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MOTIVATION AND SOCIAL PROCESSES

An Autonomy-Supportive Teaching Intervention Benefits Students in a Low-SES School Setting

Lennia Matos[a], Johnmarshall Reeve[b,c], Rafael Gargurevich[a], and Dora Herrera[a]

[a]Departamento Académico de Psicología, Pontificia Universidad Católica del Perú, Lima, Perú; [b]Institute for Positive Psychology and Education, Australian Catholic University, Sydney, Australia; [c]Department of Education, Korea University, Seoul, South Korea

ABSTRACT

We conducted the first autonomy-supportive teaching intervention in a low SES school setting. We hypothesized that the teacher-focused intervention would increase students' psychological need satisfaction and classroom engagement—just as it has been demonstrated to do in previous interventions conducted in more advantaged schools. We randomly assigned 28 Peruvian teachers who taught 14 different subjects (e.g., math) in grades 7–11 in a very low SES school district to participate or not in the autonomy-supportive teaching workshop (i.e., experimental vs. control condition). Their 672 students (332 females, 339 males) self-reported their perceived teacher support, need satisfaction (autonomy, competence, relatedness), and classroom engagement at the beginning, middle, and end of a semester. A structural equation modeling analysis showed that the hypothesized model fit the data well, and that experimental condition predicted students' T2 need satisfaction, T2 need satisfaction predicted students' T3 classroom engagement, and T2 need satisfaction mediated the effect that experimental condition had on T3 classroom engagement. These findings show that an autonomy-supportive teaching intervention can work in a low-SES setting and not just in socioeconomically advantaged schools.

KEYWORDS

Autonomy support; need satisfaction; engagement; low SES; self-determination theory; teachers

Among 77 peer nations, Peru is a relatively low SES country (ranked 64, OECD, 2023). Nationwide, the percentage of the population living in poverty is 29%, and poverty rates routinely exceed 40% in rural areas and around 26% in urban areas (OECD, 2023). These low SES conditions tend to suppress students' PISA scores (Peru is in the lower third of all the countries, $Ms = 391$ science, 408 math, 408 reading on a standardized $M = 500$, $SD = 100$ scale; OECD, 2023), and they further limit the nation's capacity to provide schools with adequately trained teachers and to provide those teachers with reasonable working conditions, learning materials, class sizes, and salaries.

Situating a school in a low SES context tends to skew its teaching staff in numerous ways. For instance, low SES schools tend to be characterized by high rates of teacher attrition (Ronfeldt et al., 2013), and the teaching staff is often disproportionally populated by beginning teachers who are just starting their teaching careers (Peske & Haycock, 2006). Teachers in low SES school settings also tend to experience relatively high levels of stress, anxiety, burnout, and depression coupled with relatively low levels of teaching self-efficacy (Bottiani et al., 2019; Elliott et al., 2024; ENDO, 2021; Ouellette et al., 2018).

CONTACT Lennia Matos lmatosf@pucp.pe Departmento Académico de Psicología, Pontificia Universidad Católica del Perú, Lima, Perú.

In the specific case of Peru, many teachers (46%) work with low job security, as they often work on a short-term, fixed-term contract (ENDO, 2021). One-fifth (21%) of Peruvian teachers report having to work a second job to make financial ends meet (ENDO, 2021). This prevailing sense of job insecurity takes its toll on Peruvian teachers because, when asked to describe their ideal future over the next 5 years, only 30% of Peruvian teachers say they would like to continue teaching (ENDO, 2021). A driving factor behind such low commitment is a high workload, and most teachers must use extra time after school to do their job. During their classroom teaching, many Peruvian teachers find it overwhelmingly difficult to attend to their students' socioemotional problems (57% of teachers; ENDO, 2021), implement good or best pedagogical practices (49% of teachers), and successfully meet parental requests and demands (48% of teachers).

A context of poverty and socioeconomic inequalities not only tends to stress teachers, but it also tends to squeeze out opportunities to provide instruction in ways that allow students to pursue and satisfy their psychological needs (and hence their classroom thriving; van Egmond et al., 2017). More specifically, a low SES context can challenge teachers' capacity to provide students with autonomy, competence, and relatedness need-satisfying instruction. Recognizing this, Peruvian teachers generally express a strong desire to receive capacity-growing professional development training. In this context, we sought to provide Peruvian teachers in very low SES schools with a professional development opportunity to participate in an autonomy-supportive teaching intervention (Reeve & Cheon, 2021). Past research shows that such a teacher training experience does provide teachers with a sense of opportunity and support to master the teaching practices that reliably satisfy their students' psychological needs and, hence, energize their students' engagement, learning, and achievement (e.g., Cheon et al., 2019, 2020, Flunger et al., 2019; Ulstad et al., 2018). Moreover, this same teacher training experience also generates important and large *teacher* benefits, such as greater psychological need satisfaction of their own as well as greater intrinsic motivation to teach, greater teaching self-efficacy, greater vitality and job satisfaction, greater passion for teaching, and lower emotional and physical exhaustion (Cheon et al., 2014; Cheon et al., 2020).

For some scholars (Chao & Tseng, 2002; Markus & Kitayama, 2003), the principles of self-determination theory, autonomy-supportive teaching practices, and a teacher's valuing of students' psychological needs might be relevant and beneficial only in relatively high SES schools and countries. To address this concern, a pilot study was conducted in Medellin, Colombia (Niemiec & Muñoz, 2019), but this South America autonomy-supportive teaching intervention study was conducted in a middle SES setting. Moreover, the authors of that previous intervention study highlighted several study limitations, including the lack of random assignment to conditions (intervention and control), the lack of T1 baseline scores, and the employment of a cross-sectional rather than longitudinal research design. Therefore, to our knowledge, the need-satisfying and engagement-boosting benefits of an autonomy-supportive teaching intervention have not been demonstrated in a very low SES school context.

The purpose of the present study was to test the hypothesis that a self-determination theory-based autonomy-supportive teaching intervention conducted in a very low SES school context would increase students' psychological need satisfaction and classroom engagement. We focused on students' motivation and engagement because previous research showed that students attending low SES schools tend to show relatively low levels of both motivation and engagement, and also that these lower levels of motivation and engagement partially explain why low SES students show relatively lower school achievement than do their counterparts in medium and high SES schools (Tomaszewski et al., 2020). To pursue this purpose of training teachers to support students' classroom motivation and engagement to a higher level, we conducted an autonomy-supportive teaching intervention in Peruvian schools situated in very low SES conditions. For context, Figure 1 shows one of the participating schools, a very low SES school showing some of the low SES circumstances the participating schools faced, including deteriorating floors, walls or

Figure 1. Photograph of one of the participating schools.
Note. School in Ventanilla Callao district, Peru. Source: Author-created photograph.

roofs as well as a lack of adequate access to drinking water or electricity. Our expectation was that when teachers in these low SES Peruvian schools participated in an SDT-based autonomy-supportive teaching intervention, then their students would show higher motivation (need satisfaction) and classroom engagement than would the students of teachers in a no intervention control group.

Autonomy-supportive teaching and students' psychological needs

Autonomy-supportive teaching is the instructional effort to identify students' interests, preferences, and concerns and to nurture students' psychological needs so that students become increasingly able and willing to volitionally self-engage themselves in classroom learning activities (Aelterman et al., 2019; Reeve & Cheon 2021; Patall et al., 2018; Reeve et al., 2022). Past research has shown that teachers who participate in an autonomy-supportive teaching professional development experience can learn autonomy-supportive teaching to a high level (e.g., Aelterman et al., 2014; Reeve & Cheon, 2024). Further, when these teachers do provide highly autonomy-supportive instruction, then their students report significantly higher levels of autonomy, competence, and relatedness need satisfaction (Fin et al., 2019; Huéscar et al., 2020; Tilga et al., 2019) and significantly higher levels of classroom engagement (Reeve et al., 2020, Reynders et al., 2019; Tessier et al., 2010).

Teachers who participate in an autonomy-supportive teaching workshop gain a greater willingness and capacity to enact teaching practices such as taking the students' perspective, supporting students' interests (by supporting their psychological needs), supporting students' valuing and

internalization of teacher requests (also by supporting their psychological needs), and transforming their existing controlling teaching practices (e.g., utter directives and commands, use pressuring language) into autonomy-supportive alternatives (e.g., provide explanatory rationales for each teacher request, use invitational language).

These more autonomy-supportive teaching practices allow students to experience a rising level of psychological need satisfaction as the academic year unfolds (Cheon et al., 2018, 2019, 2020). Autonomy is the psychological need to feel personal causation and volitional endorsement while initiating and regulating one's behavior; competence is the psychological need to seek out optimal challenges, take them on, and exert persistent effort and strategic thinking to feel more effective during academic tasks and challenges; and relatedness is the psychological need to establish close emotional bonds and attachments with one's classmates so to feel a sense of belongingness and social-emotional connection (Ryan & Deci, 2000, 2017; Vansteenkiste et al., 2020). The satisfaction of these basic psychological needs in a classroom setting is linked to a wide variety of positive student outcomes, such as higher quality motivation (i.e., intrinsic motivation, internalization of external regulations; Vasconcellos et al., 2020), prosocial behavior (Hodge & Gucciardi, 2015), higher student academic performance (Black & Deci, 2000), better adaptation to school (Chirkov & Ryan, 2001), psychological well-being (Martela & Sheldon, 2019), and classroom engagement (Hospel & Galand, 2016; Jang, 2008).

Of particular interest to the present study was the capacity of students' experiences of psychological need satisfaction to catalyze classroom engagement. Classroom engagement is a multidimensional phenomenon (Fredricks et al., 2019; Reschly & Christenson, 2022), which means that students can involve themselves in a learning activity in multiple ways, including behaviorally, cognitively, emotionally, and agentically. Behavioral engagement is the extent to which the student mobilizes their effort and persistence to meet or exceed the challenges and demands of the learning activity; cognitive engagement is the extent to which students allocate their attention, concentration, and problem-solving strategies toward the learning activity at hand; emotional engagement is the extent to which students experience a positive affective connection (e.g., interest, enjoyment, or feeling good) with the learning activity; and agentic engagement is the extent to which students contribute constructively into the flow of instruction they receive, as by making a suggestion or expressing a preference (Reeve, 2013; Reeve et al., 2025; Jang et al., 2016; Patall et al., 2019; Skinner et al., 2008).

Hypothesized model

The research question driving the present study was whether an autonomy-supportive teaching intervention provided to teachers in low-SES Peruvian schools would benefit the students of these teachers in terms of greater psychological need satisfaction. The hypothesized model appears in Figure 2. The study's independent variable was teacher participation in the AST workshop (or not), the educationally important outcome variable was students' classroom engagement, and the hypothesized mediating process was the extent to which students experience psychological need satisfaction. As shown by the boldfaced downwardly sloped line in the upper left of Figure 2, we hypothesized that teachers who participated in the AST workshop (i.e., experimental condition) would increase their students' T2 psychological need satisfaction (H1, *Hypothesis 1*). We next hypothesized that students' T2 gains in psychological need satisfaction would increase their T3 classroom engagement (H2, *Hypothesis 2*). Together, H1 and H2 constituted a mediation model—namely, autonomy-supportive teaching → T2 psychological need satisfaction → T3 classroom engagement, so we further tested the hypothesized model in Figure 2 for a mediation effect in which gains in T2 psychological need satisfaction explained why experimental condition facilitated T3 classroom engagement. Figure 2 adds the thin-faced lines needed to represent the necessary statistical controls for this model test, including autoregressive paths for need satisfaction and classroom engagement as well as the statistical controls of grade level and student gender.

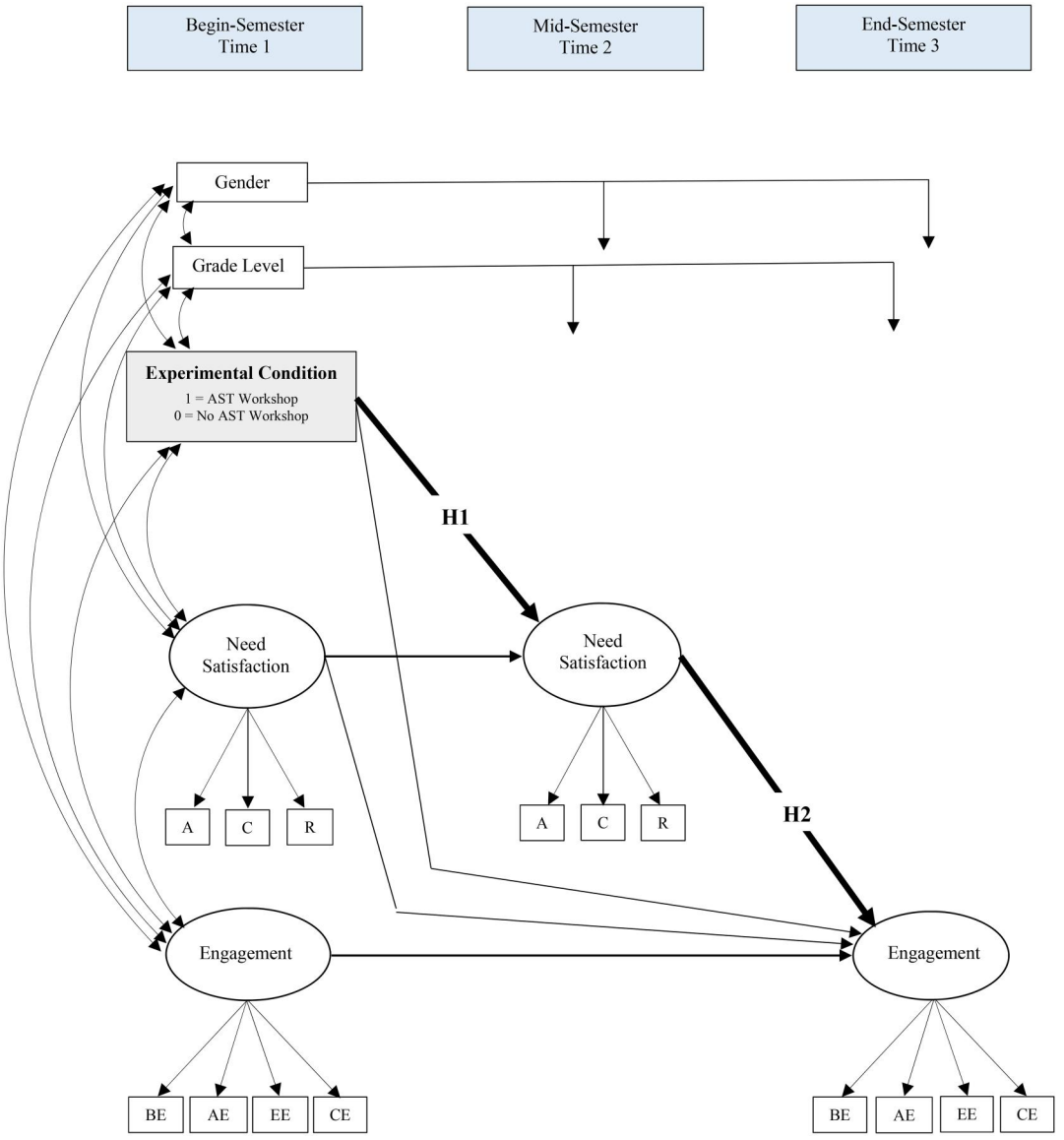

Figure 2. Hypothesized model.
Note. Thick boldfaced lines represent hypothesized paths, while thin-faced lines represent autoregressive effects, statistical controls, or indicators of a latent construct. Rectangles represent indicators; ovals represent latent variables. H = Hypothesis. A = Autonomy need satisfaction; C = Competence need satisfaction; R = Relatedness need satisfaction; BE = Behavioral engagement; AE = Agentic engagement; EE = Emotional engagement; CE = Cognitive engagement.

Method

Participants

Teachers were 28 full-time certified teachers from two large grade 7–11 schools in Ventanilla Callao, Peru. Around 30% of the families in the Ventanilla school district live in a high level of poverty. In Peru, around 29% of the nationwide population is considered poor. According to an analysis of levels of poverty of Lima, Ventanilla was identified in the poorest group (Group 3) which has the highest socioeconomic vulnerability in the nation (National Institute of Statistics & Informatics, 2018, 2024).

The teachers were 19 females and 9 males who taught one of 14 different subject matters (e.g., mathematics, history, art, communication). All teachers were ethnic Peruvian. On average, teachers were 37.7 years old ($SD = 12.5$; *range* = 23–61; 6 did not indicate their age) and had an average of 13.6 years of teaching experience (SD = 11.7; *range* = 1–34; 4 missing). All 28 teacher-participants completed all aspects of the study (retention rate = 100%).

Students in these 28 classrooms were 672 ethnic Peruvians in the following grade levels: 177 grade 7 (26.3%); 104 grade 8 (15.5%); 121 grade 9 (18.0%); 106 grade 10 (15.8%); and 164 grade 11 (24.4%). These 672 student-participants featured 332 (49.5%) females and 339 (50.4%) males (1 student did not report their gender) with 277 (41.2%) students in the experimental condition and 395 (58.8%) students in the control condition.

Regarding statistical power, generally accepted guidelines for a multilevel analysis suggest the need for 50 L2 units with at least 10–15 participants per L2 unit (Lüdtke et al., 2011; Morin et al., 2022). Our sample of 28 teachers (L2 units) with an average class size of 24.0 students/class (L1 units) was underpowered by 44% for an L2 analysis but was sufficiently powered for our L1 analyses.

Procedure and research design

The first author's University Research Ethics Committee approved the research protocol (0178–2016). We recruited teachers from two schools in Ventanilla Callao, Peru (north of Lima) to participate in a study on "classroom instructional strategies". We applied our random assignment to conditions at the teacher level. This random assignment produced 12 teachers (and their 277 students) in the experimental or intervention condition, and 16 teachers (and their 395 students) in the control or no intervention condition.

The research design was a randomized control trial with longitudinally assessed dependent measures. We collected three waves of data during the first half of the academic year in which students completed the same questionnaire at the beginning (T1; weeks 1–3), in the middle (T2; weeks 10–12), and at the end (T3; weeks 18–20) of the semester. On each occasion, we administered the survey at the end of the class period. The questionnaire began with a consent form in which the aim of the study was explained, the voluntary character of their participation, and that they could stop answering the questionnaire at any time without any adverse consequence. Then, students completed the questionnaire about their experience in that one particular class. We assured students that their responses would be confidential and used only for the research study.

Our plan was to collect the first wave of student data during week 1. However, we were able to collect only 70% of students' baseline (T1) data in the first week of classes. This was because the school principals scheduled when we could enter each classroom to collect the data. That meant that 30% of the baseline data were collected in week 2 or week 3. Because of this delay in collecting the full baseline data, we planned to test for the group equivalence of T1 scores for students of teachers in the experimental condition vs. students of teachers in the control condition. We report this group equivalence test in the Preliminary Analyses section at the beginning of the Results.

Autonomy-supportive teaching (AST) workshop intervention

The delivery of the 3-part, 8-h autonomy-supportive teaching (AST) workshop followed the contents, activities, and step-by-step procedures of previously published workshops (e.g., Cheon et al., 2018, 2019, 2020). In brief, Part 1 of the AST workshop was a 3-h, information-based morning presentation that took place one week before the school year began. It introduced autonomy-supportive teaching, its benefits, and the seven recommended autonomy-supportive instructional behaviors. Part 2 was a 3-h, skill-based afternoon workshop on the same day as Part 1.

It focused on the practical "how to" of the seven recommended autonomy-supportive instructional behaviors (e.g., take the students' perspective, present learning activities in need-satisfying ways, provide explanatory rationales for teacher requests). We described and modeled each instructional strategy *via* a series of brief, professionally-produced video clips. Teachers then practiced, refined, and discussed the strategies until teachers felt sufficiently skilled to try it out in their own classrooms. Finally, Part 3 took place one month after the beginning of the academic year—after teachers had actual classroom experience with autonomy-supportive teaching. It featured a peer-to-peer group discussion that focused on teachers' experiences with autonomy-supportive teaching, and how to improve and personalize its classroom application.

To clarify what teachers in the experimental group learned during the AST workshop, Table 1 lists, defines, and provides an example of each of the seven recommended autonomy-supportive teaching practices. During Part 1, teachers became familiar with these teaching practices and observed expert models demonstrating each teaching practice (*via* professionally created video clips). During Part 2, teachers practiced these instructional strategies and received guidance and feedback while doing so. During Part 3, teachers discussed their month-long use of these teaching practices in the context of a collaborative learning community environment.

Measures

Self-reported measures were used to assess a manipulation check (perceived teacher support) and the two dependent measures (psychological need satisfaction, classroom engagement). For each questionnaire, we had available a Spanish translation that had been used successfully in previous studies (e.g., Matos et al., 2018). Students answered each item using a 7-point Likert scale that ranged from 1 (strongly disagree) to 7 (strongly agree).

Perceived teacher support

To assess perceived teacher support, we used a 9 item questionnaire that included both the 6-item short version of the Learning Climate Questionnaire to assess perceived autonomy support (LCQ; Williams & Deci, 1996; e.g., "I feel that my teacher in this class understands me") and the 3-item perceived involvement scale adapted from the Perceptions of Parents Scales (POPS, Grolnick et al., 1997; e.g., "My teacher in this class finds time to talk with me"). Students' responses on the 9-item overall perceived teacher support questionnaire were highly internally consistent: $\sigma = .86$, Time 1; $\sigma = .88$ at Time 2, and $\sigma = .86$ at Time 3.

Psychological need satisfaction

To assess students' psychological need satisfaction, we used the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS scale; Chen et al., 2015), though we only used the 12 items that measured basic psychological need satisfaction. The BPNSFS includes four items to assess autonomy satisfaction (e.g., "In this class, I feel a sense of choice and freedom in the things I undertake"), four items to assess competence satisfaction (e.g., "In this class, I feel confident that I can do things well"), and four items to assess relatedness satisfaction (e.g., "In this class, I feel that the people I care about also care about me"). Students' responses on the 12-item overall psychological need satisfaction scale were highly internally consistent: $\sigma = .82$, Time 1; $\sigma = .84$ at Time 2, and $\sigma = .85$ at Time 3.

Classroom engagement

We assessed classroom engagement as a four-dimensional phenomenon, using the behavioral engagement and the emotional engagement scales of the Engagement versus Disaffection with Learning questionnaire (Skinner et al., 2009), the Deep Learning questionnaire (Senko & Miles, 2008)

Table 1. Seven recommended autonomy-supportive teaching practices.

1. Take the Students' Perspective	
Definition	The teacher sees and experiences classroom events, requirements, and activities as if he or she were the students.
Example	Conduct a formative assessment, such as a Mentimeter question, to ask for students' input on an upcoming learning activity such as, "Do you want to work in groups?"
2. Invite Students to Pursue Their Personal Interests and Goals	
Definition	While presenting a learning activity, the teacher encourages the students to use that activity as an opportunity to pursue a personal interest or a personal goal.
Example	In discussing an assigned book, the teacher asks, "What did you find most interesting about the book?"
3. Present Learning Activities in Need-Satisfying Ways	
Definition	Present the learning activity in a way that not only creates an opportunity to learn something new, but also an opportunity to experience psychological need satisfaction.
Example	The teacher pairs students together and asks them to pursue a prosocial goal together (creating an opportunity to experience relatedness need satisfaction).
4. Provide an Explanatory Rationale for Each Teacher Request	
Definition	When making a request, the teacher takes a moment to first explain the personal benefit or personal usefulness of that request to the students.
Example	The teacher says, "Let's use respectful language. Why? Because by using respectful language we will be we building a classroom community where everyone feels accepted, feels welcomed."
5. Acknowledge and Accept Negative Feelings	
Definition	When students complain and express negative emotionality, acknowledge and accept that those feelings have potential legitimacy, given the circumstances.
Example	The teacher says, "I see some bored faces out there. I understand, as we have covered this material several times now, haven't we? If I were you, I may feel the same way."
6. Rely on Invitational Language	
Definition	When making an engagement request, use a tone of voice and word choice that communicates understanding and support (while minimizing pressure).
Example	The teacher says, "You *might* want to work with a partner; you *may* find that helpful."
7. Display Patience	
Definition	When students struggle, show an optimistic calmness that communicates your confidence in their capacity for effective, responsible self-regulation.
Example	During a teacher-student conversation, the teacher spends more time listening (to the student's plans and strategies) than talking (telling the student what to do).

Note. Based on: Reeve, J., Ryan, R. M., Cheon, S. H., Matos, L., & Kaplan, H. (2022). *Supporting students' motivation: Strategies for success*. Routledge.

for cognitive engagement, and the Agentic Engagement Scale (Reeve, 2013) for agentic engagement. Students' reports on the 5-item behavioral engagement scale (e.g., "In this class, I work as hard as I can.") were moderately internally consistent (σs at T1, T2, and T3 = .71, .71, and .68). Students' reports on the 5-item emotional engagement scale (e.g., "In this class, I feel good.") were moderately internally consistent (σs = .78, .77, and .77). Students' reports on the 4-item cognitive engagement scale (e.g., "When learning about a new topic in this course, I usually try to summarize it in my own words.") were also moderately internally consistent (σs = .74, .78, and .77). And students' reports on the 5-item agentic engagement scale (e.g., "In this class, I let my teacher know what I need and want") were also moderately internally consistent (σs = .79, .81, .82).

Data analyses

The data had a two-level longitudinal structure with repeated measures (3 waves) nested within students (Level 1, $N = 672$) nested within teachers/classrooms (Level 2, $k = 28$). Given this hierarchical

data structure, we used group-mean centering for the variables included in the hypothesized model. Group-mean centering transforms each participant's score into a "relative to the class average score" on that variable, a centering strategy that allowed us to account for the nested nature of the data set.

In the data analyses, we conducted two sets of analyses-preliminary analyses and the primary analysis. In the preliminary analyses, we evaluated the random assignment to conditions by looking for group equivalence (experimental vs. control) on participants' baseline scores, and we tested for the effect of the intervention on the manipulation check (perceived teacher support). In the primary analysis, we tested for the fit of the hypothesized model depicted in Figure 2, and this analysis included the tests of the underlying measurement model and the mediation analysis.

Preliminary analyses

To evaluate the fidelity of the random assignment, we conducted a series of 10 t-tests to compare baseline (T1) scores of participants assigned to the experimental condition vs. participants in the control condition on the two demographic variables (gender, grade level) and the eight dependent measures (perceived teacher support; autonomy, competence, and relatedness need satisfaction; and behavioral, agentic, emotional, and cognitive engagement).

To evaluate the manipulation check, we tested whether students in the experimental condition perceived their teachers as more supportive than did the students in the control condition. To do so, we used a repeated measures ANOVA in which the dependent variable was perceived teacher support (assessed at T1, T2, and T3), the independent variable was experimental condition (control = 0; experimental = 1), and the two covariates were gender and grade level.

Primary analyses

To evaluate the hypothesized model; we conducted a structural equation modeling analysis. To do so, we used Mplus 8.3 (Muthén & Muthén, 2019) with the maximum likelihood-robust estimator (MLR) and full information maximum likelihood (FIML) estimation procedures for handling missing data. To evaluate model fit, we used the following goodness-of-fit statistics: Root-mean-square error of approximation (*RMSEA*), standardized root-mean-square residual (*SRMR*), comparative fit index (*CFI*), and Tucker-Lewis index (*TLI*). For *RMSEA* and *SRMR*, adequate and excellent fit are reflected by values lower than .08 and .06; for *CFI* and *TLI*, adequate and excellent fit are reflected by values greater than .90 and .95 (Marsh et al., 2005).

Before testing the hypothesized model, we tested its underlying measurement model. The measurement model included 14 indicators (the rectangles in Fig. 2) to create 4 latent variables (the ovals in Fig. 2). Assuming the fit of the measurement model was adequate, we next tested the hypothesized model by adding experimental condition as a T1 predictor (0 = control condition, 1 = experimental condition) and the two T1 covariates of gender (0 = male, 1 = female) and grade level (1 = 7^{th} grade, 2 = 8^{th} grade, 3 = 9^{th} grade, 4 = 10^{th} grade, and 5 = 11^{th} grade).

Lastly, we conducted a mediation analysis. Together, Hypotheses 1 and 2 constitute a mediation-based model (i.e., T2 need satisfaction mediates the direct effect of experimental condition on T3 engagement). To conduct this mediation test, we used Preacher and Selig (2012) Monte Carlo approach to resampling to construct the appropriate 95% confidence interval (*CI*s) for the hypothesized mediator (T2 need satisfaction) and then Selig and Preacher (2008) web-based utility to generate and run R code for simulating the sampling distribution of the indirect effect (20,000 values). If the 95% *CI* does not include zero, then the indirect effect is significant ($p < .05$).

Results

Preliminary analyses

In the first preliminary analysis, we tested for the success of the random assignment to conditions. To do so, we explored for any mean difference in baseline (T1) scores for participants

assigned into the two conditions. No condition effect was evident on 9 of the 10 T1 scores: gender (p = .748); autonomy (p = .433); competence (p = .603); relatedness (p = .634); behavioral engagement (p = .547); agentic engagement (p = 770); emotional engagement (p = .067); and cognitive engagement (p = .812). For grade level, however, the condition effect was significant with students in the experimental condition coming from higher grades than students in the control condition (*M*s = 3.3 vs. 2.8, p <.01). Given this result, we (1) included grade level (and gender) as statistical controls (T1 covariates) in the test of the hypothesized model, as can be seen in the upper part of Figure 2 and (2) gained some assurance that collecting the T1 baseline data for 30% of the students during weeks 2 and 3 (instead of week 1) did not undermine group equivalency at T1.

In a second preliminary analysis, we tested whether the students in the experimental condition perceived their teachers as more supportive than did the students in the control condition. Experimental group students did perceive their teachers as more supportive, $F(2, 1340) = 3.18$, p = .042 (*M*s at T1, T2, and T3 = 4.84, 5.07, 4.94 [experimental] vs. 4.85, 4.76, 4.83 [control]).

Hypothesized model

The 14-indicator, 4-latent variable measurement model fit the data reasonably well, $\chi^2(64) = 135.09$, $p < .001$, *RMSEA* = .041, *SRMR* = .034, *CFI* = .970, and *TLI* = .958. Factor loadings for all 14 indicators were substantial and statistically significant ($p < .001$). We next tested the hypothesized model, and it too fit the data reasonably well, $\chi^2(111) = 273.27$, $p < .001$, *RMSEA* = .047, *SRMR* = .064, *CFI* = .939, and *TLI* = .927. Figure 3 shows the unstandardized beta weights (*B*) [with standard errors in parentheses] for the hypothesized model's hypothesized paths, autoregressive effects, and statistical controls. Table 2 reports the descriptive statistics and intercorrelations for all variables (experimental condition, latent variables, and statistical controls) included in the test of the hypothesized model.

As shown in Figure 3, experimental condition increased T2 need satisfaction (B = .21, SE = .08, p = .014), which confirmed H1. This mid-semester gain in need satisfaction then increased T3 engagement (B = .27, SE = .08, p = .001), which confirmed H2. In the mediation analysis, the 95% confidence interval for T2 need satisfaction as a mediator of the indirect effect of experimental condition on T3 engagement did not include zero (.009, .124), thereby confirming mediation.

Discussion

The present investigation evaluated the extent to which a SDT theory-based autonomy-supportive teaching intervention was able to promote gains in students' psychological need satisfaction in a low SES educational setting. The Peruvian secondary grade level teachers who participated in the intervention did facilitate their students' psychological need satisfaction, compared to teachers in the control condition. This facilitating effect had not been previously shown to occur in a low SES school environment. So, even when the schooling environment offers teachers compromised infrastructure, restrictive resources, multiple sources of stress, and minimal opportunities to provide need-satisfying instruction, the greater autonomy-supportive teaching from teachers in the experimental condition still benefited students in terms of gains in psychological need satisfaction. This is a highly meaningful student benefit because gains in psychological need satisfaction have been consistently shown to facilitate valued student outcomes such as learning, achievement, skill development, and psychological well-being—just as students' gains in psychological need satisfaction facilitated their later gains in classroom engagement in the present study. When the present findings are integrated into the now vast literature on autonomy-supportive teaching interventions, the confidence level rises for the conclusion that students in general (and not just students in advantaged schools) benefit from highly autonomy-supportive teaching.

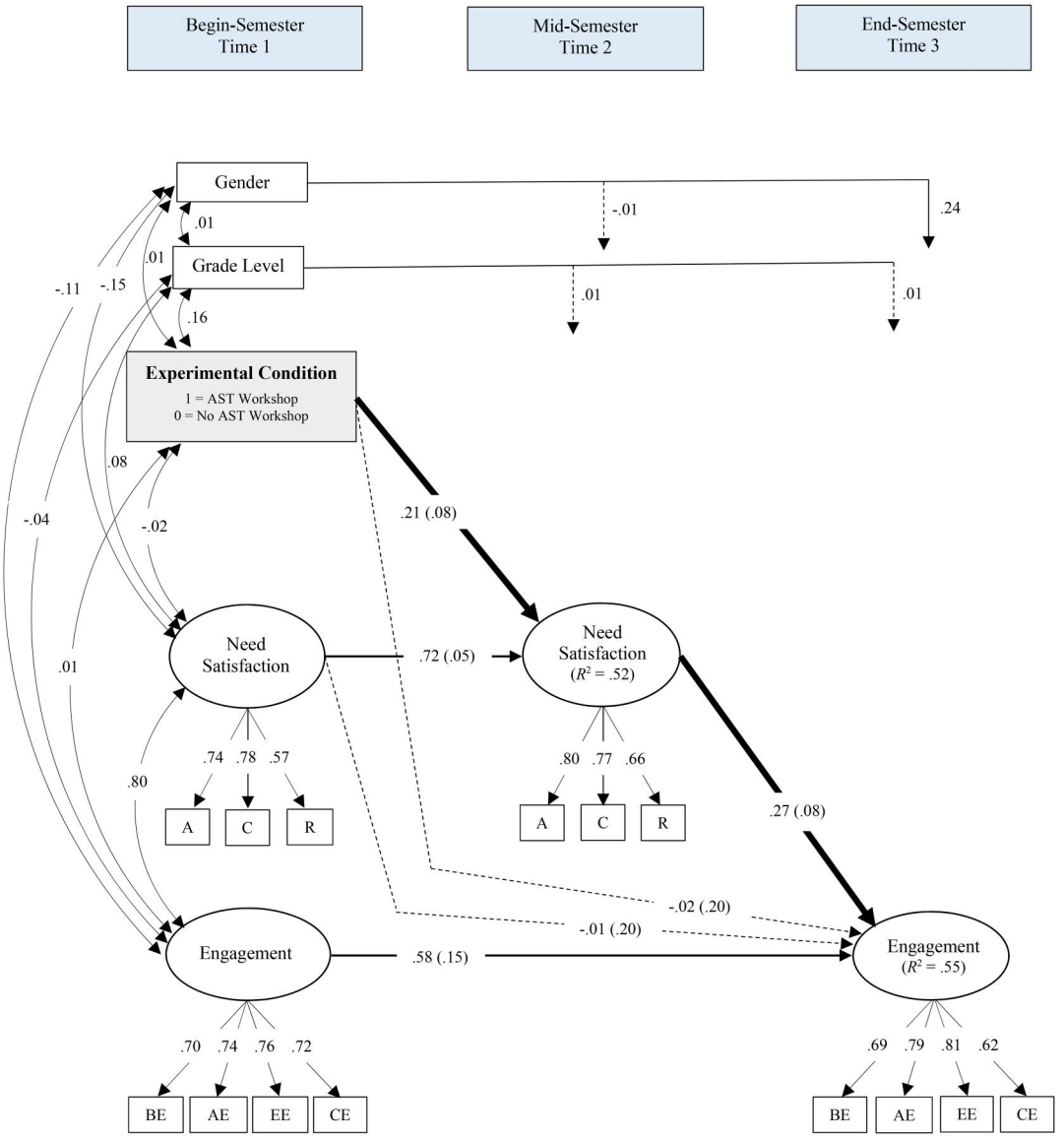

Figure 3. Results from the test of the hypothesized model.
Note. Thick boldfaced lines represent hypothesized paths, while thin-faced lines represent autoregressive effects, statistical controls, or indicators of a latent construct. Rectangles represent indicators; ovals represent latent variables. Numbers represent unstandardized beta weights (with standard errors in parentheses).
Solid lines represent significant paths ($p < .05$), while dashed lines represent non-significant paths.
A = Autonomy need satisfaction; C = Competence need satisfaction; R = Relatedness need satisfaction; BE = Behavioral engagement; AE = Agentic engagement; EE = Emotional engagement; CE = Cognitive engagement.
Overall Model Fit: $X^2(111) = 273.27$, $p < .001$. *RMSEA* = .047, *SRMR* = .064, *CFI* = .939, *TLI* = .927.

The finding that teacher-enabled gains in T2 psychological need satisfaction fueled students' T3 gains in classroom engagement is a particularly encouraging finding because it has been found that student engagement tends to be relatively lower for students attending low-SES schools, compared to students attending middle or high-SES schools (Tomaszewski et al., 2020). Usually, economic difficulties and a lack of resources and opportunities for need satisfaction interfere with students' classroom engagement. That was not the case in the present study, at least for the students in the experimental group classrooms, as gains in psychological need satisfaction allowed

Table 2. Descriptive statistics for and intercorrelations among the variables included in the test of the hypothesized model.

Variable	1.	2.	3.	4.	5.	6.	7.
Time 1 Baseline							
1. Experimental Condition	–	−.03	.01	.13	.05	.01	.16
2. Need Satisfaction		–	.81	.71	.63	−.15	.08
3. Classroom Engagement			–	.57	.71	−.11	−.04
Time 2 Mediators							
4. Need Satisfaction				–	.57	−.01	.04
Time 3 Outcome							
5. Classroom Engagement					–	.10	.03
Statistical Controls							
6. Grade Level						–	.01
7. Class Size							–
Descriptive Statistics							
Mean	0.41	5.24	5.13	5.33	5.21	0.51	3.0
Standard Deviation	0.49	0.91	0.91	0.93	0.89	0.50	1.5

$N = 672$ students. Any correlation $r \geq .08$ is statistically significant, $p < .05$.

these students in a low-SES setting to somewhat overcome these social contextual limitations (Archambault et al., 2020). The mediation analysis suggested that the observed gains in students' engagement were not directly attributable to the teaching practices and the teacher's supportive motivating style but was, instead, directly attributable to the experiences of psychological need satisfaction that these supportive teachers were able to provide.

Autonomy-supportive teachers are able to enhance their students' classroom engagement because their autonomy-supportive teaching practices vitalized and supported their students' psychological needs. But, in a very low SES educational setting, the teachers in the experimental group also helped students overcome their environmental vulnerabilities by providing low SES students with a protective relationship space. An analogy for this "protective space" is the so-called "umbrella effect" (Ryan & Deci, 2017). During class and during teacher-student interactions, the autonomy-supportive teacher holds a protective metaphorical umbrella over the students to shelter them against the socioeconomic storms that surround them in their everyday lives. According to Ryan and Deci (2017, p. 380), the educator's "first job is not to let the elements harm those for whom we are responsible. Thus, we need to hold up an umbrella of need supports and create a sheltered, nurturing educational environment." By being autonomy-supportive, teachers in the experimental condition made a special effort to understand the students' everyday concerns and stressors (*via* perspective taking) and to be responsive to the obstacles and constraints their students faced that might otherwise pull them away from experiencing psychological need satisfaction in the classroom.

Said another way, and following the research of Archambault and her colleagues (2020), the students of teachers in the experimental group might have perceived their teacher as providing both protective relatedness-supportive instruction and empowering autonomy-supportive instruction. If so, this would mean that the students' experiences of safety, security, and socio-emotional connection (i.e., the umbrella effect) might be an especially important teacher-student relationship dynamic in low SES school environments (Archambault et al., 2020). This seems like an important consideration for future research on autonomy-supportive teaching interventions in low SES schooling environments. Because low SES students face a storm of socioeconomic forces that students in mid and high SES environments do not, perhaps future autonomy-supportive teaching interventions in low SES environments might help teachers learn perspective taking, interest support, value support, *and* the umbrella effect. We note that we did not assess for an umbrella effect in the present study, so we encourage future research in low-SES educational settings to test for this hypothesized umbrella effect.

Limitations

Four methodological concerns limit the conclusions that can be reached from the present findings. First, our sample of low-SES schooling was represented singly by low socioeconomic schools

in Ventanilla, Peru. Future research will need to conduct similar studies in other low-SES school environments to learn if the present findings apply generally to low-SES schooling or only narrowly to the low-SES schools featured in the present study.

Second, the relatively small sample size of teachers in the present study left our hypothesis tests somewhat underpowered. We encourage future research to include a larger sample size of teachers.

Third, we assessed all dependent measures through self-report. Future research might consider a multi-informant study to collect teacher-reported and classroom observer scores as informative supplemental dependent measures.

Fourth, in a true randomized control trial with longitudinally assessed dependent measures, all baseline scores would be collected prior to or at least concurrently with the intervention's experimental manipulation. In the present study, we were able to collect only 70% of students' baseline scores during the first week of classes, as school-based scheduling constraints pushed out the baseline data collection for 30% of the students to weeks 2 or 3. Fortunately, the group equivalency test (see preliminary analysis) showed equivalent T1 scores for students of teachers in the experimental and control groups. That the experimental condition effect did not spill over to bias students' week 2 or week 3 scores was not an unexpected finding, however, because it routinely takes about one month before teachers can make the professional development transition to become a more autonomy supportive teacher post-intervention (Reeve, J., & Cheon, S.H., 2024). Teachers need a month of actual classroom practice to get comfortable with autonomy-supportive teaching, as they need this time and opportunity to experiment with the new autonomy-supportive teaching practices, try out new things, and observe how their students react to each autonomy-supportive teaching practice. That said, we acknowledge that best practices in a randomized control trial with longitudinally assessed dependent measures would feature baseline data collection in week 1.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Lennia Matos http://orcid.org/0000-0003-2271-4816
Johnmarshall Reeve http://orcid.org/0000-0002-6827-293X
Rafael Gargurevich http://orcid.org/0000-0001-6346-4134
Dora Herrera http://orcid.org/0000-0002-8327-9435

Data availability statement

Data are available from the corresponding author, [LM], upon request from researchers.

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