaken in a single context, replication in other learning environments is essential to verifying and extending these findings. For replications of this study, careful attention to the quality and difficulty of the pre-post and formative assessments might help

clarify some of the unexpected and lack of connections between formative assessments and the motivations that framed the study.

Future studies might use a straightforward cross-lagged model or latent change score analyses – rather than employing a latent curve – to allow for longitudinal modelling between course interest and formative assessments across the course. Such designs/analyses, by collecting multiple data points for self-efficacy, might also provide an opportunity to extend our understanding of the reciprocal relationships between self-efficacy, interest, and the formative testing that underlie the present study. Future studies might also use formative assessments to assess other components of courses: Peer learning experiences and experiential learning experiences.

The course used for this study was just four weeks and 24 hours in length. It is entirely possible that some of the tested relationships might take longer to become apparent. Longer courses, using the same micro-analytic, intensive design paired with rigorous modelling are necessary to assess this limitation. Longer courses with more space might include a wider variety of formative assessment and formative assessments that stretch beyond the classroom (e.g., mastery testing; Morphew et al., 2020). The present study relied on multiple choice questions aiming to keep the time on tests short. In the current study, tests were reviewed with teachers but opportunity to review answers with peers might be another component of the formative assessment process worth including in future studies.

Another potential limitation of the study is that there might be other confounding variables that could be included. Examples include ethnicity, socioeconomic status, year level, and field of study (e.g., STEM versus non-STEM; Shum et al, 2021) among others. Despite using the same course materials, instructor differences might also have played a role. Future studies could include these constructs to explore whether they might also shape students' course interest and learning outcomes.

Finally, our study's focal outcomes included domain interest, self-efficacy, and post knowledge. Although we chose some of the most theoretically relevant variables that could shape these outcomes, we acknowledge that there might be other factors that might play a role. For example, we were not able to capture whether students explored additional readings outside the course, whether they engaged in discussions with their peers, and whether they asked for more teaching opportunities from their supervisors. All these factors are outside the specific learning context we investigated and could also potentially shape the focal outcomes. We encourage future studies to also add in a qualitative component, which is more open-ended by nature, to help understand other potentially relevant factors that could affect students' learning outcomes.

11. Conclusions

Students in higher education have been learning for a long time (formally and informally). As a result, it makes sense that what they bring with them is central to their learning outcomes. The current study's findings support longstanding calls for teaching to first understand the student's stage of learning for a given domain (Alexander & Murphy, 2024), leverage what they have, and build from there.

In addition to the interest students have for a course at the start, whether it grows is central to critical outcomes like their future ability to persist in the face of challenges (i.e., self-efficacy) and continue to re-engage with the domain of study (Renninger et al., 2024). Curricula need to be designed to support the growth of students' knowledge but it should also be designed to support growth in their interest for the course of study.

We know far too little about assessment in general and even less about formative assessment specifically. Assessment is often referred to as the black box of education (Black & Wiliam, 1998b; Hattie, 2009), but unlike *Schrödinger's* cat in the box, only good things can come from opening it up and playing with it. Well-designed empirical research is one means of broadening the field and bringing well-established psychological theory to bear. Despite having only scratched the surface of theory and practice when it comes to formative assessment, the evidence we have suggests it is a powerful and flexible means of supporting students across formal education. Imagine what we might do with it if we set about researching it systematically.

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Conflict of interest statement

The authors declare no known conflicts of interest with research presented herein.

13 Appendix

Table 4
Test items. Correct answers are bolded. All questions were weighted equally.

Prior Knowledge
1) Which of the following statements is/are true regarding Outcomes-based Approach to Student Learning (OBASL)? I) OBASL centres around the content students are supposed to understand from the course. II) OBASL explicitly focuses on the learner's interests, and what learners want to learn. III) It is the teacher's primary responsibility to effectively convey knowledge and skills to students. A) I only, B) I and II only, C) III only, D) I and III only, E) None of I, II, and III
2) Which of the following is NOT true about formative assessment? A) Teachers can receive feedback on how the class is performing overall. B) Implementation can be difficult in large classes because of intensive resources required. **C) Students will have to work hard to make up for a poor performance on formative assessment affecting their final grade.** D) Formative assessment identifies strengths and weaknesses in student understanding. E) None of the other responses.

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Table 4 (*continued*)

3) Which of the following is an appropriate intended learning outcome? By the end of a 10-min lesson on secondary school physics, students should be able to … A) Appreciate daily life examples of momentum. B) Understand Newton's Third Law C) Explain the material taught in the lesson **D) Draw diagrams and label forces acting on objects** E) None of the other responses.
4) Which of the following principles about effective feedback is correct? A) As long as the feedback is presented in question form to inspire students, there is no need to arrange dialogue with them. B) Students tend to remember negative comments, not the positive ones. Thus, linking the negative and positive comments in a single sentence with "but" will help to provide a balance. C) Teachers should provide as much feedback as possible, to reflect the reality that there is always room for improvement. D) Feedback from peers is effective because it is usually constructive. **E) The sooner students receive feedback after submitting work the more effective it is for their learning.**
5) Which of the following is/are NOT true about standards-referencing assessment? I) It should be used for all assessments II) A students' grade is determined by comparing against fellow students III) Raising standards would reduce the number of high grades. A) II only, **B) I and II only,** C) II and III only, D) I and III only, E) All of I, II, and III
6) Which of the following is NOT true about rubrics? **A) Analytic rubrics are better suited than Holistic rubrics to grade summative assessments.** B) Rubrics are not appropriate for marking all assessments C) Rubrics often have some level of subjectivity. D) Samples of completed work matching rubric levels would support student understanding. E) None of the other responses
Module 1 – Pre class reading assignment formative assessment
1) In constructivism, what is the basis on which students construct meaning of new information? **A) Prior knowledge** B) Teacher's clear teaching C) Students' interaction with peers D) Testing students to make sure they understand new knowledge E) None of the other responses
2) Constructive alignment considers alignment between … A) Students' goals, Students' interests, and Students' course selection **B) Teaching and Learning Activities, Assessments, and Learning outcomes** C) Research postgraduates' teaching to the lecturer's teaching, and student's learning D) Research postgraduates/TAs acting as a bridge between the teacher and student. E) Teaching and Learning Activities, Assessments, and Learning objectives
3) Which of the following ideas was not covered in the pre-module reading about why postgraduates should learn about educational theory? A) Learning theory helps postgraduates develop confidence about teaching B) Postgraduates could use the theoretical background to communicate with other teachers about teaching and learning C) Postgraduates are expected to make decisions about how to teach in the class D) Studying theory and research will help postgraduates avoid serious mistakes or wasting time in teaching **E) Postgraduates are expected to do educational research to understand the effectiveness of their teaching.**
4) Social learning is described in the pre-module reading to be effective for which of the following reasons? I) Much of what is learned is outside what is taught formally II) Competition is a driver of learning III) Students observe and "copy" one another A) III only, **B) I and III only,** C) I and II only, D) All of I, II, and III, E) None of I, II, and III
Module 1 – Classroom learning formative assessment
1) OBASL (Outcomes-Based Approach to Student Learning) most closely lines up with what topic discussed in the pre-class reading? A) Constructivism and Objectivism **B) Constructive Alignment** C) Social learning to achieve learning outcomes D) Learning educational theory E) None of the other responses.
2) In the computer science lesson you observed, which of the following do you think would be appropriate learning outcomes? By the end of the lesson, students should be able to I) Understand the definition of an algorithm II) List and explain examples of our daily use of algorithms III) Implement Bubble-sort in Python IV) Complexity of algorithms A) I and II only, B) I, II, and III only, C) II and III only, D) All of I, II, III, and IV, **E) None of the other responses**
3) In John Biggs' three levels of thinking about teaching, which of the following characterises the difference between level 2 and level 3 teachers? A) Including and improving teaching facilitation B) Preparing demonstrations to improve lecturing. C) Providing additional office hours, and samples for rubrics.

(*continued on next page*)

Table 4 (*continued*)

D) Raising minimum standards so that students have to achieve the learning outcomes to perform well in the course. E) All of the other responses are correct.
4) For the Written Reflection assignment in this course, students need to A) Write about all five Areas of Activity B) Write a reflective account on two of your classmates' teaching **C) Write 500 words on each part plus/minus 10%.** D) Write only for your teaching demonstration E) None of the other responses.
Module 2 – Classroom learning formative assessment
1) Which of the following is an appropriate verb from our lesson today on learning outcomes? By the end of today's lesson, you should be able to _____ intended learning outcomes. A) Learn about, B) Understand, **C) Design,** D) Be familiar with, E) None of the other responses
2) Which of the following learning outcomes follow the principles discussed in today's lesson? By the end of today's lesson, you should be able to I) Design, update, and make curriculum changes to courses. II) Perform constructive alignment across an entire course. III) Align teaching and learning activities to intended learning outcomes. A) I only, **B) III only,** C) I and III only, D) II and III only, E) None of I, II, or III
3) Which of the following is not a requirement of the teaching demonstration in Modules 3 and 4? A) Some interactivity with your audience is required. B) The intended learning outcomes must be presented at the beginning of the teaching demonstration. C) Timing of the teaching demonstration should be between 9 and 11 min D) Teaching slides need to be submitted the night of the teaching demonstration. **E) None of the other responses (i.e., all of the other responses are requirements of the teaching demonstration)**
4) Which of the following questions/issues should be considered while designing the "main phase" of the lesson? A) How will the session be introduced to the students? B) How could students become interested in the lesson? **C) How could students' understanding be developed?** D) How could students' understanding be reinforced? E) How could students get prepared for the next session?
Post Knowledge Test
1) Which of the following statements about OBASL is/are NOT true? I) Classroom Learning Activities should constructively align with supporting students' performance in Assessments II) Learning outcomes describe the knowledge that teachers will pass onto students by the end of the class/course. III) OBASL places equal weighting on teachers and students in the learning process." A) I only, B) II only, C) I and III only, **D) II and III only**, E) All of I, II, and III
2) Which of the following is not an essential principle to follow when designing and facilitating classroom learning activities? A) Designing good questions and prompts are just as important as choosing the kind of activity to facilitate. **B) Having a discussion component with other classmates.** C) Providing clear instructions for the activity. D) Ensuring the activity is aligned with the learning outcomes. E) All of the above are essential principles to designing and facilitating classroom learning activities.
3) Which of the following is an appropriate intended learning outcome? By the end of a 10-min lesson, students should be able to … I) Understand why lessons should be designed following the Opening-Main Phase-Closing structure II) Explain the concept of constructive alignment between the different components of Outcomes-Based Approaches to Student Learning. III) Appreciate a well-planned lesson with meaningful interaction between the teacher, peers, and students. **A) II only**, B) I and II only, C) II and III only, D) All of I, II, and III, E) None of the other responses.
4) Which of the following statements about rubrics is/are TRUE? I) Analytic rubrics match students against standards, but holistic rubrics do not. II) In analytic rubrics, Individual judgments are made for each criteria, rather than lumping criteria together. III) Holistic rubrics are less subjective than analytic rubrics. A) I only, **B) II only**, C) I and II only, D) II and III only, E) All of I, II, and III.
5) Which of the following statements about feedback is NOT true? A) Task-feedback provides indicators of how well students are performing in a given task. B) It is important to limit the amount of feedback provided to students. **C) Process-feedback provides higher-level feedback than self-regulated feedback because it focuses on the process of improving.** D) Feedback is no longer considered as information from teachers given to learners, but is a two-way process involving dialogue. E) Formative feedback should be provided to students in a timely manner so students could act on feedback for the next assessment.
6) Which of the following is NOT true about standards/criterion-referencing assessment? I) Raising standards would reduce the number of high grades. II) It should be used for all assessments at HKU III) A students' grade is determined by comparing against fellow students A) I only, **B) III only**, C) I and III only, D) I, II, and III, E) None of the other responses.

Table 5
Survey items. The range and labels for all items including "How well does this statement match you?" were 1 – Not at all, 2 – Very little, 3 – Somewhat, 4 – Quite a bit, 5 – A great deal, 6 – Completely.

Domain Interest (Renninger & Schofield, 2014)	Range and Labels
1) How much do you know about teaching?	1 – Almost nothing, 2 – Very little, 3 – Fair amount, 4 – Quite a bit, 5 – A great deal, 6 – Almost everything
2) In your spare time, how often have you tried to learn about teaching?	1 – Almost never, 2 – Rarely, 3 – Sometimes, 4 – Often, 5 – Usually, 6 – Almost always
3) I have spent time learning about teaching on my own. How well does this statement match you?	See caption
Self-efficacy for Teaching (Tschannen-Moran & Hoy, 2001)	See caption
1) I can craft good questions for students. How well does this statement match you?	See caption
2) I can help students value their learning. How well does this statement match you?	See caption
3) I can foster students' creativity. How well does this statement match you?	See caption
4) I can help students think critically. How well does this statement match you?	See caption
Course Interest	See caption
1) This course is personally meaningful. How well does this statement match you?	See caption
2) This course is interesting. How well does this statement match you?	See caption
3) I want to learn by taking courses like this. How well does this statement match you?	See caption

Table 3
All *βs* for Fully Forward Cross-lagged Model Test.

	Intercept	Slope	Prior Domain Interest	Prior Knowledge	Module 1 pre-class	Module 1 post-class	Module 2 post-class	Post Domain Interest	Post Self-efficacy	Post Knowledge
Gender		.04	.11*	.01		−.07	.14	−.03	−.05	−.09
Intercept					−.02		−.09	.43**	.44**	−.13*
Slope								.27*	.26*	−.02
Prior Domain Interest	.11*	−.12*			−.04		−.07	.49**	.32**	−.03
Prior Knowledge	−.12*	.04				.06	.08*	−.05	−.03	.10*
Module 1 pre-class	.08	−.21*				.11*	.21**	.00	.03	.17*
Module 1 post-class		−.07					.09*	.05	.09	.08
Module 2 post-class								−.06	−.03	.17**

Note: *p < .05; **p < .01.

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