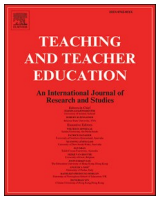
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Research paper



Longitudinal effects of a scenario-based learning intervention on preservice teacher self-efficacy☆

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ABSTRACT

We explore how an online 'scenario-based learning' (SBL) intervention is associated with the teaching-related self-efficacy of 1261 preservice teachers recruited from an initial teacher education (ITE) program in the UK. Participants completed four 1-hour online sessions involving realistic classroom scenarios and received real-time feedback on their responses. Results showed a positive upward trajectory for self-efficacy with some variation among the self-efficacy subdomains. Results from open-ended responses following the intervention showed how reflection on scenarios and feedback played a role in preservice teachers' self-efficacy. The findings highlight the benefits of providing preservice teachers with low-risk, authentic classroom experiences bolstered by expert feedback and opportunities for reflection.

1. Introduction

For preservice teachers, the field-based teaching placement represents a critical transformational phase of initial teacher education (ITE; Anderson & Stillman, 2013). How well a preservice teacher navigates the placement influences future career opportunities and intentions (Krieg et al., 2021), but also has an impact on the pupils being taught and on the reputation of the ITE program represented by the preservice teacher. Teaching placements provide preservice teachers with the opportunity to build their teaching *self-efficacy* (domain-specific confidence), *competence* (skills and knowledge), and what Shulman (1987), and more recently, Loughran (2019), call *pedagogical reasoning* (i.e., the thinking that informs professional practice) in a close approximation of professional practice. Pedagogical reasoning refers to the *unseen* aspects of teaching practice and brings to the foreground the 'whys' of in-context teaching decisions (Shulman, 1987). This specialized form of reasoning is developed when teachers engage with possible solutions to a wide range of pedagogical problems, and is sharpened through interactions with experienced colleagues (Loughran, 2019). ITE programs around the world strive to ensure that preservice teachers entering the classroom as teachers for the first time are well-prepared and confident to develop their pedagogical reasoning, and ready to address a host of pedagogical and personal challenges.

Teacher education programs can prepare preservice teachers for initial teaching placements by providing activities that deliver authentic and challenging classroom scenarios that stimulate pedagogical reasoning. We designed an online 'scenario-based learning' (SBL) intervention that presents preservice teachers with a series of brief video- and text teaching scenarios, an opportunity for self-reflection, and tailored feedback from experienced teachers. The classroom scenarios for the SBL intervention were co-developed with practicing teachers and teacher educators based on their own classroom practice and experience mentoring preservice teachers. Similar to Grossman et al.'s description of approximation of practice (2009), SBL involves encouraging preservice teachers to take on the "role and persona" of a teacher, while providing feedback on their efforts and decision-making (Grossman, 2009, p. 283). In this study we incorporate video- and text-based approximations of practice through provision of a four-session SBL intervention aimed to build the self-efficacy and pedagogical reasoning of preservice teachers preparing for teaching

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placements.

1.1. Preparing preservice teachers for teaching placements

For many preservice teachers, the teaching placement represents the first exposure to professional practice, with research showing that performance during the placement is associated with effectiveness as a practicing teacher (e.g., Krieg et al., 2021). One key to success in teaching placements is preparing preservice teachers to apply their knowledge and thinking to the challenges that arise throughout the teaching day. Preparation for teaching placements is not only about building knowledge and skills, but about *situated learning* that recognizes the complexity and nuance of classroom context (Anderson & Stillman, 2012). Teaching placements are rated as among the most psychologically demanding experiences of ITE (Chaplain, 2008): strategic and impactful preparation is needed to boost preservice teachers' confidence and readiness to succeed in the transformation from student to teacher. A key aspect of preparing preservice teachers for teaching placements is ensuring that they feel prepared and confident to face the challenges that they will encounter when they enter the classroom. Interventions designed to build preservice teachers' teaching-related self-efficacy can lead to successful experiences in the teaching placement (Brown et al., 2015).

1.2. Teachers' self-efficacy

The current research is grounded in our understanding of self-efficacy, defined as beliefs in one's capabilities to carry out the courses of action required to achieve desired outcomes (Bandura, 1997). Based in the broader framework of social cognitive theory, self-efficacy has been shown in a wide range of contexts to play a role in influencing how an individual navigates through life's challenges. Bandura proposes four sources of self-efficacy: enactive experiences, vicarious experience (i.e., observing successful others), verbal persuasion (feedback), and interpretation of physiological states, each of which contributes to an individual's beliefs in their capabilities to succeed in an endeavour. The four sources of self-efficacy are 'activated' through cognitive processing, i.e., through self-reflection on self-efficacy sources and their salience in a particular context. Navigating new challenges draws heavily on one's self-efficacy beliefs, and these beliefs are especially important when individuals face new vocational experiences. Bandura noted that "when facing new occupational role requirements, adaptation is a … complex process of self-development" (1997, p. 30), with self-efficacy beliefs playing a prominent role in vocational development. For preservice teachers, the developmental challenge of transitioning from student to teacher demands not only specific knowledge and skills, but the confidence with which to implement them.

Teachers' self-efficacy—domain-specific beliefs teachers hold that they can positively influence student learning—has received considerable research attention in the last two decades, with research showing that the level of teaching-related self-efficacy is significantly and positively associated with classroom effectiveness (Klassen & Tze, 2014). Furthermore, teachers' self-efficacy has been shown to counteract negative emotions experienced during teaching placements (Hascher & Hagenauer, 2016), and is linked with novice teachers' retention in, and commitment to, the profession (Chesnut & Burley, 2015). Preservice teachers' self-efficacy is dynamic and influenced by positive enactive and vicarious experience and constructive feedback, particularly due to their limited experience in the field (Pfitzner-Eden, 2016). While some efforts have been made to investigate how preservice teachers' self-efficacy may change during ITE, research in this area has primarily focused on monitoring change during teaching placements (Klassen & Durksen, 2014; Berg & Smith, 2018), and much of this research has relied on research designs with only two measurement points (e.g., Berg & Smith, 2018), meaning that the shape of change over time is not detectable. Teachers' self-efficacy has been shown to fluctuate over time (Zee & Koomen, 2016), and not always in a linear fashion (Klassen & Chiu, 2010), meaning that multi-wave longitudinal designs can provide greater insight into temporal patterns of change during important phases of teacher development.

Although teachers' self-efficacy is hypothesized to have a universally relevant effect on teaching behaviors that transcends demographic factors (e.g., culture, sex, age), there are documented differences in levels of self-efficacy across demographic categories. For example, males and majority ethnic groups have reported higher levels of self-efficacy than females and minority ethnic groups (e.g., Huang, 2012), although findings vary across domains and ethnic groups (Sheu et al., 2018). Recent research by Sackler et al. (2021) showed that teachers' self-efficacy operates in similar ways across cultural groups, although there were variations across groups in some efficacy domains. Similarly, age plays a role in the self-efficacy of teachers, with Klassen & Chiu, 2010 showing growth and then decline over age groups and career stages. Using U.S.-based data from the 2018 Teaching and Learning International Survey, Yoon and Kim (2022) found differences in teachers' self-efficacy profiles by sex and experience, concluding that demographic characteristics play a role in influencing self-efficacy beliefs. Mok et al. (2023) proposed that building self-efficacy during teacher education programs and teaching placements is crucial to support preservice teachers' teaching-related skills and practice. Therefore, interventions designed to boost the self-efficacy of aspiring teachers should be tested to determine their effectiveness across demographic groups.

Research exploring preservice teachers' experiences in teaching placements provides clues to mechanisms for ways to boost self-efficacy. The teaching placement involves potential exposure to the four sources of self-efficacy through practical experience in context (i.e., mastery experiences), observing how qualified teachers approach challenging classroom situations (i.e., vicarious experiences), feedback and verbal persuasion (e.g., from mentors), and a range of affective states (Pfitzner-Eden, 2016). Ma et al. (2022) noted two factors that may lead to increases in preservice teachers' self-efficacy: first, provision of a protective environment incorporating feedback from experienced teachers, and second, exposure to authentic teaching experiences including role-playing activities. Similarly, Brown et al. (2021) highlighted the importance of expert feedback and authentic teaching experiences in preparing preservice teachers for the classroom. However, the quality and value of experiences can vary between teaching placements (Darling-Hammond, 2020), with preservice teachers' interpretation of these experiences positively, or negatively, influencing teaching self-efficacy beliefs (Pfitzner-Eden, 2016). Although there is little debate about the importance of providing actual teaching experience in well-supported 'live' classroom settings, if preservice teachers do not feel confident and prepared prior to placements this may have a detrimental impact on their experiences and teaching confidence (Lindqvist et al., 2017). Therefore, the provision of simulated teaching experiences that provide opportunities to reflect and receive feedback on complex teaching situations and include components informed by the sources of self-efficacy beliefs may serve as a useful complement to conventional teaching placement experiences.

1.3. Scenario-based learning interventions

Scenario-based learning (SBL) is an online intervention that provides participants with a *situated learning experience* (Lave & Wenger, 1991) in which learning is engendered through the interactions of person, activity, and context. In the case of SBL, the aspiring teacher considers an authentic and contextualized classroom scenario, and subsequently engages with feedback from more experienced teachers in a supported, low-risk setting. The scenarios in SBL can target specific domains; in this study, the four SBL domains chosen in collaboration with our teacher educator partners included managing student behavior, adapting teaching to meet all student needs, time management, and working

closely with colleagues, which have been found to be challenging for early career teachers (e.g., Watzke, 2007).

Theories underpinning SBL interventions (social cognitive theory, Bandura, 1997; situated learning theory, Lave & Wenger, 1991; pedagogical reasoning, Loughran, 2019) suggest that pedagogical knowledge and reasoning develop through the interaction of knowledge, experience, and context. Sometimes known as 'case-based learning' or 'near-world simulations' (Errington, 2011), SBL provides participants with the opportunity to reflect on their pedagogical knowledge, and to enact that knowledge in authentic simulated classroom contexts. Research on a single-session SBL intervention has shown increases in preservice teachers' perceived confidence and readiness to enter initial teaching placements, with feedback from participants indicating highly favorable reactions to the intervention, with over two-thirds of participants stating that they felt 'more confident' about starting a teaching placement after completing the intervention, and nearly three-quarters stating they felt 'more prepared' to begin their first teaching placement (Bardach et al., 2020).

SBL interventions for beginning teachers can be designed to feed into at least three of Bandura's four sources of self-efficacy (1997). First, SBL provides *enactive experience* through participants' engagement in authentic classroom challenges which require reflection on possible courses of action. Second, SBL provides some elements of *vicarious experience* or modelling through detailed guidance on the decision-making of experienced teachers (e.g., *You've rated this response as appropriate. Experienced teachers rated this as inappropriate. A key challenge many teachers encounter is how to … Here are some suggested strategies from experienced teachers …*). Third, SBL can provide *verbal persuasion* through messaging about response alignment (e.g., *Fantastic! The majority of your responses to the classroom scenarios were the same or similar to how experienced teachers suggested they would approach these situations*). Providing simulations of teaching activities to preservice teachers allows for safe and guided early teaching experiences, with opportunity for reflection and growth, and the opportunity to build preservice teacher learning at the earliest stage of professional development (Mikeska et al., 2022).

1.4. Current study

Preservice teachers with robust teaching self-efficacy are more likely to experience success during teaching placements and express higher commitment to the profession (e.g., Chesnut & Burley, 2015). Building and testing scalable online teaching interventions that boost teachers' self-efficacy has the potential to contribute to the preparation and readiness of preservice teachers before and during teaching placements and during early career teaching. In this study, we build on previous work that focused on the development and testing of single-session SBL interventions (Bardach et al., 2021; Klassen et al., 2021) by using a short-term longitudinal design[2] to test the effects of a four-session SBL intervention on preservice teachers' self-efficacy beliefs.

Research Question 1. ***(RQ1)***: What is the pattern of change in preservice teachers' overall self-efficacy over four SBL sessions? Based on Bandura's social cognitive theory, we hypothesize that exposure to authentic experiences, coupled with feedback, modelling, and reflection, will result in increases in preservice teachers' overall teaching self-efficacy.

Research Question 2. ***(RQ2)***: What are the differences in the starting points and trajectories of change for participants identifying as female and male? Based on conflicting data on gender differences in self-efficacy levels and patterns (e.g., Huang, 2012; Sheu et al., 2018), we make no directional hypothesis associated with RQ2.

Research Question 3. ***(RQ3)***: What is the pattern of change in preservice teachers' domain-specific self-efficacy beliefs? Based on prior research into self-efficacy development by task (e.g., Chan, 2008; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2007), we anticipate that changes in self-efficacy beliefs may vary in relation to specific domains of teaching.

Research Question 4. ***(RQ4)***: What are the differences in the starting points and trajectories of change for students from majority and minority ethnic backgrounds? Based on conflicting data on ethnic differences in self-efficacy levels and patterns (e.g., Sheu et al., 2018), we make no directional hypothesis associated with RQ4.

Research Question 5. ***(RQ5)***: What are participants' perceptions of the role of self-reflection and teacher feedback in relation to classroom scenarios on their teaching confidence? Based on previous research on single-session interventions (e.g., Bardach et al., 2020), we hypothesized that participants would report a positive effect of self-reflection and teacher feedback on their preparedness for teaching.

2. Method

This study tested the patterns of change in overall and domain-specific self-efficacy associated with the delivery of a four-session scenario-based learning intervention delivered to preservice teachers over a six-week period. Participants could only access each session in the week in which it was released (i.e., they could not complete all sessions in a single sitting or in a single week). The short-term longitudinal design included self-efficacy measured at five points: a pre-test followed by four post-tests that were delivered after each SBL session in the intervention.

2.1. Participants

Data for this study were collected from 1305 secondary-level preservice teachers enrolled in a one-year, post-graduate ITE program that attracts applicants from all regions of England and Wales. We identified and contacted this ITE program for involvement in this study due to its stated focus on recruiting a diverse and nationally representative cohort of preservice teachers every year. During the period of the SBL intervention, which took place in the first two months of the ITE programme, participants in the ITE programme spent five days of observation in a school, attended in-programme teaching on effective pedagogy, and attended group discussions on a range of topics (e.g., creating a positive classroom environment, developing pupils' intrinsic motivation, and addressing low-level disruption). The SBL intervention was a compulsory component of the ITE program—termed a 'hurdle requirement'—meaning that participation was mandatory, but not graded. However, participants' agreement for the use of the data for research purposes was voluntary; 44 participants did not provide their consent for their data to be used for research purposes, resulting in a final sample of 1261 preservice teachers (65% identifying as female, 34% as male, 1% as other). The mean age of participants was 24.63 years ($SD = 5.01$). A total of 80% of participants identified as white British (majority ethnic group in subsequent analyses), 10% as Asian and/or Asian British, 4% as Black and/or Black British, and 6% identified as multiple or other ethnic groups (minority ethnic group).

2.2. Materials

2.2.1. SBL materials

The classroom scenario content was developed using a critical incidents approach (e.g., Buyse & Lievens, 2011) in which researchers conducted 1:1 and focus group interviews with experienced teachers who were asked to describe critical incidents faced by novice teachers

[2] We acknowledge that longitudinal designs often involve extended periods of time, sometimes over several years. In this study we use the term 'short-term longitudinal design' to refer to repeated observations of participants over the period of a few weeks.

and the various ways (positive and negative) that these teachers responded. The scenario development process involved (a) identifying the target domains for the scenarios, (b) developing and revising the scenario content, and (c) establishing the scoring key through concordance panels with experienced teachers. Please see Durksen & Klassen, 2018; Bardach et al., 2020 for a detailed description of the process. The content of the feedback delivered to participants for each scenario was created through workshops with experienced educators (defined as having more than five years of teaching experience and experience supervising preservice teachers). The scenario and feedback content followed the same development process described by Klassen et al. (2021) and Bardach et al. (2021).

Twenty-four scenarios were arranged into four themed sessions, each including six scenarios. The session themes included (a) managing behavior, (b) adapting teaching, (c) time management, and (d) working with colleagues. For each scenario, participants were invited to (a) watch a brief animated video or read a text-based classroom scenario, (b) score the appropriateness of a set of three response options, with ratings of (1) *inappropriate* to (4) *appropriate,* based on what a beginning teacher working in a school should do; (c) provide a brief personal reflection on their ratings for each of the response options; and then (d) receive real-time tailored feedback from experienced teachers based on the level of alignment between their responses and the experienced teachers' responses (see Fig. 1 for example of an SBL item).

The feedback from the experienced teachers for each response option included (a) an indication of participants' alignment with the experienced teachers' ratings for the response option (e.g., *Experienced teachers agree! As you suggest, this response would be inappropriate*); (b) the experienced teachers' reasoning and the factors considered in the specific situation (e.g., *Responding to the situation in this way is confrontational and may lead to an escalation of poor behaviour from the students. This would then impact negatively on the learning of the other students in the class. It may also create a poor relationship with the two students who may then disengage from learning in your lesson*); (c) alternative strategies that may be more appropriate in the circumstances (e.g., *It may be a better strategy to stop the lesson briefly and tell the two students to pay attention);* (d) the reason why these strategies may be more effective (e.g., *This makes it clear that you are aware they are talking and that you are not happy with their behaviour),* and (e) how to implement the suggested strategies in practice and their potential benefits (e.g., *It is important that you use a firm, but not aggressive, tone of voice. Avoid engaging in conversation with them and continue with the lesson immediately after you have called them out as this shifts the focus of the lesson back to the learning with a minimal amount of fuss and disruption. It also sends a clear message to the rest of the class about your behaviour expectations*).

At the end of each session, participants received a feedback report based on the alignment of their scoring and the proposed scoring from experienced teachers accompanied by a summary of teaching strategies designed to further develop teaching competencies. The session report included background about the intervention, a summary of the session theme (e.g., behavior management), and a tailored message based on the level of alignment of participant's responses with those from experienced teachers (e.g., *Great! Many of your responses were similar to how experienced teachers suggested they would approach these situations …*). The session report concluded with suggested strategies addressing the session theme. Upon completion of all four sessions, participants received a concluding feedback report that included further resources addressing the four themes and an online certificate of completion.

The scoring template for the scenarios (i.e., ratings of appropriateness for the response options) was set by experienced educators during the content development process. The score for each classroom scenario response was based on the distance-measure approach outlined by Patterson et al. (2013) which allocates points depending on the distance of participants' scores from the expert-determined scoring key. Using a similar approach to that of Bardach et al. (2021), participants were awarded five points for direct alignment, three points for one position away, one point for two positions away, and zero points for three positions away from the expert-determined best response. Scores for each session were used to provide tailored real-time feedback to participants based on their scoring alignment; however, actual scores were not presented to participants. The maximum score for each session was 90 (6 scenarios x 3 response options x 5 maximum points), and the maximum score for all four sessions was 360.

In addition, participants were asked to provide an optional comment at the end of the four sessions on whether and how the intervention contributed to readiness to begin the teaching placement (*Following the completion of this scenario-based learning module, do you feel more prepared to begin teaching?* [*YES/NO/UNSURE*]. *Please explain why or why not*).

2.2.2. Self-efficacy measure

Teacher self-efficacy was measured using 11 items, with 10 items adapted from the Norwegian Teacher Self-Efficacy Scale (NTSES; Skaalvik & Skaalvik, 2007) and 1 additional item developed for this study. The adaptation of the NTSES included a change of wording in the stem (based on advice from Bandura [1997], from *How **certain** are you … ?* to *How **confident** are you … ?*) We also chose items for each domain with high factor loadings in the original NTSES. Participants were asked to indicate how confident they were in relation to four domains: (a) adapting instruction to individual students' needs (three items; e.g., *provide realistic challenge for all students*); (b) maintaining discipline (two items; e.g., *help students with behavioral problems to follow class rules*); (c) cooperating with colleagues and parents (two items; e.g., *cooperate effectively and constructively with other teachers*); and (d) motivating students (three items; e.g., *motivate students who show low interest in schoolwork*). An additional self-developed item measured participants' perceived confidence to succeed in their upcoming ITE program. Items were rated on a 6-point Likert scale from (1) *Not confident at all* to (6) *Very confident*. Participants completed these items on five occasions (i.e., a pre-test before session 1 and four post-test measurement points).

2.3. Procedure

Participants completed four 1-h SBL sessions delivered within a six-week window. Each session contained six brief, realistic, text- or video-based classroom/school scenarios that were based on professional challenges that beginning teachers encounter in the classroom (e.g., Miulescu, 2020). The themes of the four SBL sessions included (1) creating a positive classroom culture, (2) managing behavior and differentiating the curriculum for all students, (3) organization and managing workload, (4) and communicating with parents and colleagues.

Participants were asked to complete one SBL session each week in their own time on a device of their choice (i.e., mobile phone, tablet, laptop). The links to each session were posted on the ITE provider's webpage, and were active for six weeks in total, to allow for completion by participants who were not able to meet the weekly schedule.

To begin the SBL intervention, participants first completed a registration form via an online survey platform which included the participant information and consent statement followed by demographic questions. Following registration, participants received an email confirmation which provided further information about the intervention, login details, and the link to the first session in the series. Participants were advised to complete each session independently in one sitting, but there was no formal proctoring of responses. Participants completed a pre-test questionnaire measuring self-efficacy at the start of the first session, and an identical post-test questionnaire at the end of each of the four sessions, along with an open-ended question on participant perceptions on whether and how the intervention influenced their preparation for the teaching placement.

Q. You are in your first month of teaching. Janelle, who is usually a very keen pupil, is late to class. You tell her that she is required to come in for a detention at lunch because she is late. She swears at you in front of the class.



Rate the appropriateness of each of the options in terms of what a beginning teacher should do (Inappropriate; Somewhat Inappropriate; Somewhat Appropriate; Appropriate).

Option A

	Inappropriate	Somewhat inappropriate	Somewhat appropriate	Appropriate
Take Janelle outside the class and ask her what is bothering her today	○	○	○	○

Please briefly explain the rationale behind your response to Option A

Question Feedback

This section allows you to view how most experienced teachers rated the question. You can use the feedback from experienced teachers to reflect on your own responses to the question.

Q. You are in your first month of teaching. Janelle, who is usually a very keen pupil, is late to class. You tell her that she is required to come in for a detention at lunch because she is late. She swears at you in front of the class.



Option A

	Inappropriate	Somewhat inappropriate	Somewhat appropriate	Appropriate
Take Janelle outside the class and ask her what is bothering her today	○	○	●	○

You thought Option A was *appropriate.*

Your rationale: Speaking to Janelle in private would enable me to understand the cause of Janelle's behaviour. It would be important to do this in private so other members of the class did not overhear the conversation.

Your rating was close to how most experienced teachers rated this option. The majority of experienced teachers thought that his would be a ***somewhat appropriate*** way to approach this situation.

Removing Janelle from the classroom to speak with her will diffuse the situation and may give you the opportunity to understand the events leading up to Janelle's lateness and subsequent inappropriate behaviour.

Building positive and empathetic relationships with pupils is an important part of being a teacher, however through not addressing Janelle's inappropriate behaviour it may lead to others thinking this is acceptable behaviour.

Fig. 1. Example of the scenario-based learning activity and feedback.

2.4. Analyses

We used latent growth curve modelling (LGCM) to assess the trajectory of change in self-efficacy over the five time periods in the intervention (Muthén & Muthén, 2017). LGCM is based on structural equation modelling (SEM) and has advantages over other analysis approaches such as repeated measures ANOVA that have traditionally been used in education research to analyze longitudinal data. The advantages of LGCM—a relatively new approach that uses latent variables—is that it evaluates between-group and within-group differences in longitudinal data (Alessandri et al., 2017), accounts for measurement error, and allows for more flexibility to describe non-linear change. Analysis approaches that use latent variables are considered best-practice for the analysis of longitudinal data in education research (Diakow, 2018).

Our LGCM analysis started with an unconditional (or baseline) model which excludes covariates that may explain differences in growth trajectories. After testing the unconditional model, we tested conditional models which included three covariates: ethnicity (ethnic majority group or ethnic minority group), sex (identify as male or female), and age. For each model we tested the intercept (starting point) and the slope (trajectory of change over time) of the data (see Fig. 2 for the proposed LGC model). The intercept represents the initial self-efficacy scores obtained by participants in the pre-test questionnaire and the slope variable represents the change in self-efficacy over the course of the intervention.

Missing data were managed using full information maximum likelihood (FIML) estimation, meaning that data from all participants were included in the analysis, including the participants who had data missing for one or more of the measurement points (Cham et al., 2017). The percentage of missing data was 1.67% for Session 2, 2.38% for Session 3, and 2.85% for Session 4. As the percentage of missing data was under 5%, it was deemed as likely to have a negligible impact on the findings (Jakobsen et al., 2017). Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) were used to assess goodness-of-fit. CFI and TLI values above .90, and RMSEA and SRMR values below .08 indicate adequate fit to the data (Little, 2013). We also used Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) to compare models, with smaller AIC and BIC values suggesting a better fitting model (Vasantha & Venkatesan, 2014).

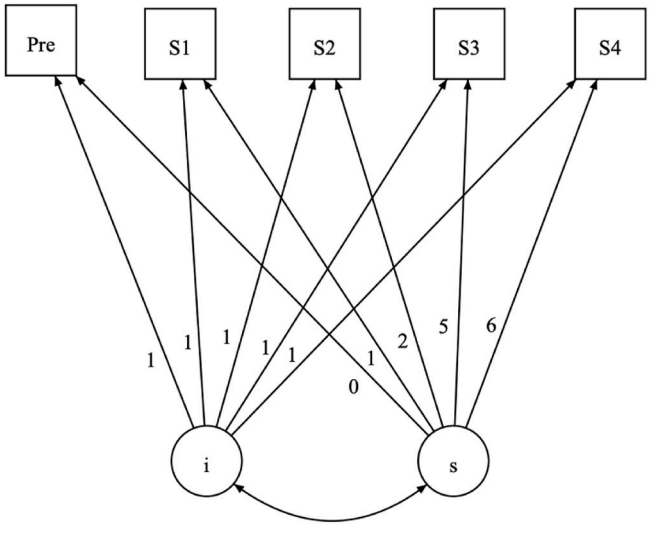


Fig. 2. Proposed Unconditional Latent Growth Curve Model.
Note. i = intercept factor; s = slope factor; pre = pre-test; S1 = Session 1 post-test; S2 = Session 2 post-test; S3 = Session 3 post-test; S4 = Session 4 post-test. The loadings for the latent intercept factor were all set to 1 to reflect that this remains constant for each participant over time. The indicator paths for the slope factor were set to 0, 1, 2, 5, and 6 to reflect the units of time (i.e., 7 days) between each measurement point.

Open-ended responses. Our optional open-ended question on participant perceptions was analyzed using theoretical (i.e., deductive) thematic analysis (e.g., Proudfoot, 2022), an approach that sets out *a priori* codes, in this case, evidence for the salience of scenario content, personal reflection, and expert feedback relating to teaching confidence. We followed guidance from Robinson (2021) for analysing large samples of brief text data derived from an open-ended response format. A deductive analysis provides a less rich description of the data than an inductive approach, but when integrated into a predominantly quantitative study, the approach can provide insight into the numerical findings (Proudfoot, 2022). In this study, the unit of analysis was participants whole responses (i.e., 1–2 sentences) to capture the sentiment of their entire responses. We used the deductive analysis to shed light on the relevance of scenario content, reflection, and expert feedback on participants' views of how the intervention prepared them for the teaching placement.[3]

3. Results

3.1. Self-Efficacy Scores

Table 1 provides self-efficacy scores by sex and ethnicity for the five time points (pre-test and post-test session scores), with total self-efficacy score and the five domains, along with internal consistency (Cronbach's alpha) for total and domain scores. Note the similar patterns in self-efficacy scores between participants identifying as male and female (other gender categories were too small to analyze). Participants from minority ethnic backgrounds rated their baseline self-efficacy scores higher than participants from majority ethnic backgrounds (see section on latent growth curve models for additional information). Internal consistency for total self-efficacy and sub-domains was acceptable for the total self-efficacy score and the four multi-item domains, ranging from $\alpha = .73$ (*Cooperate* Session 3) to $\alpha = .94$ (*Total SE* Session 3).

3.2. Latent growth curve modelling

The first step in LGCM is to test how the data fits the hypothesized growth curve models, to understand if the patterns are mostly linear, or follow another pattern (e.g., curvilinear). We evaluated model fit using a range of fit indices (e.g., chi-square, CFI, TLI, RMSEA) that are frequently used when testing latent growth curve models. The unconditional—or baseline—linear LGC model showed acceptable fit to the data; please see Appendix A for the full range of fit indices.

We found that the mean overall self-efficacy score at pre-test was 49.375 ($p < .001$) and the intercept variance was 43.131 ($p < .001$), suggesting that there were individual differences in self-efficacy scores at pre-test. Self-efficacy scores increased on average by 1.005 ($p < .001$) units between measurement points, while the slope variance was .896 ($p < .001$), indicating that growth significantly varied between individuals. In response to Research Question 1, we found that self-efficacy scores increased from the pre-test to the first post-test, and remained stable between the first and second post-tests, before rising again in the third and final post-tests. The covariance between the intercept and the slope was negative and significant (−2.026, $p < .001$), suggesting that participants with lower initial self-efficacy scores had a greater rate of increase in self-efficacy scores over the intervention period, in comparison

[3] Some ITE programs using this SBL intervention (although not the program where we collected data for this study) incorporate weekly follow-up sessions to discuss the nuances of the scenarios and response options in order to further develop pedagogical reasoning.

Table 1
Descriptive statistics for self-efficacy total scores and subdomain scores by sex and ethnicity.

SE domain	All participants				Male			Female			Majority ethnic group			Minority ethnic group		
	n	α	M	SD	n	M	SD	n	M	SD	n	M	SD	n	M	SD
Pre-test																
Total SE	1259	.89	48.42	6.93	429	48.56	6.57	816	48.44	7.06	995	48.18	6.76	264	49.33	7.48
Adapt	1259	.93	12.42	2.33	429	12.55	2.25	816	12.39	2.36	995	12.36	2.33	264	12.65	2.35
Discipline	1259	.87	7.24	1.98	429	7.40	1.94	816	7.16	2.00	995	7.14	1.94	264	7.58	2.10
Coop.	1259	.75	10.20	1.43	429	10.17	1.38	816	10.23	1.45	995	10.21	1.40	264	10.15	1.56
Motivate	1259	.85	13.63	2.43	429	13.45	2.29	816	13.75	2.48	995	13.54	2.37	264	13.95	2.62
Succeed	1259	–	4.94	.80	429	5.00	.73	816	4.92	.81	995	4.92	.77	264	5.00	.88
Session 1 post-test																
Total SE	1259	.92	51.55	7.06	429	51.36	6.73	816	51.75	7.16	995	51.33	6.86	264	52.38	7.75
Adapt	1259	.89	12.90	2.50	429	13.03	2.40	816	12.87	2.52	995	12.79	2.47	264	13.28	2.57
Discipline	1259	.88	9.03	1.71	429	8.97	1.76	816	9.07	1.69	995	9.00	1.67	264	9.15	1.85
Coop.	1259	.74	10.34	1.38	429	10.32	1.30	816	10.37	1.41	995	10.36	1.34	264	10.27	1.52
Motivate	1259	.89	14.19	2.42	429	13.94	2.24	816	14.35	2.48	995	14.12	2.34	264	14.47	2.67
Succeed	1259	–	5.08	.74	429	5.10	.69	816	5.09	.75	995	5.05	.72	264	5.20	.82
Session 2 post-test																
Total SE	1238	.92	51.47	7.07	420	51.66	6.80	805	51.46	7.15	977	51.31	6.94	261	52.09	7.49
Adapt	1238	.87	13.32	2.33	420	13.42	2.23	805	13.28	2.38	977	13.26	2.29	261	13.52	2.48
Discipline	1238	.87	8.59	1.73	420	8.71	1.71	805	8.55	1.73	977	8.53	1.71	261	8.85	1.77
Coop.	1238	.78	10.28	1.48	420	10.27	1.47	805	10.30	1.49	977	10.30	1.48	261	10.21	1.51
Motivate	1238	.88	14.27	2.27	420	14.21	2.13	805	14.33	2.33	977	14.21	2.25	261	14.48	2.36
Succeed	1238	–	5.01	.74	420	5.05	.75	805	5.00	.73	977	5.01	.72	261	5.03	.78
Session 3 post-test																
Total SE	1229	.94	53.99	55.40	418	54.31	6.80	797	53.93	7.22	973	54.01	6.96	256	53.91	8.01
Adapt	1229	.91	14.23	2.29	418	14.35	2.16	797	14.21	2.32	973	14.23	2.24	256	14.24	2.46
Discipline	1229	.88	9.22	1.70	418	9.39	1.66	797	9.16	1.66	973	9.19	1.67	256	9.36	1.80
Coop.	1229	.73	10.52	1.40	418	10.59	1.29	797	10.51	1.43	973	10.57	1.36	256	10.35	1.52
Motivate	1229	.90	14.83	2.36	418	14.75	2.22	797	14.91	2.36	973	14.83	2.25	256	14.83	2.72
Succeed	1229	–	5.17	.69	418	5.23	.69	797	5.15	.69	973	5.18	.68	261	5.13	.73
Session 4 post-test																
Total SE	1223	.95	55.40	7.28	415	55.78	6.90	794	55.32	7.30	967	55.35	7.10	256	55.60	7.92
Adapt	1223	.93	14.69	2.30	415	14.81	2.11	794	14.66	2.35	967	14.67	2.25	256	14.75	2.46
Discipline	1223	.90	9.62	1.70	415	9.77	1.68	794	9.56	1.68	967	9.57	1.66	256	9.79	1.83
Coop.	1223	.82	10.70	1.35	415	10.77	1.30	794	10.68	1.35	967	10.72	1.34	256	10.61	1.40
Motivate	1223	.91	15.09	2.31	415	15.08	2.21	794	15.14	2.30	967	15.08	2.25	256	15.14	2.56
Succeed	1223	–	5.30	.70	415	5.36	.65	794	5.28	.72	967	5.30	.69	256	5.30	.73

Note. Total SE = Total Self-Efficacy score (Max = 66); Adapt = Adapt instruction to individual student needs domain (Max = 18); Discipline = Maintain discipline domain (Max = 12); Coop. = Cooperate with colleagues and parents domain (Max = 12); Motivate = Motivate students domain (Max = 18); Succeed = Succeed in programme (Max = 6); Majority ethnic group = identify as white British, Scottish, Irish, or Welsh; Minority ethnic group = participants identifying as Black or Black British, Asian or Asian British, and multiple or other ethnic groups.

to those with higher initial self-efficacy scores.

3.2.1. Conditional latent growth model for overall self-efficacy beliefs

The time-invariant covariates of age, sex, and ethnicity were then added in a 'conditional model' to investigate the extent to which they predicted self-efficacy intercept and slope growth factors. There was no significant effect for age or sex on intercept (starting point) or slope (rate of change). However, ethnicity had a significant effect on self-efficacy scores at baseline (*Intercept* for ethnicity = 1.143, p = .016, R^2 = .072), with participants in the minority ethnic group obtaining higher initial mean scores (M = 49.33, SD = 7.48) in comparison to the majority ethnic group (M = 48.18, SD = 6.76). Ethnicity also had a significant effect on the slope (*Slope* for ethnicity = −.147, p = .04, R^2 = −.064), indicating that participants in the minority ethnic group who reported higher self-efficacy (initial mean scores), saw a slower increase in self-efficacy scores in comparison to the majority ethnic group. The rate of change in the slope for participants in the majority ethnic group was 1.339, whereas the rate of change for participants in the minority ethnic group was (1.339 + - .147) = 1.192.

3.2.2. Multigroup latent growth curve models

To address Research Question 2 (and RQ4), we conducted multigroup LGCM to investigate sex differences in the patterns of change in overall self-efficacy beliefs by running the linear model separately for male and female participants. The model suggested that male and female participants experienced similar growth trajectories during the SBL intervention with similar initial mean self-efficacy scores, with M = 49.336 for males, $p < .001$; M = 49.483 for females, $p < .001$. Female participants had a larger intercept variance (44.500, $p < .001$) in comparison to male participants (38.894, $p < .001$).

The rate of increase in self-efficacy scores over the course of the intervention was also similar for male (*Slope* = 1.074, $p < .001$) and female participants (*Slope* = .973, $p < .001$), with a slightly larger slope variance observed for female participants (.969, $p < .001$) compared to male participants (.702, $p < .001$). The covariance between the intercept and slope was significant and negative for both male (−1.550, $p < .001$) and female participants (−2.338, $p < .001$). This indicates that in both groups those with higher initial self-efficacy scores had a less steep increase in self-efficacy over the course of the intervention; however, this relationship was more pronounced for female participants.

We then investigated the growth trajectories in self-efficacy for the majority vs. minority ethnic groups, χ^2 (df = 20) = 530.435 ($p < .001$). Participants in the majority ethnic group (*Intercept* = 49.175, $p < .001$) had slightly lower baseline self-efficacy scores in comparison to participants in the minority ethnic group (*Intercept* = 50.144, $p < .001$). The intercept variance was higher for participants in the minority ethnic group (50.064, $p < .001$) compared to the majority ethnic group (41.007, $p < .001$). The rate of change in self-efficacy was 1.029 (*Slope* variance = .888, $p < .001$) and .915 (*Slope* variance = .899, $p < .001$) for the majority and minority ethnic groups, respectively. The covariance

between the intercept and slope was −2.050 ($p < .001$) for the majority group and −1.768 ($p < .001$) for the minority group. This suggests that in both groups those with higher initial self-efficacy scores saw a slower increase in self-efficacy in comparison to those who started with lower self-efficacy beliefs; however, this relationship was stronger for the majority ethnic group. Fig. 3 graphically portrays the changes in mean self-efficacy scores by sex and ethnicity for the five time points, and Appendix B displays the parameter estimates.

3.2.3. Latent growth models for self-efficacy domains

To respond to Research Question 3 (change in domain-specific self-efficacy), we used the whole sample to investigate the growth trajectories for the five self-efficacy sub-domains (from Skaalvik & Skaalvik, 2007) including (1) *adapting instruction to individual students' needs*, (2) *maintaining discipline*, (3) *cooperating with colleagues and parents*, (4) *motivating students*, and (5) perceived confidence to *succeed in the ITE program*. Appendix C shows the statistics from the unconditional growth models for the five sub-domains.

Adapting Instruction to Individual Students' Needs. For the *adapting instruction to individual students' needs* domain, the unconditional model showed an acceptable fit to the data. The intercept mean was 12.474 ($p < .001$) and the intercept variance was 4.856 ($p < .001$) indicating individual differences in initial scores for this domain. The slope mean was .368 ($p < .001$), and the slope variance was .120 ($p < .001$) suggesting that growth also varied between participants. The covariance between the intercept and slope was negative and significant, −.349 ($p < .001$), indicating that participants with lower initial self-efficacy scores in this domain were more likely to have a greater increase in self-efficacy beliefs throughout the intervention.

Maintaining Discipline. As seen in Appendix C, the unconditional linear model was a poor fit to the data, so we tested nonlinear models (i.e., curvilinear and 'piecewise' models in which the pattern of change occurs in, for example, two phases). We first tested a quadratic model that showed continued poor goodness of fit, followed by a piecewise model with two slopes, the first covering the pre-test and session 1 post-test period, and the second slope covering the session 2 to 4 period of the intervention. The piecewise model improved the model fit in comparison to the linear model. The intercept mean was 7.234 ($p < .001$) and the intercept variance was 2.183 ($p < .001$). The slope mean was 1.546 ($p < .001$) and .269 ($p < .001$) for slope 1 and slope 2 respectively. The variance for slope 2 was .189 ($p < .001$), and the covariance −.198 ($p < .001$), indicating that participants with higher *maintaining discipline* scores at the second post-test had a less steep growth trajectory over the remainder of the intervention, in comparison to those with lower initial scores.

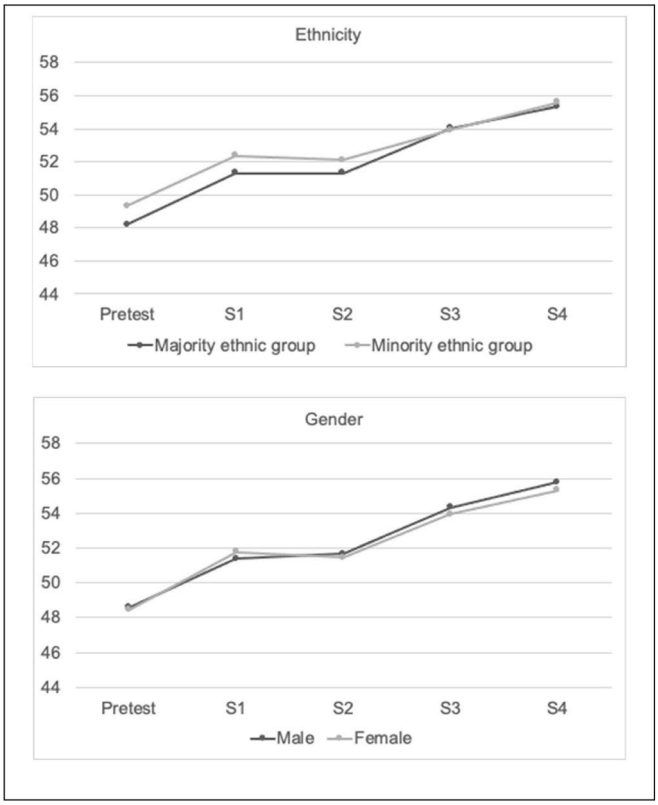


Fig. 3. Mean Self-Efficacy Scores by Gender and Ethnicity.
Note. S1 = Session 1 post-test; S2 = Session 2 post-test, S3 = Session 3 post-test; S4 = Session 4 post-test.

Cooperating with Parents and Colleagues. The goodness-of-fit indices suggested that the linear growth curve model showed an acceptable fit. The intercept mean and variance were 10.210 and 1.716 respectively, and both were statistically significant ($p < .001$). This suggests that there were individual differences in participants' self-efficacy beliefs towards *cooperating with parents and colleagues* prior to the intervention. The slope mean was .077 ($p < .001$), the slope variance was .041 ($p < .001$), and the covariance between the intercept and slope was −.131 ($p < .001$). The trajectory of change in this domain was dependent on individual differences and those with higher initial scores saw a less steep increase in their self-efficacy beliefs compared to those with lower initial scores.

Motivating Students. The linear growth curve model showed an acceptable fit to the observed trajectory for participants' self-efficacy beliefs towards *motivating students*. The mean initial score for this domain was 13.795 ($p < .001$), with variance observed between individuals (4.773, $p < .001$). The slope mean was .219 ($p < .001$) and the variance was .101, ($p < .001$). The covariance between the intercept and slope was negative and significant (−.287, $p < .001$).

Succeeding in the ITE Program. The linear LGC model was an acceptable fit to the data in relation to participants' self-efficacy beliefs towards *succeeding in their upcoming ITE program*. The mean starting value was 4.968 ($p < .001$) with a variance of .473 ($p < .001$), and the slope mean and variance were .051 ($p < .001$) and .010 ($p < .001$) respectively. The covariance between the intercept and slope was −.037 ($p < .001$), which similarly to the other self-efficacy domains, suggests that those with lower initial self-efficacy beliefs in this domain saw a steeper increase in their scores over the course of the intervention in comparison to participants who had higher baseline self-efficacy scores.

3.3. Participant perspectives on SBL intervention

After concluding the SBL intervention, we responded to Research Question 5 by asking participants for responses to the question, *Following the completion of this scenario-based learning module, do you feel more prepared to begin teaching (Yes/No/Unsure)? Please explain.* Of the 1223 participants who completed Session 4, 93% indicated 'yes' the SBL intervention was helpful in preparation for teaching, while 6.1% were 'unsure'. Open-ended responses were provided by 1089 participants and were analyzed using a deductive thematic analysis approach (e.g., Proudfoot, 2022; Robinson, 2021) which examined the *a priori* codes of *scenario content, personal reflection,* and *feedback*. The purpose of using *a priori* codes with deductive thematic analysis in a mixed methods study is to replicate the theory underpinning the quantitative findings. We wanted to understand the roles that exposure to a variety of scenarios, reflection, and feedback played in supporting the measured teaching self-efficacy beliefs. Based on the approach suggested by Robinson (2021), responses were collated in a spreadsheet, read repeatedly, and coded using our *a priori* (deductive) coding categories. The deductive analysis of the individual responses—with responses coded for *scenario content, reflection,* and *feedback* showed how these three components enhanced participants' experiences. Additional codes focused on *multiple components* (i.e., combination of scenarios, reflection and feedback)

and *additional factors* were subsequently added following familiarisation with the data.

Participants noted the importance of *scenario content*, and particularly the range of situations they encountered in the scenarios as a way of applying their knowledge of theory in context in a low-risk setting, e.g., "*It's been great to think through a lot of different scenarios that could arise in my new career - and have the chance to weigh up how best to respond to them without the pressure of doing it for real"* and *"It makes some of the techniques and theories we have discussed less theoretical and easier to imagine.*" Other participants noted that the scenarios provided insight into the realities of teaching helping them to feel more prepared: "*I feel like I can now more accurately understand and envisage some scenarios that might occur in everyday teacher life and feel more prepared to tackle these.*" The range of content—often unanticipated—was noted by participants as one factor that led to increased awareness of classroom challenges: *"It raised my awareness of several situations that I had not previously anticipated coming up in the classroom."* In total, the code of *scenario content* was noted (by itself) by 12.7% of participants as salient in preparation for teaching. As seen below, many more participants commented on the role of scenario content in conjunction with reflection and feedback.

We analyzed the open-ended responses for the code of 'reflection', which included phrases such as 'reflect/reflection, 'think about', 'consider'. In line with Bandura's emphasis on the importance of cognitive processing of the sources of self-efficacy, participants noted that reflection led to better decision-making: "*It has encouraged me to develop my thinking around scenarios and to fully consider the consequences of my actions"* and "*Getting into the practice of thinking about my potential courses of action deeply, thoroughly, and reflectively has been very helpful … by the end, I feel like my ability to stop, take a step back, and think, has seen quite a lot of development, and I found that my emotional responses to the scenarios were a lot more manageable.*" The value of reflecting on thought-processes was noted as a substantial contributor to the usefulness of the SBL intervention by 11.1% of participants.

Our preservice teacher participants noted the importance of feedback from experienced teachers in building confidence. The code of 'feedback' included phrases such as 'feedback', 'responses from teachers', and 'experienced/professional teachers', with 17.2% of participants highlighting the feedback as being the most valuable component of the SBL intervention. Participants noted a range of feedback elements, and the modelling of strategies, increased confidence in teaching, including, "*Working through and reading answers from experiences teachers of the same scenarios that I was nervous/worried to encounter has massively helped me understand how to best respond.*" Participants compared their own responses with those of practicing teachers, resulting in an increased sense of confidence: "*I feel more prepared and confident as I got a chance to see my answer choices in comparison to experienced teachers.*" Participants also noted that they learnt new strategies and approaches from the feedback, e.g., "*the feedback from experienced teachers has been invaluable, especially where they differed from my opinion, as I was able to see an alternative (and better!) course of action."*

Finally, we found that most participants (53.5%) expressed that the combination of scenarios, reflection, and feedback (i.e., *multiple components*) contributed to a sense of capability in teaching. It was frequently noted that these elements enhanced confidence by enabling an insight into teaching, the application of knowledge in context, reflection on decisions and their impact, and consideration of feedback and modelling to inform future practice. For example, "*I have been able to think carefully about a lot of different scenarios that I might meet as a teacher, and this reflection along with the expert guidance has given me more confidence in dealing with them when they arise*." Participants reported that the intervention had a positive impact on their teaching self-efficacy and feelings of preparedness. For example, "*These tasks have increased my confidence and have exposed me to real life teaching scenarios. They have proven to be a great development tool in the training process*" and "*The SBL module covered a lot of scenarios that I had previously wondered how I would manage. Knowing now the most appropriate way to react in certain situations will help me immeasurably in the school environment"* and *"The scenarios offered an insight into the types of situations teachers could face in school, and the teacher feedback provided a useful explanation of how most professionals would approach these situations. If they did occur in the classroom, I would now feel more confident in exercising my judgement and doing the right thing.*"

However, some participants (5.5%) noted that while that while the SBL activities were useful, *additional factors*, such as more teaching experience, would be required to further increase their confidence: "*… this is definitely helpful. That being said, I still need to further develop the skills to be adaptable and to react appropriately in these situations and that will only come with time and personal experience.*" Overall, the elements of scenario content, reflection, and feedback were seen as important contributions to building preservice teachers' confidence to succeed in the classroom.

4. Discussion

The aim of this study was to test the patterns of change in preservice teachers' overall and domain-specific teaching self-efficacy over the duration of an online intervention delivered prior to the initial teaching placement in a teacher education program. The results showed that preservice teachers' self-efficacy is dynamic, and responsive to interventions designed to reflect Bandura's proposed sources of self-efficacy. We saw an upward trajectory in preservice teachers' self-efficacy beliefs across five measurement points, with individual differences observed in the initial starting point and the rate of change. The hypothesis associated with RQ1 was partially supported. Participants with higher initial self-efficacy beliefs saw a less steep increase in self-efficacy across the intervention in comparison to participants with lower baseline beliefs (RQ1). Next, initial overall self-efficacy scores and the trajectory of change were found to be similar for male and female participants (RQ2). Although an upward trajectory was observed for the majority of the self-efficacy sub-domains, there was a different pattern of change for the maintaining discipline sub-domain. This suggests that the development of self-efficacy beliefs may vary depending on the particular domain, partially supporting RQ3. Participants in the minority ethnic group had higher baseline self-efficacy scores and a slower rate of change in comparison to the majority ethnic group who had lower initial self-efficacy beliefs, with differences in scores lessening over the course of the intervention (RQ4). Finally, in answer to RQ5 (participants' perceptions of reflection on scenarios and expert feedback), we found that participants viewed the opportunity for reflection and the provision of feedback interacting with scenario content to influence their confidence for teaching.

4.1. Changes in teachers' self-efficacy

Preservice teachers' overall self-efficacy beliefs increased throughout the intervention period, with a steep incline observed from the pre-test to the first post-test, with levels remaining constant from the first to second post-test, before a further increase from the second to final post-test. This upward trajectory supports and extends prior research into the positive effect of a single SBL session, with the same format and components, on preservice teachers' self-efficacy beliefs (Bardach et al., 2021), and suggests that multiple SBL sessions can contribute to further increases in preservice teachers' teaching self-efficacy over time. The covariance between the intercept and slope latent variables was statistically significant and negative, suggesting that preservice teachers with lower initial self-efficacy beliefs had a steeper increase in self-efficacy across the measurement points, in comparison to participants who had higher self-efficacy beliefs prior to the SBL intervention. This finding suggests that less-confident preservice teachers may benefit more from the intervention than their more confident peers, and further raises the question of whether the intervention should be targeted at those preservice teachers who express

higher levels of doubt about their teaching capabilities.

The finding of overall growth has important implications for practice, as higher self-efficacy beliefs have been found to be associated with a range of positive teacher outcomes, including better classroom organisation and management strategies (Burić & Kim, 2020; Tschannen-Moran & Woolfolk Hoy, 2001), more effective differentiation of instruction (Suprayogi et al., 2017), increased job satisfaction and commitment (Avanzi et al., 2013; Barouch Gilbert et al., 2014), and decreased likelihood of stress and burnout (Skaalvik & Skaalvik, 2017; Zee & Koomen, 2016). In turn, teachers' beliefs regarding their capabilities may play an important role in their behaviors, how they perceive and respond to achievements and failures, and their motivation to persevere in challenging situations (Bandura, 1997, 2012; Swan et al., 2011). The identification of online scalable supports that can assist preservice teachers to develop their self-efficacy beliefs may play an important role in helping to prepare them to enter the classroom.

We see from the qualitative data that this increase in self-efficacy may be attributable to the multiple components that make up the SBL intervention (i.e., engagement with realistic scenarios, self-reflection, expert feedback). The components are based on the principles of situated learning (Lave & Wenger, 1991) and situated cognition (Brown et al., 1989) theories, which hold that learning should be embedded within realistic workplace contexts and tasks so knowledge and problem-solving skills (e.g., responding to classroom challenges) can be developed in a way that is reflective of the workplace environment. Opportunities for reflection and articulation of reasoning, in addition to feedback, scaffolding, and modelling of domain-specific tasks from experienced members of the workplace community, can also help to promote learning and understanding (Herrington et al., 2014; Herrington & Oliver, 1995). Several studies have highlighted that the combination of feedback and self-reflection can enable individuals to evaluate their thought processes and instructional strategies while monitoring their progress against models of best practice (Coulson & Harvey, 2013; Darling-Hammond et al., 2017), and may lead to increases in self-efficacy beliefs. Thus, the process of engaging with realistic classroom scenarios, reflecting on decision-making processes, and receiving tailored feedback from more experienced teachers in the current SBL intervention may have contributed to increases in participants' self-efficacy beliefs (Bardach et al., 2021; Prilop et al., 2019).

The combination of components found in the SBL intervention are linked to the key sources involved in the development of self-efficacy (Bandura, 1997). According to Bandura (1997), self-efficacy is formed via enactive mastery experiences, vicarious experiences, verbal persuasion and physiological states influencing an individual's perceptions of their capabilities. Enactive mastery experiences have been found to play an important role in teachers' self-efficacy development (Tschannen-Moran & Woolfolk Hoy, 2001); which may explain the perceived value of the classroom scenarios to participants in the current study. The preservice teachers reported that engagement with virtual teaching scenarios enabled the application of theory to practice, and insight and preparation for a range of situations prior to beginning teaching. Preservice teachers receive relatively limited opportunities to reflect and apply their knowledge in context while receiving feedback in a low-risk environment prior to professional placements, in comparison to other fields such as medical and legal education (Errington, 2011). Therefore, the engagement with virtual scenarios may have enabled a more gradual exposure to workplace events and tasks in a less pressurised environment in comparison to teaching placements, potentially contributing to the perceived value of the scenarios in promoting preservice teachers' confidence. However, most participants noted that it was the combination of scenarios, reflection, and feedback that influenced their self-efficacy beliefs.

The inclusion of reflective activities is aligned with Bandura's suppositions about the importance of cognitive processing of the sources of self-efficacy. Participants were provided with space to reflect—to cognitively process, in Bandura's terms—the reasons for their decisions in each scenario. According to participants in their open-ended responses, the inclusion of these proposed sources of self-efficacy in the SBL intervention contributed to the observed increase in self-efficacy beliefs. In terms of building self-efficacy beliefs, exposure to experiences (i.e., the scenarios in this intervention) are vital in providing situated events to facilitate the assessment of one's capabilities; however, this alone is not a sufficient pathway to boost self-efficacy. Cognitive processing (i.e., reflection) on the experiences is necessary to enable comprehension, evaluation of progress, and elicit potential changes to beliefs and behaviours (Mathew et al., 2017; Pfitzner-Eden, 2016). Immediate reflection in relation to specific events can also reduce the challenges associated with recalling the reasoning behind actions retrospectively, potentially increasing the value and accuracy of the reflective practice (Cimer et al., 2013). However, in a busy classroom environment (e.g., during teaching placements), reflection 'in the moment' is not always feasible due to time and practical restrains (Wieringa, 2011). The reflective activities in the SBL intervention prompted immediate reflection in relation to specific situations, and time and space for processing, which may have facilitated participants' ability to evaluate and assign meaning to their experiences.

Feedback and modelling are also salient to the learning process and the development of confidence in one's capabilities. Engagement with model strategies and guidance in context, and the opportunity to evaluate progress in comparison to experienced colleagues, can confirm or challenge the existing beliefs and knowledge an individual holds and also increase motivation towards goals (Hattie & Timperley, 2007). However, feedback can vary in its effectiveness (Thurlings et al., 2012), with immediate and specific feedback from a trusted source who is knowledgeable in the area being particularly beneficial (Hattie & Gan, 2011; Weber et al., 2018). In alignment with prior research into effective feedback, participants in the SBL intervention immediately engaged with positively framed feedback from a trusted source of experienced educators in relation to specific classroom events, potentially enhancing the value of the feedback.

Vicarious experience and social persuasion can influence the interpretation of experiences and self-efficacy beliefs (Bandura, 1997; Darling-Hammond et al., 2017), especially in the early stages of a teaching career when confidence may be lower due to limited practical experience (Klassen & Chiu, 2010; Pfitzner-Eden, 2016; Tschannen-Moran & Woolfolk Hoy, 2001). Complementing these findings, the preservice teachers highlighted the importance of seeing how experienced teachers would approach scenarios and model strategies (i.e., vicarious experience) and receiving context-specific feedback (i.e., verbal persuasion), with numerous mentions of boosts to teaching confidence when the feedback from experienced teachers confirmed participant decision-making. While preservice teachers may frequently receive feedback related to assessments or observations, as the SBL intervention was virtual and not assessed, participants may have felt less pressurised, potentially contributing to positive appraisals of their experiences. Positive experiences and interpretations of one's capabilities can promote self-efficacy, while negative evaluations of experiences can have the opposite effect (Bandura, 1997; Pfitzner-Eden, 2016). Therefore, the perceived success in relation to approaching teaching situations and receiving positive feedback during the intervention, and reflecting on this experience, may have contributed to the observed increases in the preservice teachers' self-efficacy beliefs. Previous studies (e.g., Bardach et al., 2020) have shown the importance of scenarios, reflection and feedback experimentally, but only for cross-sectional interventions. In the current study, we showed the patterns of preservice teachers' self-efficacy growth over time, and using brief, open-ended, qualitative data, built an understanding of participant perceptions of the reasons for the patterns of growth.

4.1.1. Self-Efficacy Sub-Domains

The observed pattern of change in self-efficacy was found to differ by domain. While there was an upward linear trend for most of the self-

efficacy subdomains, a non-linear trajectory was observed for the maintaining discipline domain. There was a sharp increase in scores in this subdomain from the pre-test to the first post-test, followed by a slight decline from the first to second post-test, although the decline did not reach pre-test levels. Self-efficacy related to maintaining discipline then continued to follow an upward trajectory from the second to final post-tests. This is in alignment with prior research that has indicated that self-efficacy beliefs can vary based on the specific task rather than being universal across all domains of teaching (Chan, 2008; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2007). Managing student behavior has consistently been identified as a key challenge in the early stages of a teaching career (Boakye & Ampiah, 2017; He & Cooper, 2011; Miles & Knipe, 2018), and preservice teachers have been found to have lower self-efficacy beliefs in this domain (Chan, 2008). Thus, as participants in the current study were at the very beginning of their ITE program and may have had limited practical teaching experience, it is plausible that they may have lacked confidence in their capabilities in relation to this particularly challenging domain of teaching. This may partially explain why self-efficacy beliefs in relation to maintaining discipline were seen to fluctuate over the course of the SBL intervention rather than developing in a purely linear fashion. Furthermore, the slight decline in the maintaining discipline sub-domain during the second post-test may have been due to the second SBL session containing scenarios focused on managing student behavior. Thus, some participants may have felt less efficacious in relation to maintaining discipline immediately after completing these scenarios as they gained insight into this complex area of teaching.

4.1.2. Subgroup differences in self-efficacy beliefs

Male and female participants had comparable baseline self-efficacy beliefs and showed similar growth trajectories during the SBL intervention. However, the intercept and slope variances were higher for female participants indicating higher levels of individual variation in baseline scores and growth in comparison to male participants, with participants with lower initial scores seeing a steeper increase in self-efficacy beliefs over the course of the intervention. Prior research has found significant sex differences in relation to specific subdomains of teacher self-efficacy (Avanzi et al., 2013; Skaalvik & Skaalvik, 2007), which may be partially attributable to alternate societal sex roles and socialisation processes that may have contributed to differing levels of efficacy beliefs in particular domains according to sex (Parham et al., 2015). Thus, it is plausible that different socialisation processes may have contributed to the higher level of individual variation in self-efficacy scores observed for female participants in the present study. However, the limited sex differences in baseline self-efficacy beliefs and growth trajectories are consistent with previous research using the Teachers' Sense of Efficacy Scale (TSES) that established that sex was not a significant predictor of teachers' overall self-efficacy beliefs (Tschannen-Moran & Hoy, 2007), and suggests that the SBL intervention was effective at enhancing self-efficacy beliefs for male and female participants.

Teacher self-efficacy beliefs were also found to increase throughout the SBL module for minority and majority ethnic group members. However, participants in the minority ethnic group had higher self-efficacy beliefs at baseline, with a larger intercept variance in comparison to majority ethnic group members. Ethnicity also predicted the slope trajectory, with minority ethnic group members showing a slightly slower rate of change over the course of the intervention in comparison to the majority ethnic group. The observed differences in the rate of change may be due to the minority ethnic group reporting higher average baseline self-efficacy beliefs which may have contributed to slower growth as they already felt confident in their capabilities prior to the intervention. This is an interesting finding that warrants further investigation, but the finding does complement Sheu et al.'s (2018) study which found that there were differences based on ethnicity in terms of the effect of Bandura's proposed sources of self-efficacy (i.e., enactive experiences, vicarious experiences, verbal persuasion, and affective states), with minority group members' self-efficacy being less likely to be influenced by negative affective states (Bandura, 1997). Thus, it is plausible that alternate life experiences, and how these experiences were interpreted by individuals, may have contributed to the observed differences in initial self-efficacy beliefs in terms of ethnicity, with prior negative experiences and physiological states potentially having a less detrimental impact on ethnic minority group members' self-efficacy development. Alternatively, factors that were not included in the current analysis may have also contributed to this finding. Further research could disaggregate the majority and minority ethnic groups and conduct research in different cultural contexts to further investigate this finding.

4.2. Implications and future directions

The findings from the current study extend prior research on the benefits of SBL in teacher education (Bardach et al., 2021; Klassen et al., 2021), and have important implications for practice. The findings suggest that multiple online SBL sessions consisting of realistic classroom scenarios, reflection exercises, and feedback may help preservice teachers feel more confident in their teaching capabilities, which may be beneficial when they first enter the classroom. At the same time, there are implications for practice that relate to the 'bumpy' development of preservice teachers' self-efficacy by domain. Our finding that preservice teachers' confidence to manage student behavior grew more unevenly than confidence in other domains highlights the importance of addressing the consistently recognized anxiety that many preservice teachers hold (e.g., Miles & Knipe, 2018). Increasing the intensity of SBL interventions in target domains, for example, for understanding and managing classroom behaviors, is an area of priority in further SBL research. When preservice teachers first start teaching, they can face numerous professional and psychological challenges (Aarts et al., 2020; Dicke et al., 2015), and it is imperative that preservice teachers feel prepared and confident on their teaching placements, as performance during the teaching placement is associated with future teaching outcomes (Krieg et al., 2021). Thus, there is value in identifying supports that may help preservice teachers feel more efficacious and prepared before they begin teaching.

4.3. Limitations

While the study's findings have important implications, there are several limitations to the study that future research should address. First, as the SBL intervention was conducted alongside a five-week preparation program administered by the ITE provider, we were not able to determine whether the observed effects are solely attributable to the SBL intervention, the preparation program, or a combination of the two. Administering the SBL during the ITE program allows for the possibility of a 'positive contamination' effect in teaching self-efficacy. However, the self-efficacy measures were administered in the context of the SBL intervention, and we suggest that the wording of the open-ended measures (i.e., *Following the completion of this scenario-based learning module, do you feel more prepared to begin teaching?*) helped focus participants on the intervention. Nevertheless, future research would benefit from including a control group who completed the ITE preparation program without the SBL intervention to establish the extent to which the observed effects were solely attributable to the SBL intervention. The inclusion of a control group was not possible in the current naturalistic study due to the ITE providers' requirement that all preservice teachers on their program should have access to the SBL intervention. Second, we were only able to access certain demographic information about participants (i.e., sex, ethnicity), therefore, further investigations could include other covariates that may be relevant, such as prior academic achievement and teaching experience, to determine their effects. Third, we aggregated ethnicity into majority and minority ethnic groups due to

the comparably small number of participants in the minority ethnic group; however, future research should seek to investigate potential differences in self-efficacy beliefs depending on specific ethnic identity.

Fourth, the findings are based on preservice teachers' self-reports as we were investigating participants' personal beliefs. Additionally, participants' open-ended responses regarding the perceived value of the SBL intervention at the end of the final session were not compulsory, and while most participants responded, this self-selection may have influenced the nature of the qualitative findings. It would be worthwhile to triangulate the findings with other data sources, such as mentor observations or other indicators of performance. For example, a think-aloud observation study would allow us to observe participants while completing the intervention in real-time, and would provide insight into decision-making and levels of self-efficacy. Fifth, while we monitored the trajectory of change in self-efficacy over the course of the intervention, we do not know if the observed increase in self-efficacy was maintained following the completion of the SBL intervention. Therefore, further research should evaluate whether the effects are maintained over time, and how group differences affect the stability of subdomain scores. Despite these limitations, the findings suggest that the SBL intervention helped promote preservice teachers' self-efficacy beliefs prior to their ITE teaching placement.

5. Conclusions

Providing tailored feedback on classroom decision-making to preservice teachers can be challenging due to time and resource restrictions. For ITE programs aiming to integrate conceptual understanding with practical experience, interventions that can provide preservice teachers with a controlled introduction to full classroom responsibility can form an invaluable component of the curriculum. Therefore, online and scalable SBL activities may be a promising resource for helping preservice teachers build their teaching confidence prior to their teaching placements. SBL activities enable preservice teachers to reflect on their decision-making processes in relation to events that other teachers have encountered in the classroom, while receiving tailored feedback from more experienced teachers, potentially helping them feel more prepared to approach similar situations when they start teaching.

CRediT authorship contribution statement

Jade V. Rushby: Writing – original draft, Project administration, Investigation, Conceptualization. **Robert M. Klassen:** Supervision, Project administration, Investigation, Conceptualization. **Tracy L. Durksen:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Andreas Pfaffel:** Methodology, Formal analysis, Conceptualization. **Lisa Bardach:** Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis.

Declaration of competing interest

We followed ethical guidelines set out by our universities and by relevant ethics guidelines (e.g., BERA, APA, AERA). The article has not been submitted or published elsewhere. We did not use generative AI to write or prepare the manuscript. All authors played a substantive role in conducting the research and preparing the manuscript.

Appendix A

Model Fit Indices for the Latent Growth Curve Analyses of Overall Self-Efficacy.

Growth Model	χ^2	*df*	CFI	TLI	RMSEA	SRMR	AIC	BIC
Unconditional linear	523.86**	10	.923	.923	.202**	.041	35831.76	35883.15
Conditional linear (with covariates)	545.327**	19	.919	.894	.149**	.036	35403.44	35485.49

Note. CFI = Comparative Fit Index; TFI = Tucker-Lewis Index; RMSEA = Root Mean Square Error Approximation; SRMR = Standardized Root Mean Square Residual; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.
Conditional linear model included covariates of age, gender, and ethnicity.
**$p < .001$.

Appendix B

Parameter Estimates for Overall Self-Efficacy from Multigroup Latent Growth Curve Modeling.

Group	Intercept		Slope		Cov (I, S)
	M	Var	M	Var	
Male	49.336**	38.894**	1.074**	.702**	−1.550**
Female	49.483**	44.500**	.973**	.969**	−2.338**
Majority Ethnic Group	49.175**	41.007**	1.029**	.888**	−2.050**
Minority Ethnic Group	50.144**	50.064**	.915**	.899**	−1.768**

Note. Cov = covariance, Var = variance, I = Intercept, S = Slope.
**$p < .001$.

Appendix C

Model Fit indices and Parameter Estimates for the Self-Efficacy Sub-Domains from Unconditional Latent Growth Curve Modeling.

SE Domain	χ^2	*df*	CFI	TLI	RMSEA	SRMR	AIC	BIC	Intercept		Slope		Cov (I, S)
									M	Var	M	Var	
Instruction[a]	167.07**	10	.968	.968	.112**	.112	23463.54	23514.94	12.474**	4.856**	.368**	.120**	−.349**
Discipline[a]	1034.70**	10	.737	.737	.285**	.234	21784.36	21835.76	8.071**	2.207**	.255**	.044**	−.107**
Discipline[b]	421.23**	9	.89	.88	.191**	.079	21172.92	21229.46	7.234**	2.183**	1.546**/.269**	.00/.189**	−.198**
Cooperate[a]	98.71**	10	.979	.979	.084**	.049	17677.056	17728.45	10.210**	1.716**	.077**	.041**	−.131**
Motivate[a]	130.36**	10	.976	.976	.098**	.064	23383.88	23435.27	13.795**	4.773**	.219**	.101**	−.287**
Succeed[a]	159.53**	10	.960	.960	.109**	.067	10134.78	10186.18	4.968**	.473**	.051**	.010**	−.037**

Note. SE = Self-efficacy; Instruction = Adapt instruction to individual students' needs SE subdomain; Discipline = Maintain discipline SE subdomain; Cooperate = Cooperating with parents and colleagues SE subdomain; Motivate = Motivate students SE subdomain; Succeed = Succeed in ITE program SE subdomain; CFI = Comparative Fit Index; TFI = Tucker-Lewis Index; RMSEA = Root Mean Square Error Approximation; SRMR = Standardized Root Mean Square Residual; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; Cov = Covariance, I = Intercept; S = Slope.
**$p < .001$.
[a] Unconditional linear LGC model.
[b] Piecewise LGC model. Figure before/is slope 1 (phase 1), and figure after/is slope 2 (phase 2).

Data availability

Data will be made available on request.

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