Supporting Pre-service Teachers' Motivation Beliefs and Approaches to Instruction through an Online Intervention

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Abstract

Background: Previous research has shown that pre-service teachers have low responsibility for student motivation and feel underprepared to deal with motivational issues. As an extension, researchers have designed interventions to shift teachers' beliefs about motivation or equip them with approaches to instruction, but never both.

Aims: Following best practices for motivation interventions, we created a one-session online intervention and tested its efficacy to shift pre-service teachers' self-reported beliefs and approaches to instruction to be more supportive of student motivation. The intervention included priming, materials designed for mindsets or for approaches to instruction, a consolidation activity, and take-home materials.

Sample: A convenience sample of 384 pre-service teachers from one Canadian university participated.

Methods: We embedded an experimental design into multiple sections of a required assessment course. After completing a pre-test, participants were randomly assigned to one of four conditions: beliefs-only, approaches-only, combined beliefs and approaches, or control. After completing the online module, students received a lecture on assessment practices and motivation.

Results: The results from our MANCOVA showed that pre-service teachers who participated in the beliefs-only condition reported increased levels of responsibility for student motivation, more growth mindset beliefs, and less fixed mindset beliefs than participants in the other conditions. The approaches-only condition did not influence self-reported mastery or performance approaches to instruction and the combined condition had no effect on beliefs or approaches.

Conclusions: We discuss the implications for educating pre-service teachers about student motivation and suggest that beliefs and approaches to instruction need to be addressed separately.

Supporting Pre-service Teachers' Motivation Beliefs and Approaches to Instruction through an Online Intervention

Researchers have shown that teachers' beliefs and approaches to instruction (Hattie, 2012) have important implications for students' motivation and achievement (Lau & Nie, 2008). As a natural extension, researchers have designed interventions to shift teachers' beliefs about motivation (Seaton, 2018) or equip them with approaches to instruction (Cheon et al., 2018), but rarely both. Designing an intervention that targets both beliefs and approaches, particularly during initial teacher education, may be especially beneficial to prepare novice teachers to support student motivation. In this research, we tested the efficacy of a one session online intervention designed to shift pre-service teachers' self-reported beliefs and approaches to instruction to be more supportive of student motivation. We rooted the intervention content in motivation theory (Dweck, 1999; Lauermann & Karabenick, 2011; Linnenbrink-Garcia et al., 2016; Ryan & Deci, 2000), followed recent recommendations for intervention design (Cheon et al., 2018; Yeager et al., 2016), and used a randomized control with pre-service teachers to assess its efficacy.

Teachers' Beliefs Related to Student Motivation

The 2013 Organisation for Economic Co-operation and Development (OECD) Teaching and Learning International Survey (TALIS) measured teachers' efficacy for instruction, classroom management, and student engagement. Although labeled "engagement" the survey items (Tschannen-Moran et al., 1988) closely resemble ideas that are central to student motivation such as "I can motivate students who show low interest in school work". In Alberta, Canada, where this research was conducted 64% and 75% of TALIS respondents felt they could do "quite a bit" or "a lot" in the domains of instruction and classroom management respectively; whereas, only 58% reported that that level of efficacy in regards to student engagement/motivation (Alberta Education, 2013). In Canada,

teacher education and licensure are provincially regulated and bachelor of education programs can be quite diverse in their requirements (van Nuland, 2011). This deficit in supporting student motivation can be particularly concerning because students' motivation is suggested to be "the greatest resource educators can tap" (Niemiec & Ryan, 2009, p. 134). Without confidence in this domain, teachers may fail to capitalize on its potential.

Efficacy beliefs share a nomological net with the construct of *personal responsibility,* which Lauermann and Karabenick (2011) define "as a sense of internal obligation and commitment to produce or prevent designated outcomes" (p. 135). Personal responsibility is particularly relevant in Canada, where external accountability systems are less rigid that in the United States for example (Alberta Teachers'Association, 2004). According to this framework, teachers assume varying levels of personal responsibility in four domains: student motivation, student achievement, relationships with students, and the quality of their own teaching. Higher levels of personal responsibility in general are beneficial for teachers' emotions, optimism, and hopefulness (Eren, 2014). Despite positive associations with outcomes, researchers consistently find that practicing and pre-service teachers report substantially lower levels of responsibility for student motivation than the other three domains (Berger et al., 2013; Daniels et al., 2016; Daniels et al., 2018; Eren, 2014; 2015; 2017; & Eren & Çetin, 2019; Lauermann & Karabenick, 2013).

Exploring this disparity in detail, Daniels and colleagues (2018) conducted a convergent sequential mixed method study examining teachers' quantitative scores and their experiences of being responsible for student motivation. They found that some teachers viewed motivation as a quality that they can and should influence; whereas, other teachers viewed motivation as an innate quality that students "seem to have been born with" (Daniels et al., 2018, p. 7). Similarly, Shalter-Bruening (2010) found that some teachers believe that students will just *be* adequately motivated and, therefore, do not feel the need to address

motivation. Mindsets (Dweck, 2006) may provide a theoretical explanation for these beliefs. According to Mindset Theory, people tend to approach a variety of personal qualities with either a fixed mindset, meaning the quality cannot be increased, or a growth mindset, meaning that the quality can be developed. Teachers' descriptions of student motivation (Daniels et al., 2018; Shalter-Bruening, 2010) imply that they may view motivation as a personal quality that ranges in terms of being fixed or growth. Taken together, a lack of personal responsibility and a fixed mindset for student motivation represent two obstacles pre-service teachers face in supporting student motivation. Scholars implore teacher education programs to examine pre-service teachers' beliefs in order to be as effective as possible (Pajares, 2013). Our research contributes to an understanding of beliefs related to motivation specifically and also tests a mechanism by which beliefs can shift.

Belief-based interventions. Arguing that teachers will benefit from instruction on mindset theory to bring about sustained change in their practices and their students' mindsets, Seaton (2018) used a pragmatic epistemological stance with mixed methods to study teachers' responses to mindset training. She found a statistically significant increase in growth mindsets from pre-test to post-test as well as at a three-month follow-up. Moreover, participants strongly identified the training as contributing to their ability to implement adaptive motivation practices in their classrooms.

Although we found no other instances of mindset or belief-based interventions for teachers, such interventions for students' mindsets (Blackwell et al., 2007) have proven quite successful. As a recent example, Yeager and colleagues (2019) used a pre-registered report with a nationally representative sample to show that a one-time online administration of a growth mindset intervention increased low-achieving grade nine students' grades and persistence. As these brief and targeted belief-based interventions continue to show success with students, there is reason to think that similar interventions for pre-service teachers may

be able to shift their beliefs towards greater responsibility and growth.

Teachers' Approaches to Instruction Related to Student Motivation

Evidence suggests that teachers feel underprepared to manage issues related to student motivation (Hardré & Sullivan, 2008; Turner et al., 2011), even though researchers regularly provide recommendations as such (for reviews see Elliot et al., 2017; Karabenick & Urdan, 2014). To enhance adaptive motivation, most researchers recommend approaches to instruction that include supporting autonomy, focusing on mastery, building relationships, providing choice, and avoiding competition (Linnenbrink-Garcia et al., 2016). While some research shows that teachers' approaches to instruction align with these sorts of motivation principles, it also shows that teachers make instructional decisions for intuitive rather than evidence-based reasons (Hardré & Sullivan, 2008). In one study with pre-service teachers specifically, Daniels and colleagues (2016) showed that although responsibility for student motivation was negatively associated with intention to establish classroom performance goal structures it failed to be positively associated with mastery goal structures and use of explanatory rationales.

In addition to self-report, researchers have used observational studies to ascertain the approaches to instruction that distinguish highly motivating teachers from less motivating. Such observations show that highly motivating teachers tend to approach instruction in a way that focuses on student learning, participation, and effort while supporting student wellbeing, positive emotions, collaboration, and building strong rapport (Anderman et al., 2011; Patrick et al., 2003; Turner et al., 2003; Reeve et al., 1999). Reeve and Cheon (2014) claim that what sets motivating teachers apart from controlling ones may come down to "the teacher's tone and sentiment" (p. 299). Because pre-service teachers do not necessarily encounter learning related to student motivation, intervention related to instructional approaches may also be an important consideration in teacher education.

Interventions for instructional approaches. Although researchers have a good sense of which approaches to instruction support adaptive motivation, these approaches are inconsistently communicated to pre-service and practicing teachers through empirical articles, books, professional development, or online modules. One of the most well-developed formal interventions addressing approaches to instruction is the Autonomy Support Intervention Program (ASIP). ASIP is a "carefully-designed, theory-based, and workshop-oriented training program [for teachers] to learn how to become more autonomy supportive toward their students during instruction" (Cheon et al., 2018, p. 43-44). ASIP is delivered to teachers in three parts over several months and involves information on motivation, how-to skills, and group discussions related to autonomy-supportive practices. A substantial body of evidence shows that teachers who complete ASIP are more autonomy-supportive (Cheon et al., 2012; Cheon et al., 2016; Cheon et al., 2014; Cheon & Reeve, 2015) and their students have improved motivation and outcomes (Cheon et al., 2012; Cheo et al., 2016; Chatzisarantis & Hagger, 2009; Tessier et al., 2010; Vansteenkiste et al., 2007).

ASIP is a relatively intensive formalized intervention program based exclusively on self-determination theory, even though other discrete motivation theories offer additional or alternative approaches that can be effective. As an alternative to pitting theoretical recommendations against each other, Linnenbrink-Garcia and colleagues (2016) synthesized the most common discrete motivation theories to produce the following five motivation design principles: support competence; support autonomy; select personally relevant, interesting activities; emphasize learning, de-emphasize competition; support feelings of relatedness. It is important to note that these design principles are not prescriptive. Motivation researchers are clear that there is no single way to approach instruction to guarantee student motivation. Thus, rather than offering pre-service teachers a "toolbox" for student motivation, it seems important to help them understand how some approaches to

instruction are well-poised to support student motivation.

Best Practices in Motivation Interventions

Because of the surge in intervention research, recent meta-analyses and reviews have evaluated the circumstances under which motivation interventions are most effective whether targeting students broadly, pre-service teachers specifically, or practicing teachers. For example, mindset interventions are most successful when they provide a specific and targeted message in an inconspicuous way (Yeager & Walton, 2011). Attributional Retraining (AR) is most effective when existing beliefs are questioned prior to the intervention and a consolidation exercise follows the treatment message (Haynes et al., 2009). For consolidation, researchers have used a variety of techniques including paraphrasing, elaborating, practicing, and applying the information to one's own experiences (Weingartner & Parker, 1984). Autonomy supportive interventions appear most effective when they are brief, explain "how to" implement theory, and utilize a combination of presentation materials and take-home resources (Su & Reeve, 2011).

Evidence for online interventions. Evidence is fast accumulating that these types of interventions can be successfully delivered online. Yeager and colleagues' (2019) national study of a mindset intervention highlights the broad reach and scalable scope of online interventions. Although on a smaller scale, the intensive ASIP intervention described above has been effectively transitioned to a web-based delivery that involved lecture videos, comprehension tests, and weekly activities (Tilga et al., 2019). Online formats are particularly advantageous because they are low-cost in terms of delivery, maximize implementation fidelity, and can be embedded into teacher education programs or offered as free-standing professional development.

Current Study and Purpose

It seems that some pre-service teachers adopt approaches to instruction that align with

motivation research while others do not. Likewise, some pre-service teachers seem to view student motivation as a relatively fixed quality and thereby possibly not their responsibility. Thus, it seems that pre-service teachers could benefit from an intervention that addresses inaccurate motivation beliefs and presents approaches to instruction aligned with motivation in a brief and online format. The purpose of this research was to build such an intervention and test its efficacy in a sample of pre-service teachers. By focusing on pre-service rather than practicing teachers, the intervention stands to establish adaptive beliefs and practices during the formative years of training. Because no intervention has targeted both beliefs and approaches to instruction, we created separate treatment materials for each target of the intervention and examined the effects of each separately as well as in combination. We had three research questions: (1) Does the beliefs intervention impact pre-service teachers' responsibility for motivation and mindsets? (2) Does the approaches to instruction intervention impact pre-service teachers' mastery and performance approaches? (3) Is a combined beliefs-approaches intervention more efficacious than separate modules? Through the combined scenario we recognize that changing beliefs can be an important first step in being open to different instructional approaches.

Method

We used a pre-post experimental design with random assignment to four conditions: beliefs-only, approaches-only, combined beliefs and approaches, and control. The university research ethics board approved the procedures and design.

Design of the Intervention

Drawing across the collective recommendations for designing motivation interventions and all components are housed in a self-contained online module. The intervention begins with *personal priming* to get pre-service teachers thinking about their subjective beliefs regarding responsibility and motivation (Haynes et al., 2009). Pre-service

teachers watch videos of two teachers describing feelings of either high or low responsibility for student motivation. The teachers in the videos wrote their own scripts by combining their personal perspective with transcripts documenting other teachers' thoughts about personal responsibility for student motivation (Daniels et al., 2018). Then, pre-service teachers indicate which teacher they related to more, and write an explanation why (Daniels et al., 2020).

After priming, pre-service teachers receive the *treatment message*, which is discrete, precise, and involves minimal theory (Su & Reeve, 2011; Yeager & Walton, 2011). There are four forms of the treatment message: beliefs-only, approaches-only, combined, or control. For the beliefs-only treatment message, pre-service teachers read a mock "Psychology Today" article that contained accurate content about mindsets and emphasized that "teachers can enhance student motivation and mindsets." For the approaches-only treatment message , pre-service teachers work through an interactive visualization tool presenting six approaches to instruction that support motivation: supporting autonomy, facilitating mastery, building relationships, modeling behavior, considering task design, and using rewards. These approaches were selected based on existing recommendations (e.g., Linnenbrink-Garcia et al., 2016) as well as teachers' direct statements about how they motivate students (Radil, 2017). Each approach included information describing what it is, why it is important to motivation, and suggestions on how to implement it. For the combined treatment material, pre-service teachers read the article first and then work through the visualization tool. Finally, for the control treatment material, pre-service teachers read an article of similar length to the beliefs article about formative and summative assessment in schools taken largely verbatim from an online practitioner journal.

Next, we included an *active consolidation exercise* to reinforce the treatment message (Haynes et al., 2009). Tailoring this to pre-service teachers specifically, they will write a

letter to a principal of a new school built specifically to support student motivation indicating what contribution they could make and why they wanted to work there. Finally, pre-service teachers could indicate if they wanted *supplementary materials* (Su & Reeve, 2011) including articles, videos, and researcher-created worksheets emailed to them after the session .

Procedure

The experiment was embedded into seven sections (3 in fall and 4 in winter) of a required course on classroom assessment that occurred before pre-service teachers' first teaching placement and all students were eligible to participate. In exchange for class time, the lead researcher agreed to give a 50-minute lecture on motivation and classroom assessment following the experiment. Pre-service teachers gained access to the pre-test survey through their online class management system and completed it independently before the session. On a pre-determined day, they arrived in class for the online session and a guest lecture on motivation and assessment. The lead researcher delivered the in-class session with at least one research assistant in attendance. The lead researcher described the study to the pre-service teachers and then as a full class, they watched two videos that served the function of priming. After the videos, pre-service teachers used their own or provided electronic devices to log-on to the intervention website, which automatically randomly assigned them to one of the four conditions. The researcher explained that they should work through their online module individually and that neighbors may have different modules and that they may work on something else when they were finished. The researcher and research assistant circulated through the room to troubleshoot and to monitor progress. Anecdotally, no one seemed rushed or to be interested in the other modules. The post-test was included as the last part of each module and included two items asking pre-service teachers to (a) consent for their responses to be used for research purposes and (b) participate in a follow-up questionnaire one month later during their practicum placement. . After all sessions were

completed, a data brief describing some preliminary results was prepared and shared with pre-service teachers via the online classroom management system.

Participants

The seven sections of the assessment course provided seats for 770 undergraduate pre-service teachers (Figure 1). Of the possible 770 students, 543 attended class the day of the intervention and agreed for their responses to be included in the research. We identified three reasons to be excluded from the planned analyses: not having a pre-test, spending < 10 minutes in the online module, or providing no responses in the online module. After excluding participants who met these criteria, the main analyses included 384 participants described in Table 1. There was no formal manipulation check. Only 18% of participants consented to receive a follow-up questionnaire one month later at which time only 13 pre-service teachers participated. Due to this attrition, we focus only on the results of the single experimental session.

Measures

Independent variable. The independent variable had four levels, each representing a unique experimental condition: beliefs-only, approaches-only, combined, and control. Within the four experimental conditions, all components were identical except for the specific treatment materials as described above.

Descriptive variables. On the pre-test participants indicated their gender, age, and intended teaching level. We also noted the semester in which they participated in the research. The online system recorded the time at which participants logged into the intervention and when they submitted the post-test, which allowed us to calculate approximate time spent in the intervention.

Pre- and Post-test questionnaires. The pre-test and the post-test contained identical survey items. For beliefs related to motivation, we measured participants' growth and fixed

mindset beliefs (Dweck, 1999) and their personal responsibility for student motivation (Lauermann & Karabenick, 2013). Participants responded on a five-point Likert scale from 1 = strongly disagree to 5 = strongly agree. The psychometric properties for the summed scales were adequate (see Table 2).

We used the Patterns for Adaptive Learning (Midgley et al., 2000; PALS) to measure participants' intended mastery and performance approaches to instruction. Items on the mastery approach scale list instructional strategies describing the purpose of school as to develop competence; whereas, items on the performance approach scale suggest that the purpose of school is to demonstrate competence. Participants responded on a five-point Likert scale from 1 = strongly disagree to 5 = strongly agree. The coefficient alpha for the mastery subscale at Time 1 was lower than expected; however, we chose to retain it because it had adequate reliability at Time 2.

Rationale for Analyses and Apriori Hypotheses

After running reliability analyses for all variables, we examined correlations between the descriptive variables and the Time 1 variables to ensure that there were no systematic relationships amongst the variables that required inclusion as an additional covariate. Because the outcome variables were conceptually and empirically related, we used a multivariate analysis of covariance (MANCOVA) to test for differences between the four conditions on the outcome variables while controlling for participants' initial levels on those constructs because our interest was how the dependent variables differed between conditions not how much they changed over time. The first MANCOVA included the three measures related to pre-service teachers' beliefs about motivation (growth mindset, fixed mindset, and responsibility for motivation). The second MANCOVA included the two measures related to instructional approaches (mastery and performance). We probed any significant omnibus multivariate results with follow-up univariate tests.

We expected the belief-only and combined conditions to result in higher levels of growth mindsets and responsibility for motivation and lower levels of fixed mindsets than the approaches-only or the control condition. We expected the approaches-only and combined conditions to result in higher levels of self-reported mastery approaches to instruction and lower levels of self-reported performance approaches to instruction than the belief-only condition or the control.

Results

Preliminary Analyses

The descriptive statistics for the sample are presented in Table 1 and the self-report variables are presented in Table 2. As has been the case in previous research, pre-service teacher participants had higher scores on growth mindsets than fixed mindsets and on mastery approaches to instruction than performance. Only three significant correlations emerged amongst the demographics and study variables, and thus we did not add any additional covariates to the main analyses to retain the largest sample in each condition. Specifically, gender correlated positively with responsibility for motivation ($r = .12$, $p = .02$) and mastery goal structures ($r = .15$, $p = .003$), meaning women scored higher on these variables. Teaching level correlated negatively with responsibility ($r = -.18$, $p < .001$), meaning elementary pre-service teachers felt more responsibility for student motivation than pre-service teachers intending to teach high school. Time 1 and Time 2 self-report responses were correlated as would be expected and provide some evidence of validity for the scales (Table 3).

As was expected by the design of the intervention, pre-service teachers spent about the same amount of time working through the belief-only materials as the approaches-only materials and slightly more in the combined condition. The control condition required about the same amount of time to complete as the single treatment conditions. Each condition was

also approximately equal in terms of sample size, distribution between men and women, and teaching level.

Main Results

The assumptions for MANCOVA (Field, 2009) were met for both sets of dependent variables. Specifically, the two sets of dependent variables showed no concerns for skewness or multicollinearity, Box's test of equality of covariance matrices was non-significant with $p < .001$ as the standard accepted value, and Mahalanobis distance did not identify multivariate outliers (for beliefs MD $M = 2.99$, SD = 2.94; for approaches MD $M = 1.99$, SD = 2.00).

The analyses showed a statistically significant difference between the four conditions on the combined belief dependent variables after controlling for initial scores, $F(9, 879) = 3.61$, $p < .001$, Wilks' $\Lambda = .915$, partial $\eta 2 = .03$. All three univariate follow-up tests were also statistically significant. Partially supporting our hypothesis, the belief-only condition resulted in higher scores on the post-test measure of growth mindsets and lower scores on the post-test measure of fixed mindsets than any other condition. For responsibility for motivation, the belief-only intervention resulted in higher scores than approaches-only or the control condition but did not differ from the combined condition (See Table 4).

The multivariate test for the approaches to instruction variables was not statistically significant: $F(6, 718) = .66$ $p = .68$, Wilks' $\Lambda = .989$, partial $\eta 2 = .006$. We did not pursue any follow-up tests and concluded instead that the approaches-only condition on its own or combined with beliefs did not have a statistically significant effect on pre-service teachers' intended approaches to instruction.

Unplanned Approaches to Instruction Analyses

The non-significant results for the approaches-only condition may be caused by a ceiling effect that is often noted when working with the PALS (Midgley et al., 2000). Thus, we wanted to further explore pre-service teachers' reactions to the approaches to instruction

visualization. As part of the consolidation phase for the approaches to instruction materials (i.e., the visualization), participants were asked to indicate which strategy was their favorite and why. Additionally, they could request follow-up information on any of the approaches (Figure 2). Just over 50% of participants indicated that "relationships" was their favorite of the approaches listed and also that they wanted more information on relationships for the purposes of motivation. Only 2% of participants indicated that "rewards" was their favorite approach. Moreover, "rewards" was the only approach that students were less rather than more interested in getting more information about. Overall, 33% of participants indicated wanting more information on all six approaches, suggesting that there is an appetite to know more about instructional approaches associated with motivation.

Discussion and Implications

The purpose of this study was to examine the efficacy of a motivation intervention targeting pre-service teachers' beliefs and approaches to instruction related to student motivation. We tested separate and combined conditions to examine materials created to shift beliefs and approaches on their own and together. Overall, the results were more favorable for the beliefs intervention than the approaches or combined conditions. We discuss possible explanations for this difference as well as highlight important limitations and directions for future research.

Changes in Beliefs but not Approaches

The beliefs-only intervention resulted in a statistically significant increase in pre-service teachers' growth mindset for motivation and their personal responsibility for student motivation, along with a significant decrease in their fixed mindset. Given that personal responsibility for motivation has been regularly shown to be low (Daniels et al., 2016; 2018; Lauermann & Karabenick, 2013), this finding suggests that a brief, targeted, and truthful message can help increase pre-service teachers' responsibility for motivation at least on an

immediate post-test. The shift in mindsets is compelling because the scores were already relatively high for growth and low for fixed and yet were modified to be even more supportive of student motivation. As is often argued in support of the effectiveness of brief mindset interventions (Yeager & Walton, 2011), the intervention may have been successful because it precisely targets pre-service teachers' belief systems related to student motivation thereby further corroborating the theory.

We suggest that positioning pre-service teachers to believe that student motivation is malleable and indeed their responsibility may be a necessary pre-requisite before they seek and apply evidence-based approaches to instruction. Indeed, scholars regularly petition that teacher education programs focus on understanding pre-service teachers' beliefs in order to be as effective as possible (Pajares, 2013). The beliefs-only intervention in its entirety is archived in the Education and Research Archives (ERA) of the University of Alberta Libraries (Daniels, 2017) making it an important advancement for teacher motivation both in terms of supporting future research and impacting practice. Future research may want to explore if the mock "Psychology Today" article is sufficient on its own to shift mindsets without the priming or consolidation portions of the intervention. If this were to be the case, the mock article could be added to teacher education textbooks or presented as a class handout as a simple way to impact beliefs.

It is important to note that the effectiveness of the belief materials lost their impact when followed by the approaches materials in the combined intervention. The approaches to instruction materials not only failed to influence pre-service teachers' intended approaches to instruction, but when added after the belief materials undid their positive effect on beliefs. As one explanation, it may be that the combined intervention became overwhelming in terms of content even though the increase in time spent on the intervention was on average only 4 minutes. Because researchers rarely address beliefs and approaches together this is an

important contribution and one that intervention researchers need to consider moving forward. It also highlights the need to better integrate psychosocial belief-based theories with those that provide more practical focus on instruction.

When considering the lack of effect for the approaches intervention, on its own or in combination, several explanations are possible. First, pre-service teachers tend to report high levels of intentions to implement classroom mastery approaches to instruction and to avoid classroom performance approaches to instruction – high enough to result in a near ceiling effect for mastery (e.g., Daniels, 2015). This suggests that measurement issues may make it difficult to detect a change in this outcome. As an implication, ,motivation researchers need to design a self-report tool that is more sensitive to change. Towards this, researchers may want to consider examining the evidence of reliability and validity of existing scales if they were modified to use a positively-packed likert scale (Brown, 2004); however, observation protocols are also needed.

Second, Daniels (2015) showed that pre-service teachers' overly optimistic intentions regarding motivation change when they start teaching. Specifically, she found that all teachers increased their reliance on classroom performance approaches to instruction once they started teaching, a trajectory that was steeper for high school teachers than elementary. Thus, choosing to focus on pre-service teachers rather than practicing teachers may have worked against finding a significant effect. One option moving forward may be to use the belief-only intervention during teacher education and the approaches-only intervention as professional development for practicing teachers to test if it impacts their practice.

Third, we built the content for the approaches to instruction materials from multiple sources including best practice recommendations (e.g., Linnenbrink-Garcia et al., 2016) and teachers' own reported practices (Radil, 2017). While we believe that this diversity of strategies was appealing to pre-service teachers, it is a departure from interventions typically

rooted in a single theory such as ASIP (Cheon et al., 2018). Moreover, our visualization tool is much briefer than ASIP, which even in its web-based delivery is extended over four weeks (Tilga et al., 2019). Approaches to instruction may require a more fulsome approach to intervention than psychosocial belief-based interventions. This perspective would be further supported by the fact that participants who viewed the visualization tool overwhelmingly wanted more information than the session could provide.

Limitations and Directions for Future Research

The results of this study need to be considered in light of the following three limitations. First, we chose to test the efficacy of the intervention on pre-service rather than practicing teachers thereby narrowing the applicability of the results. We believe that targeting pre-service teachers is important because improving their beliefs and instructional approaches to student motivation could result in changes they carry through the entirety of their careers. However, it is well-known that this sample introduces some complexities both in terms of measuring constructs and drawing implications from the findings (e.g., Fives & Buehl, 2009). Thus, despite good reasons to focus on pre-service teachers, it will be important to test the efficacy of the interventions with practicing teachers and to look for differences between teaching levels.

Second, we relied exclusively on self-report data and secured post-test data only immediately following the intervention. This is a limitation to many intervention studies (e.g., Miller & Mount, 2001), and we had designed a longitudinal component to test the lasting effect of the intervention. One explanation for low levels of follow-up participation may have been because it was scheduled during a teaching practicum placement. Although we chose this timing intentionally, the burden may have been too much for students to consent. Because existing research on mindset interventions has returned a wide range of longitudinal effectiveness (Blackwell et al., 2007; Cheon et al., 2012), it will remain

important for researchers to successfully execute longitudinal self-report designs (Tilga et al., 2020) and also observational studies during actual teaching events.

Finally, although the intervention was designed to be fully independent and online, we embedded it into a course at a single institution to prioritize the experimental design with random assignment. The results of the experiment with random assignment presented here could be augmented by a more ecologically valid evaluation of the interventions determined by simply allowing people to find the resource online. This would also increase the generalizability of the results beyond a single institution. Moreover, after the intervention we provided a lecture on motivation and assessment. Although the post-test occurred before the lecture, the class format of the intervention delivery may have impacted the results.

Conclusion

[removed for word count] The results of the experiment presented here suggest that pre-service teachers' responsibility for motivation and their mindset regarding student motivation, can be influenced for the better by a brief online intervention. Likewise, pre-service teachers seem interested in gathering information on approaches to instruction that can support student motivation, even if the intervention module did not significantly influence their intended approaches to instruction. Moreover, it seems that pre-service teachers need time and space between their beliefs and the approaches to instruction because a combined intervention was not beneficial for beliefs or approaches. These three findings have important implications for teacher education because shifting beliefs is an excellent starting place (Pajares, 2013) and one that can help pre-service teachers move into their professional teaching careers believing they can influence student motivation and looking for approaches to instruction that satisfy their responsibility.

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Table 1. Description of Final Sample

Condition	Age	Gender	Teaching Level	Duration (min)
Mindset n = 99	*M* = 24.07	Men = 27	Elementary = 52	*M* = 19.50
	SD = 5.55	Woman = 69	Secondary = 47	Range 11-34
	Range 19-48	Undisclosed = 3		
Skills n = 100	*M* = 24.08	Men = 26	Elementary = 55	*M* = 20.54
	SD = 5.72	Woman = 73	Secondary = 45	Range 10-51
	Range 20-49	Non-binary = 1		
Combined n = 96	*M* = 23.56	Men = 22	Elementary = 48	*M* = 23.86
	SD = 5.26	Woman = 72	Secondary = 48	Range 10-46
	Range 20-50	Non-binary = 1		
Control n = 89	*M* = 24.22	Men = 17	Elementary = 51	*M* = 19.29
	SD = 5.97	Woman = 72	Secondary = 38	Range 10-46
	Range 19-51			
Full sample n =	*M* = 23.98	Men = 92	Elementary = 206	*M* = 20.81
384	*SD* = 5.61	Woman = 286	Secondary = 178	Range 10-51
	Range 19-51	Non-binary = 2		
		Undisclosed = 3		

Table 2. *Descriptive Statistics for Study Variables*

	Time 1 Pre-test					Time 2 Post-test				
Variable	α	*M*	*SD*	Skewness	Kurtosis	α	*M*	*SD*	Skewness	Kurtosis
Growth mindset	.84	16.92	3.34	-.27	-1.37	.89	16.75	3.96	-.47	.11
Fixed mindset	.91	9.63	3.60	.59	-.11	.91	9.11	3.43	.76	.63
Responsibility for Motivation	.88	16.71	4.47	-.21	-.34	.88	17.70	4.35	-.24	-.42
Mastery approaches to instruction	.58	17.51	1.93	-.51	-.16	.76	17.50	2.18	-.77	.27
Performance approaches to instruction	.83	11.04	4.14	.60	.18	.88	10.94	4.35	.62	-.08

Table 3. Correlations between Time 1 and Time 2 Variables

Variables	1	2	3	4	5	6	7	8	9
1. T1 Growth mindset									
2. T1 Fixed mindset	-.50*								
3. T1 Responsibility for Mot.	.35*	-.24*							
4. T1 Mastery goal structures	.25*	-.22*	.13						
5. T1 Perform. goal structures	.02	.23*	.10	.10					
6. T2 Growth mindset	.54*	-.28*	.20*	.21*	-.02				
7. T2 Fixed mindset	-.31*	.54*	-.15*	-.21*	.18*	-.29*			
8. T2 Responsibility for Mot.	.29*	-.22*	.59*	.18*	.05	.34*	-.20*		
9. T2 Mastery goal structures	.30*	-.28*	.08	.57*	-.04	.27*	-.29*	.19*	
10. T2 Perform. goal structures	-.02	.22*	.05	-.01	.66*	.02	.28*	.10	-.07

* $p < .001$

Table 4. Univariate results for belief measures

Variable					Adjusted Means by Condition			
	df	*F*	*p*	partial η2	Beliefs	Practices	Combined	Control
Growth mindset	363	4.84	.004	.04	17.79 [a]	16.12[b]	16.61[b]	16.27[b]
Fixed mindset	363	4.43	.003	.04	8.20[a]	9.56[b]	9.49[b]	9.27[b]
Resp. for motivation	363	4.82	.003	.04	18.68 [a]	17.04[b]	18.03	17.10[b]

Note. Different superscripts represent statistically significant differences at $p < .05$ based on adjusted marginal means and evaluated with the following covariate values: mindset growth = 16.88, mindset fixed = 9.65, responsibility = 16.74.

Figure 1. Flow of Participants through the Experiment

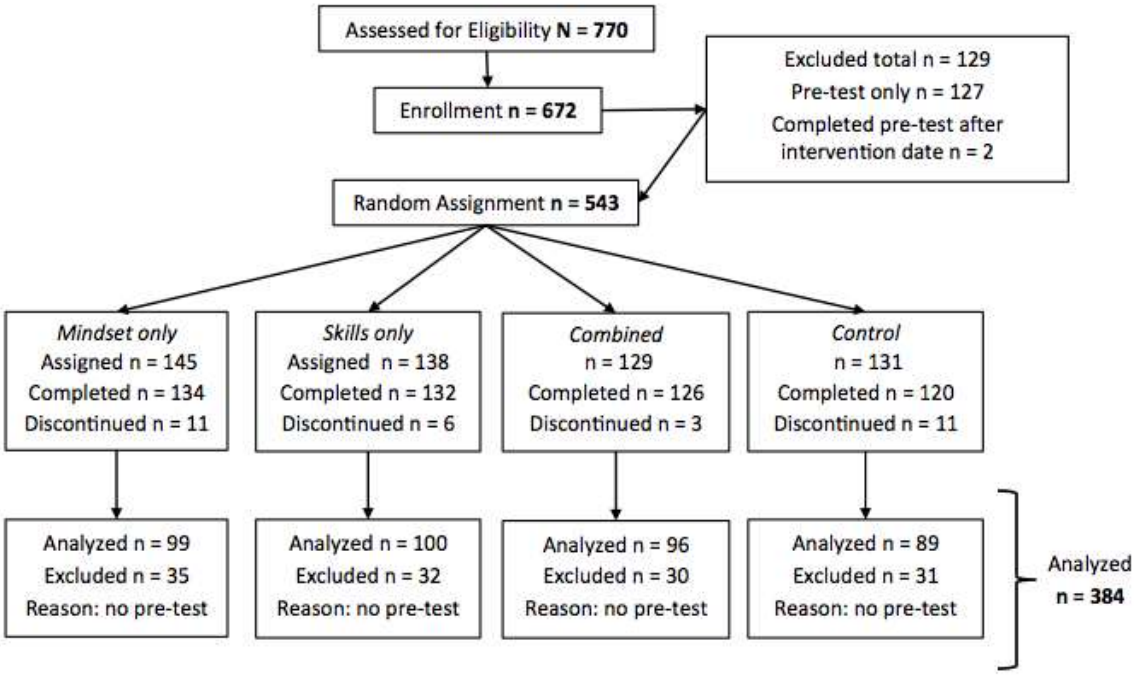

Figure 2.

Descriptive statistics for additional analysis of motivation skills