

Greater autonomy need satisfaction with a little help from my friends: a randomized control trial to increase peer-directed agentic engagement

Sung Hyeon Cheon^{a,*}, Johnmarshall Reeve^{b,c,**} , Danling Huang^b, Erika A. Patall^d, Chang-Ha Im^e, Ung Nyeon Kim^f

^a Department of Physical Education, Korea University, South Korea

^b Institute for Positive Psychology and Education, Australian Catholic University, Australia

^c Department of Education, Korea University, South Korea

^d Rossier School of Education, University of Southern California, USA

^e Center for Curriculum and Instruction Studies, Korea University, South Korea

^f Hopyeong Middle School, Gyeonggi-do, South Korea

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ABSTRACT

This preregistered study introduced the new phenomenon of peer-directed agentic engagement, defined as the student's constructive input into their peer conversations so that what happens during peer interactions will satisfy their personal motivations. Using a self-determination theory framework, the purpose of the study was to examine whether mid-semester gains in peer-directed agentic engagement would enhance late-semester autonomy need satisfaction. The research design was a multilevel randomized control trial with longitudinally assessed dependent measures. Twenty-one PE teachers (17 males, 4 females) who taught 52 classes were randomly assigned to participate (or not) in an autonomy-supportive teaching intervention, while their 1,569 middle- and high-school students (726 males, 843 females) reported their peer-directed agentic engagement, teacher-directed agentic engagement, and autonomy need satisfaction at the beginning, middle, and end of an 18-week semester. A doubly-latent multilevel structural equation modeling analysis tested the origins and benefits of peer-directed agentic engagement at both the individual student and whole class levels. At the student level, high (compared to low) baseline autonomy satisfaction energized mid-semester peer-directed agentic engagement, which increased late-semester autonomy satisfaction. At the whole class level, teachers who participated in the workshop, compared to teachers in a no-intervention control group, increased class wide mid-semester peer-directed and teacher-directed agentic engagement, which together increased late-semester class wide autonomy satisfaction. These findings reveal the origins and benefits of peer-directed agentic engagement.

1. Introduction

Autonomy is the psychological need to feel personal causation and volitional endorsement while initiating and regulating one's behavior (Ryan & Deci, 2017). Autonomy is at the center of the self-determination theory framework because it energizes and explains students' interest-taking and intrinsic motivation, internalization of external regulations, personal growth strivings and the setting of personal goals, classroom engagement, volitional functioning, and psychological well-being, and also because its rise and fall is sensitive to classroom processes and

events (Ryan, 2023; Ryan & Deci, 2017). That is, the more classrooms afford students opportunities to experience autonomy need satisfaction, the more students in those classrooms tend to show greater intrinsic motivation (Waterschoot et al., 2019), classroom engagement (Núñez & León, 2019), task performance (Cerasoli et al., 2016), academic achievement (Wang et al., 2019), positive emotionality (Zhou et al., 2021), and psychological well-being (Vite et al., 2024). Because it is such a reliable and robust catalyst to in-class thriving, it becomes an important question to ask what actions students might initiate to enhance their classroom experience of autonomy satisfaction. The

* Corresponding author at: Department of Physical Education, Korea University, Anam-dong, Seongbuk-gu, Seoul 02841, South Korea.

** Corresponding author at: Institute for Positive Psychology and Education, Australian Catholic University, North Sydney Campus, 33 Berry Street, 10th floor, Sydney 2060, Australia.

E-mail addresses: cheon78@korea.ac.kr (S.H. Cheon), johnmarshall.reeve@acu.edu.au (J. Reeve), danling.huang@acu.edu.au (D. Huang), patall@rossier.usc.edu (E.A. Patall), LCH814@korea.ac.kr (C.-H. Im), kun2535@korea.ac.kr (U.N. Kim).

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purpose of the present study was to examine whether greater peer-directed agentic engagement could do this.

1.1. Autonomy satisfaction, autonomy-supportive teaching, and agentic engagement

The most reliable classroom antecedent of autonomy need satisfaction is exposure to autonomy-supportive teaching (Aelterman et al., 2019; Cheon, Reeve, et al., 2019). Autonomy-supportive teaching is the instructional effort to identify and nurture students' interests, preferences, and psychological need for autonomy so that students become increasingly willing and able to volitionally engage themselves in classroom learning activities (Aelterman et al., 2019). Autonomy-supportive teaching is based on self-determination theory principles (SDT; Ryan & Deci, 2017), and it can be manipulated to a high level when teachers participate in an SDT-based autonomy-supportive teaching professional development workshop (Reeve, Ryan, et al., 2022). What teachers learn during such professional learning is how (and why and when) to (a) take their students' perspective, (b) present learning activities in autonomy need-satisfying ways, and (c) facilitate students' volitional internalization of societally-valued (but personally unappealing) assignments, requirements, and classroom procedures (Reeve & Cheon, 2021; Reeve, Ryan, et al., 2022). After teachers learn the "why" and "how to" of perspective taking, interest support, and value support, they do tend to teach in more autonomy-supportive ways, as perceived by their students and as rated by classroom observers (Cheon et al., 2022; Fin et al., 2019; Perlman, 2015).

When students have an autonomy-supportive teacher, they not only experience greater autonomy satisfaction, but they also display greater agentic engagement (Michou et al., 2023; Patall, Kennedy, et al., 2022; Reeve et al., 2020). Agentic engagement refers to the student's constructive contribution into the flow of instruction they receive so to better align it with their personal motivation (Patall, 2024; Reeve, 2013). When agentially engaged, students speak up to make a suggestion, offer their input, express a preference, ask a question, or let the teacher know what they want, need, prefer, and are interested in. Through such personal initiatives (through the "exercise of personal agency"; Bandura, 2006, p. 176), students contribute into the flow of instruction they receive such that the surrounding learning environment becomes increasingly attuned to and supportive of their personal motivations and strivings (e.g., needs, interests, preferences, goals; Patall, 2024; Patall et al., 2019, Patall, Kennedy, et al., 2022; Reeve, 2013; Reeve, Jang, et al., 2022).

The reason why autonomy-supportive teaching facilitates agentic engagement is two-fold (Patall, 2024). First, autonomy-supportive teachers encourage students to look inside themselves to become aware of and attuned to their own inner sources of motivation—their personal interests and preferences, their psychological needs, their personal goals and aspirations, and their possible future selves. Second, once they are aware of students' interests and preferences, autonomy-supportive teachers become willing and able to create opportunities for students to pursue the involvement and satisfaction of these personal motivations. For instance, autonomy-supportive teachers may begin a lesson with a formative assessment to learn what students prefer and are interested in doing (Mohammadi Zenouzagh et al., 2025). To the extent that students take advantage of these opportunities to communicate and act on their interests and preferences, they display agentic engagement.

The more agentially engaged students are, the more likely it is that they will experience subsequent autonomy need satisfaction (Patall et al., 2019; Reeve et al., 2020). That is, when encouraged, agentially engaged students speak up and take the action necessary to pursue their personal interests and goals (Patall, 2024). For instance, on a writing assignment, the student asks the teacher if they could write on a personally valued topic, the teacher says yes, and the student then spends class time researching, reading about, and writing on something of personal interest. In this way, greater agentic engagement facilitates

the self-determined behavior that increases autonomy need satisfaction (Patall et al., 2019; Reeve, 2013; Reeve, Jang, et al., 2022; Ryan & Deci, 2017).

We suggest that agentic engagement is an important addition to the overall self-determination theory framework because it introduces a key behavioral mechanism through which autonomy-supportive teaching makes autonomy need satisfaction possible. Specifically, autonomy-supportive teaching facilitates agentic engagement (Reeve et al., 2020), and agentially engaged students pursue their interests and personal goals in a way that makes autonomy need satisfaction more likely to occur (Bradshaw, 2023; Sheldon & Elliot, 1999). In addition, we suggest that students' own autonomy need satisfaction can facilitate agentic engagement. Specifically, the student's own naturally occurring experience of autonomy need satisfaction (in the absence of an autonomy-supportive teacher) can also energize this same interest and personal goal pursuit activity that creates the opportunity to experience autonomy need satisfaction. Thus, by adding agentic engagement to the overall self-determination theory framework, we add a mediating "action" mechanism to explain how and why autonomy-supportive teaching and personal need satisfaction energize a unique type of student engagement that is highly capable of generating autonomy need satisfaction.

1.2. Peer-directed agentic engagement might further enhance autonomy need satisfaction

To date, all studies of agentic engagement have investigated how students direct their suggestions, input, and questions toward the teacher. This makes sense because it is so often the teacher who creates and manages the learning environment. Teacher-directed agentic engagement is defined as the student's constructive contribution into the flow of instruction they receive so to align it with their personal motivation (Patall, 2024; Reeve, 2013). Classroom examples include (from Reeve & Shin, 2020, Table 1, p. 152):

- "I am interested in Stonehenge!" (i.e., let the teacher know what you are interested in).
- "I would like to add a drawing to my essay; may I do that?" (i.e., generate options).
- "I don't get it; why is the periodic table arranged in these columns and rows?"
(i.e., ask a question to help you learn).
- "A trip to the computer lab would be helpful; could we do that?"
(i.e., make a suggestion).
- "May we work with a partner?" (i.e., ask for a say in what to do and how to do it).

In that same spirit, classroom examples of peer-directed agentic engagement (individual and whole class) are similar—with two differences. First, rather than students' input and suggestions being directed toward the teacher (i.e., teacher-directed agentic engagement), it is directed toward one's classmates (i.e., peer-directed agentic engagement). Second, because peer-directed agentic engagement occurs during student-to-student interactions, rather than during student-to-teacher interactions, it is most likely to occur during group activity or during the time just before beginning an activity in which students chatter about their plans for how (or whether) to engage it. Therefore, we define peer-directed agentic engagement as *the student's constructive input into their peer conversations so that what happens during peer interactions will satisfy their personal motivations*. Classroom examples include:

- "Rowing is my favorite. Would it be okay to add rowing to our group workout today?" (i.e., let your classmates know what you are interested in)
- "We could create a webpage to share our project with the class. How about we do that? (i.e., generate options).

- “I don’t know how to add animations to PowerPoint slides. Can you show me how?” (i.e., ask a question to help you learn).
- “We have a volleyball test next week. Let’s come in before school and practice together for 20 min? I think it would be really helpful.” (i.e., make a suggestion)
- “What if we each worked on a different question? Then we can review each other’s answers and discuss. How about that approach?” (i.e., ask for a say in what to do and how to do it).

Although peer-directed and teacher-directed agentic engagement involve the same acts of agency (e.g., offering input, communicating interests), the two types differ in terms of who that agency is directed toward (i.e., teacher vs. classmates) and the typical situations each occurs (i.e., during instruction vs. during peer conversation). We expect that the two types of agentic engagement will produce similar benefits, such as greater autonomy need satisfaction. We also expect that these benefits will be complementary, as peer-directed agentic engagement likely expands the number and range of situations in which students can express agentic engagement. The two types may further complement each other in that students may express a somewhat different set of interests, preferences, and likes and dislikes to their equal-status peers than they do to the higher-status teacher. Thus, we expected that peer-directed agentic engagement would enhance autonomy need satisfaction, even after accounting for the autonomy-satisfying effect of teacher-directed agentic engagement.

Because we suggest that peer-directed agentic engagement is a new educational phenomenon, we explain how it is different not only from teacher-directed agentic engagement but from similar and potentially co-occurring constructs, such as engagement, social support, and collaborative learning. Engagement is a multidimensional phenomenon (behavioral, emotional, cognitive, and agentic) that refers to how actively involved the student is in the learning activity (Skinner et al., 2009). Agentic engagement differs from the other three dimensions because it is a proactive initiative that occurs mostly prior to the learning experience (e.g., “Teacher, I want to write about topic x; can I do that?”), while the other three dimensions are reactions that occur during the learning experience (e.g., exert effort, react emotionally, focus attention; Reeve et al., 2025). In factor analyses, agentic engagement loads as its own factor, and in multiple regression analyses it explains independent variance in student outcomes (e.g., achievement, academic progress, autonomy-supportive teaching; Reeve, 2013; Reeve & Tseng, 2011; Reeve et al., 2020). Peer-directed agentic engagement is distinct from social support, though the two can be reciprocal and mutually supportive of each other (Im et al., 2026). Essentially, social support refers to the provision and receipt of care, guidance, and help from peers (“My classmates help me. My classmates comfort me.”), while agentic engagement is proactively seeking or recruiting that same care and support (“I ask my classmates to help me learn. I let my classmates know what I want and need.”). It is also distinct from collaborative learning. During collaborative learning, students work together as a team or group (e.g., division of labor, coordinated effort) to produce a shared product; during agentic engagement, students work to transform the peer environment into something that becomes more motivationally supportive.

1.3. Origins and benefits of peer-directed agentic engagement

The present study sought to investigate the origins and benefits of peer-directed agentic engagement. We focused on the origins of peer-directed agentic engagement to understand the classroom events that could increase this beneficial way of behaving. We expected that the origins of peer-directed agentic engagement would arise at both the individual student level and at the whole class level. At the individual student level, we expected that peer-directed agentic engagement would arise out of students’ in-class experiences of autonomy need satisfaction; and at the whole class level, we expected that it would arise out of

having an autonomy-supportive teacher.

We expected that the benefit of greater peer-directed agentic engagement would be greater autonomy psychological need satisfaction, and that this would be true at both the individual and whole class levels. We focused on autonomy need satisfaction as our valued educational outcome of interest for the reasons outlined in the paper’s opening paragraph—namely, because of its capacity to energize and explain students’ interest-taking, intrinsic motivation, internalization of external regulations, personal growth strivings, the setting of personal goals, classroom engagement, volitional functioning, and psychological well-being.

We conducted a multilevel investigation, because we expected the origins and benefits of peer-directed agentic engagement to occur at both the individual and whole class levels. By focusing on the individual student level, we sought to investigate the extent to which students’ own individual level of autonomy need satisfaction at the beginning of the semester would enhance their mid-semester levels of peer-directed agentic engagement (i.e., the origins of peer-directed agentic engagement). Specifically, we expected that students who started the class with a high (vs. a low) level of autonomy need satisfaction would display greater mid-semester peer-directed agentic engagement. We further sought to investigate the extent to which a mid-semester rise in peer-directed agentic engagement would longitudinally increase end-of-semester personal autonomy need satisfaction (i.e., the benefits of peer-directed agentic engagement).

By focusing on the whole class level, we sought to investigate the extent to which autonomy-supportive teaching, experimentally manipulated to a high level, would enhance class wide peer-directed agentic engagement (i.e., the origins of peer-directed agentic engagement). Our plan was to have secondary level teachers participate (or not) in an autonomy-supportive teaching intervention so that the students of a teacher in the experimental group would be in an autonomy-supportive classroom context, as has been shown to occur in previous research (Cheon et al., 2022, Cheon, Reeve, et al., 2023, Cheon, Reeve, & March 2023, Cheon et al., 2024). We expected that when a whole class of students had an autonomy-supportive teacher, they would collectively experience higher levels of peer-directed (and teacher-directed) agentic engagement throughout the semester, compared to the whole class of students of a teacher in the no-intervention control group (i.e., the origins of peer-directed agentic engagement). We further sought to investigate the extent to which a mid-semester rise in class wide peer-directed agentic engagement would longitudinally increase end-of-semester class wide autonomy need satisfaction (i.e., the benefits of peer-directed agentic engagement).

2. Multilevel hypothesized mediation model

The multilevel, mediation-based hypothesized model appears in Fig. 1. The hypothesized model includes variables and hypotheses at both the classroom (L2) and individual student (L1) levels. We assessed all the variables included in the hypothesized model longitudinally—at the beginning (T1), middle (T2), and end (T3) of a semester.

2.1. Classroom-level hypotheses

At the classroom (L2) level, the experimental manipulation was teacher participation (or not) in the autonomy-supportive teaching workshop (the shaded grey box in the upper left of Fig. 1), the end-of-semester outcome was group level autonomy need satisfaction, and the two explanatory (mediating) processes were mid-semester levels of the whole class’s peer-directed and teacher-directed agentic engagement. We included teacher-directed agentic engagement in the hypothesized model for three reasons: (1) it is exclusively how agentic engagement has been investigated in the past; (2) we sought to investigate the extent to which teacher-directed and peer-directed agentic engagement could be conceptualized and studied as two separate

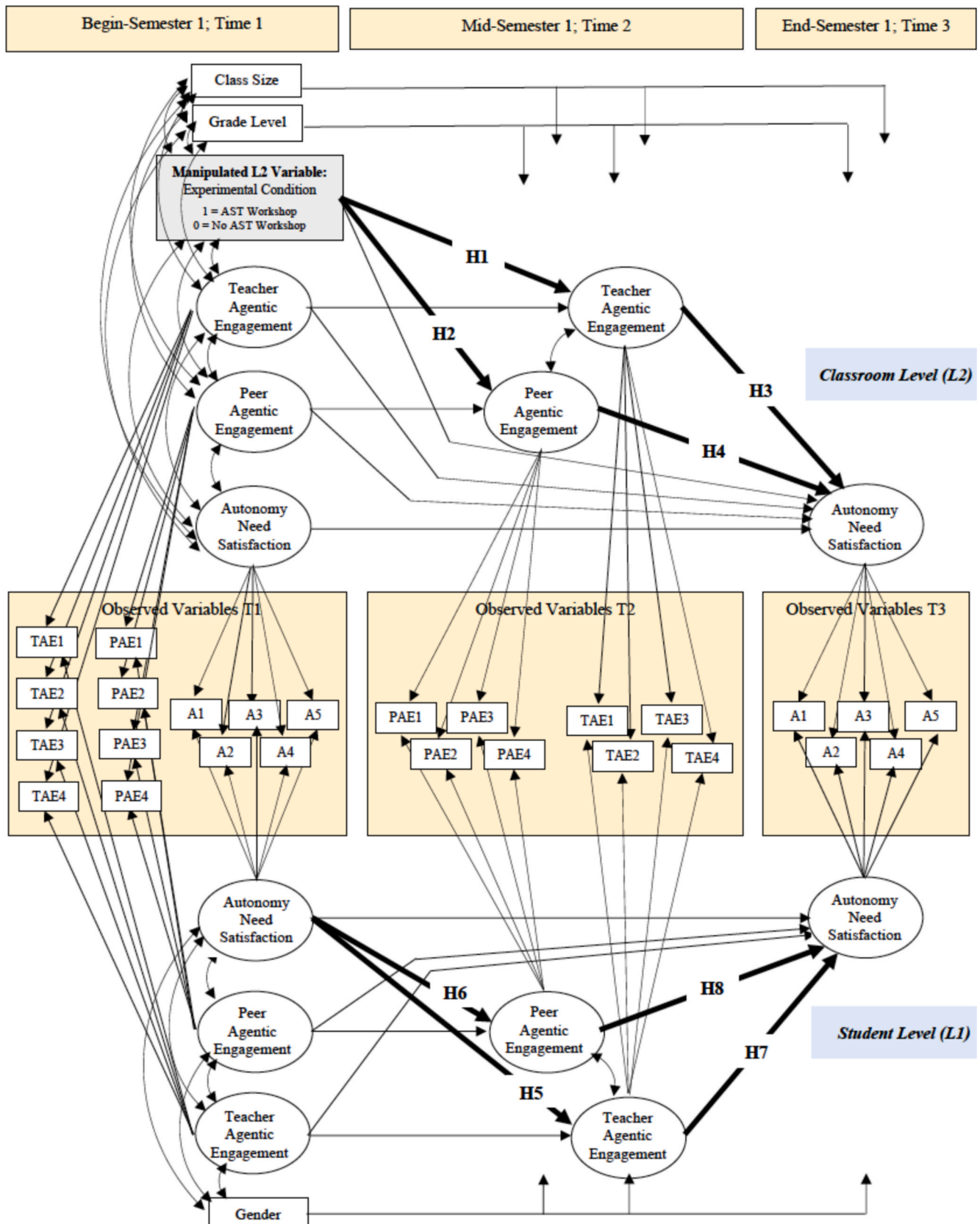


Fig. 1. DL-ML-SEM hypothesized model. Note: Thick boldfaced lines represent hypothesized paths, while thin-faced lines represent autoregression effects, statistical controls, or indicators of a latent construct. Rectangles represent indicators; ovals represent latent variables. H = Hypothesis.

constructs; and (3) we sought to determine if peer-directed agentic engagement could predict independent (additional) variance in autonomy satisfaction after controlling for (partialling out) the well-known benefits of teacher-directed agentic engagement.

At the whole class level (L2; upper half of Fig. 1), we hypothesized that autonomy-supportive teaching manipulated to a high level would increase both T2 teacher-directed (Hypothesis 1, H1) and T2 peer-directed (Hypothesis 2, H2) agentic engagement. We further predicted that both greater T2 teacher-directed (Hypothesis 3, H3) and greater T2 peer-directed (Hypothesis 4, H4) agentic engagement would increase whole class T3 autonomy need satisfaction. Because we conceptualized both types of agentic engagement as mid-semester explanatory processes, we conducted follow-up mediation analyses of these L2 hypotheses.

2.2. Student-level hypotheses

At the individual student (L1) level, the early-semester predictor was baseline level of autonomy need satisfaction, the end-of-semester outcome was individual autonomy need satisfaction, and the two explanatory mid-semester processes were peer-directed and teacher-directed agentic engagement. Unlike the hypotheses at the L2 level, the hypotheses at the L1 level did not test for an AST intervention effect. Instead, the L1 hypotheses tested for naturally occurring processes that unfolded over the three waves of data to reflect the individual student's semester-long course experience. Our expectation was that each individual student's high vs. low baseline level of autonomy need satisfaction would predict their mid-semester rise or fall in agentic engagement, which would in turn predict that same student's end-semester rise or fall in autonomy need satisfaction.

At the individual student level (L1; lower half of Fig. 1), we hypothesized that the student's baseline (T1) autonomy satisfaction would increase both T2 teacher-directed (Hypothesis 5, H5) and T2 peer-directed (Hypothesis 6, H6) agentic engagement. We further predicted that gains in both T2 teacher-directed (Hypothesis 7, H7) and T2 peer-directed (Hypothesis 8, H8) agentic engagement would increase individual T3 autonomy need satisfaction. These four student-level hypotheses (H5-H8) were included in the pre-registered hypothesized model, but they were not highlighted as stand-alone hypotheses. In contrast, the hypothesized model in Fig. 1 does feature student-level hypotheses H5-H8 as stand-alone hypotheses. So, while the pre-registered hypothesized model focused on the classroom-level hypotheses (H1-H4), the present investigation's hypothesized model tested both the classroom-level and the student-level hypotheses (H1-H8). In addition, just as we conceptualized both types of agentic engagement as mid-semester explanatory processes at the L2 level, we also conceptualized both types of agentic engagement as mid-semester explanatory processes at the L1 level; so, we conducted follow-up mediation analyses accordingly.

To confirm the effectiveness of the AST workshop experience on helping teachers become significantly more autonomy supportive and significantly less controlling, we asked the students of teachers who did (experimental condition) and did not (control group) participate in the AST workshop to report how autonomy supportive and how controlling they perceived their teacher to be throughout the semester (i.e., at T1, T2, T3). We report these "manipulation checks" findings in the first part of the Results section.

3. Method

3.1. Participants

To be eligible for the study, a teacher needed to be an experienced, full-time, physical education (PE) teacher at the secondary level in Korea. Teacher-participants were 21 certified PE teachers (17 males, 4 females) who taught in one of 21 different schools (15 middle- and 6

high-schools) dispersed throughout Seoul, South Korea. We intentionally recruited only one teacher from each school so that we could conduct a multi-site intervention trial that was free of possible cross-condition contamination. On average, teachers were 33.5 years old ($SD = 5.3$; $range = 25$ to 44) and had 6.2 years ($SD = 3.7$; $range = 2$ to 15) of PE teaching experience. All 21 teacher-participants completed all aspects of the study (retention rate = 100%). To increase the sample's statistical power, we collected data in two or three classrooms from each teacher (i.e., 21 teachers, 52 classrooms).

In these 52 classrooms were 1,569 middle-class ethnic Korean adolescents and pre-adolescents (Age: $M = 14.2$, $SD = 1.8$; $range = 12$ to 18), including: 843 (53.7%) females and 726 (46.3%) males; 1,034 (65.9%) middle and 535 (34.1%) high schoolers; and 840 (53.5%) in the experimental and 729 (46.5%) in the control condition. While all 1,569 students in these 52 classes completed the T1 questionnaire, 1,346 (85.8%) of these students completed all three waves of the study questionnaire.

Guidelines for adequate a priori statistical power to evaluate a multilevel structural equation model analysis such as the one depicted in Fig. 1 require 50 L2 units with at least 10–15 participants per L2 unit (Lüdtke et al., 2011; Morin et al., 2021). Our sample of 52 classrooms (L2 units) with an average class size of 30.2 students/class (L1 units) met these two multilevel guidelines, which suggested adequate statistical power to evaluate the multilevel hypothesized model and its eight embedded hypotheses.

3.2. Transparency and openness

This study was preregistered, including the hypothesized model and its embedded hypotheses. This preregistration document is available on the Open Science Framework (OSF) project site: https://osf.io/qhtsc/?view_only=ca97273ac8164a198aa1076d8eb836ea. The OSF project site also provides the study questionnaire, the data set, the Mplus syntax used in all analyses, the Mplus output files, and a description of the autonomy-supportive teaching workshop.

3.3. Research design and procedure

The first author's University Research Ethics Committee approved the research protocol. The research design was a multilevel randomized control trial with longitudinally assessed dependent measures.

Fig. 2 provides the study's schematic overview and timeline (i.e., the CONSORT intervention flowchart). It shows how we recruited PE teachers one month prior to the first semester of the academic year to participate in a study on "classroom instructional strategies", used a computer-generated program to randomly assign teachers to condition, and collected three waves of student-reported data. In the week before the first semester began, teachers in the experimental condition (10 teachers, 26 classrooms) participated in a 3-part, 8-hour autonomy-supportive teaching (AST) workshop, as described below. Together, these teachers completed Part 1 and Part 2 of the full-day workshop in the week prior to the beginning of semester 1. Five weeks later, these same teachers completed Part 3 of the workshop in small groups of 3 or 4 teachers (based on geographical proximity and the small group format that worked well in prior AST workshops; Yoo et al., 2025). Part 3 took place one month into the semester, because we wanted teachers to have some actual classroom experience with autonomy-supportive teaching to inform the group discussion. Teachers in the control condition (11 teachers, 26 classrooms) participated in a waitlist control group in which they relied on their "practice as usual" teaching style throughout the semester. These teachers received the full AST workshop the following semester (after the last wave of data collection was completed). The demographic characteristics and baseline dependent measures and manipulation checks were generally similar for participants in the intervention and control conditions, as shown in Supplemental Table S1.

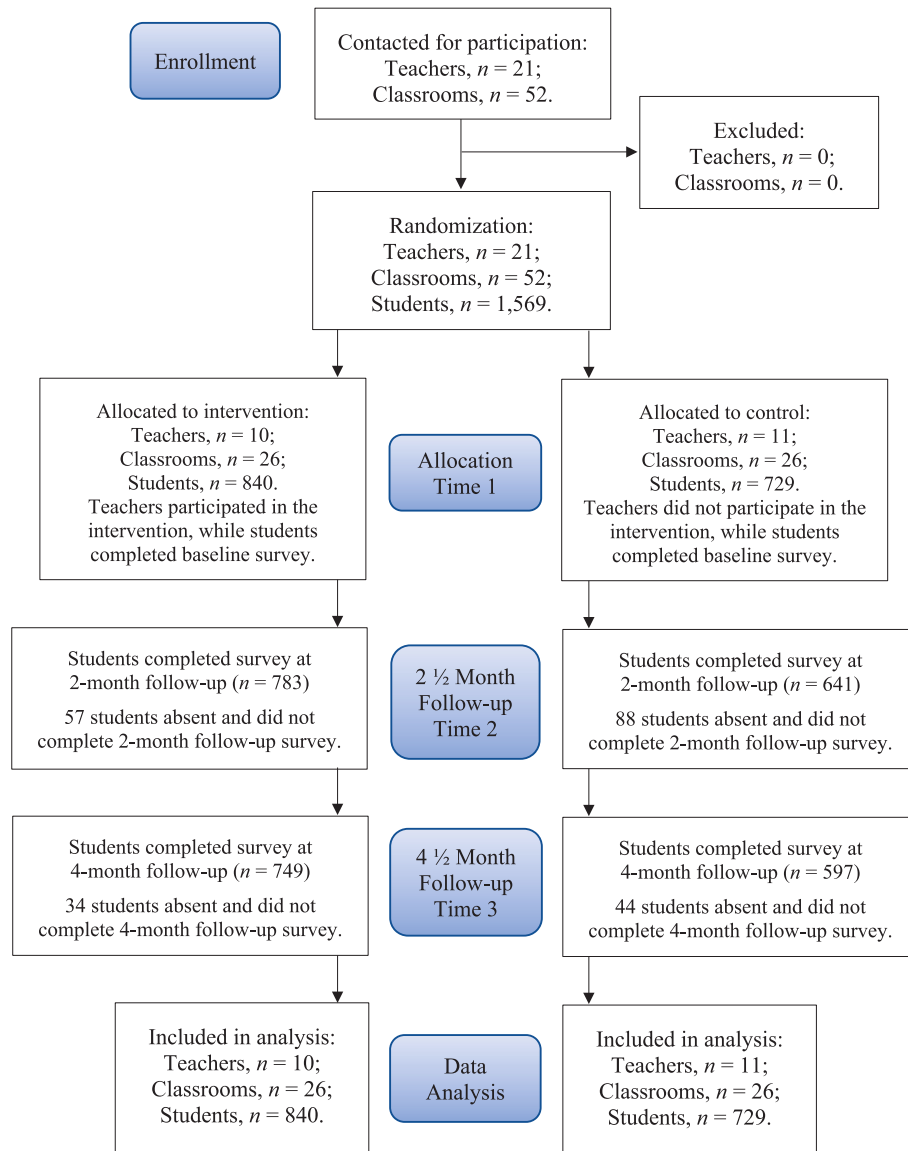


Fig. 2. Intervention flowchart (CONSORT).

As for the student-participants, we collected three waves of data over the course of one 18-week semester. Students completed the same questionnaire at the beginning (T1; week 1), middle (T2; week 10), and end (T3; week 18) of the first semester of the academic year (see the timeline in Fig. 2). The 5-minute questionnaire began with a consent form, and we used passive parental consent (“opt out”) at the request of the schools. We assured students that their responses would be confidential and used only for research purposes.

3.4. Autonomy-supportive teaching workshop

The purpose of the autonomy-supportive teaching (AST) workshop was to provide teachers with a professional development experience to learn how to become significantly more autonomy supportive and less controlling toward students during classroom instruction. As done in previous investigations, we offered the AST workshop as a 3-part, 8-hour professional development experience. Part 1 was a 3-hour, information-based morning presentation that introduced autonomy-supportive teaching, its benefits, and its empirical evidence. Part 1 also introduced, described, and modeled via professionally created videoclips the following six recommended autonomy-supportive teaching practices:

Take the students’ perspective; invite students to pursue their interests and personal goals; present learning activities in need-satisfying ways; provide explanatory rationales; acknowledge and accept negative feelings; and rely on invitational language (see Reeve & Cheon, 2021, 2024; Reeve, Ryan, et al., 2022). Part 2 was a 3-hour, skill-based afternoon workshop that focused on the practical “how to” of the recommended autonomy-supportive teaching practices. Each recommended act of instruction was described more fully, again modelled via a new set of professionally created videoclips, and practiced extensively until proficiency was attained, using teaching simulations, deliberate practice, personalized feedback, and group discussion. Part 3 featured a 2-hour small group discussion in which teachers shared their early-semester experiences with autonomy-supportive teaching and exchanged ideas on how to improve and personalize its classroom application. We provide the detailed step-by-step procedure for the design and implementation of the AST workshop on the OSF project site.

This same AST workshop has been successfully delivered in many previous investigations (Cheon, Reeve, et al., 2019, Cheon, Reeve, et al., 2023, Cheon et al., 2024; Reeve & Cheon, 2024). In these past studies, trained classroom observers have confirmed that workshop participants do expertly enact the recommended teaching practices during their post-

intervention classroom teaching, and they do so with large effect sizes ($d > 1$, compared to a no-workshop control group of teachers; Cheon et al., 2018, Cheon, Reeve, & Ntoumanis, 2019). These studies also confirm that workshop participants implement the workshop recommendations with high implementation fidelity (Cheon & Reeve, 2013; Cheon et al., 2024). Past studies further confirm that students of the workshop participants perceive their post-intervention teachers as highly autonomy supportive and as minimally controlling (Cheon et al., 2018, Cheon, Reeve, & Ntoumanis, 2019, 2023).

3.5. Measures

We present the study questionnaire on the OSF project site. Each measure used the same 1–7 response scale (1 = *strongly disagree*, 7 = *strongly agree*). For each measure, we calculated the inter-item (α) and inter-rater (ICC) reliability statistics across all three waves of data. The ICC statistic reports the proportion of the variance in the dependent measure that can be attributed to classroom (L2) membership (Morin et al., 2021).

3.5.1. Autonomy-supportive and controlling teaching

To assess perceived autonomy-supportive teaching (manipulation check #1), we used the 6-item Learning Climate Questionnaire (LCQ; Black & Deci, 2000). A sample item is, “In this PE class, my teacher listens to how I would like to do things.” Students’ reports on the LCQ were internally consistent (α s at T1, T2, and T3 = 0.90, 0.93, and 0.93, respectively) and showed a high and rising within-class consensus (ICCs = 0.142, 0.164, and 0.219).

To assess perceived controlling teaching (manipulation check #2), we used the 4-item Controlling Teacher Questionnaire (CTQ; Jang et al., 2009). A sample item is, “In this PE class, my teacher uses forceful language.” Students’ reports on the CTQ were internally consistent (α s = 0.78, 0.85, and 0.87) and showed a high and rising within-class consensus (ICCs = 0.118, 0.145, and 0.179).

3.5.2. Autonomy need satisfaction

To assess autonomy psychological need satisfaction (outcome measure), we used the 5-item Perceived Autonomy Scale (PAS; Standage et al., 2006). A sample item is, “In this PE class, I feel that I do PE activities because I want to.” Students’ reports on the PAS were internally consistent (α s = 0.89, 0.94, and 0.95) and showed a moderate within-class consensus (ICCs = 0.070, 0.102, and 0.151).

3.5.3. Agentic engagement: teacher-directed and peer-directed versions

To assess agentic engagement (the mediating process), we used two versions of the 4-item Agentic Engagement Scale (AES; Reeve, 2013). The teacher-version of the AES used a “my teacher” item referent (e.g., “In this PE class, I let my teacher know what I want and need.”). This teacher-version is the same version of the AES used in all prior research on agentic engagement (e.g., Jang et al., 2016). The peer-directed version of the AES used a “my classmates” item referent (e.g., “In this PE class, I let my classmates know what I want and need.”). Because the peer-directed AES has not been used in previous research, we provide all four items here:

- “In this PE class, I let my classmates know what I am interested in.”
- “In this PE class, I let my classmates know what I want and need.”
- “During this PE class, I express my preferences and opinions to my classmates.”
- “During this PE class, I ask my classmates questions to help me learn.”

Students’ reports on the teacher-directed AES were internally consistent (α s = 0.92, 0.94, and 0.95) and showed a moderate within-class consensus (ICCs = 0.043, 0.089, and 0.102). Students’ reports on the peer-directed AES were also internally consistent (α s = 0.92, 0.94,

and 0.94) and showed a similar moderate within-class consensus (ICCs = 0.045, 0.071, and 0.110).

3.6. Data analyses

We conducted two sets of analyses. The primary analysis tested the hypothesized model and its underlying measurement model. However, before testing the hypothesized model, we conducted a set of preliminary analyses to test for the intervention effect on the two manipulation checks (perceived autonomy-supportive teaching, perceived controlling teaching) and the outcome measure (autonomy need satisfaction).

3.6.1. Test of the hypothesized model

The data had a multilevel structure with students (Level 1, $N = 1,569$) nested within classrooms (Level 2, $k = 52$) and classrooms further nested within teachers (a cross-classified Level 2, $k = 21$). To evaluate the multilevel hypothesized model, we used a doubly-latent-multilevel structural equation model analysis (DL-ML-SEM, see Fig. 1; Marsh et al., 2012; Morin et al., 2021). In a DL-ML-SEM analysis, students’ questionnaire responses are used to create latent variables at both the student (L1) and classroom (L2) levels (see Fig. 1). Each L2 latent variable represents an aggregate group score to represent the class’s consensus on that measure (i.e., the class’s shared agreement, as reflected in that measure’s ICC statistic), while each L1 latent variable represents individual student scores. Effects at the L1 and L2 levels are analyzed as distinct effects, because a DL-ML-SEM analysis disaggregates the L1 and L2 components of students’ questionnaire responses to account for measurement error at the L1 level (based on multiple indicators of each latent variable), to control for unreliability in the aggregation of the L2 ratings as latent variables, and to control for the sampling error from the 30 or so different students in each class.

We used Mplus 8.3 (Muthén & Muthén, 2019) with the maximum likelihood-robust estimator (MLR), the “type = twolevel complex” model command, and the full information maximum likelihood (FIML) estimation procedure 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 0.08 and 0.06; for CFI and TLI, adequate and excellent fit are reflected by values greater than 0.90 and 0.95 (Marsh et al., 2005).

In a DL-ML-SEM analysis, it is important (for interpretative considerations) to establish multilevel (L1, L2) and multiwave (T1, T2, T3) measurement invariance (i.e., metric invariance; Morin et al., 2021). To do this, we fixed the factor loadings of the T2 and T3 indicators of each latent variable (at both L1 and L2) to their T1 baseline values (see the Mplus syntax on the OSF project site). This allows us to interpret changes in the T2 and T3 scores relative to their baseline anchor score, which helps produce easily interpretable effect size statistics. The measurement model included 26 indicators (the rectangles in Fig. 1) to create 12 latent variables (the ovals in Fig. 1). If the measurement model that constrains these indicators to be invariant across both level and time shows little or no decrement in fit (according to the goodness-of-fit statistics) compared to the measurement model in which the indicators are free to vary, then multilevel and multiwave measurement invariance is supported (Marsh et al., 2012).

To test the hypothesized model, we added (to the invariant measurement model) experimental condition as an uncentered L2 T1 predictor (0 = control condition, 1 = experimental condition), gender (0 = male, 1 = female) as a group mean-centered L1 covariate, and school level (0 = middle, 1 = high) and class size as two grand mean-centered L2 covariates.

Lastly, we conducted a pair of mediation analyses, one at the L2 level and another at the L1 level. At the L2 level, we tested whether T2 peer-directed agentic engagement and T2 teacher-directed agentic

engagement would double mediate the otherwise direct effect of experimental condition on T3 autonomy satisfaction. At the L1 level, we tested whether T2 peer-directed agentic engagement and T2 teacher-directed agentic engagement would double mediate the otherwise direct effect of T1 autonomy satisfaction on T3 autonomy satisfaction. To conduct both mediation analyses, we used the “model indirect” command within Mplus (see the Mplus syntax on the OSF project site).

3.6.2. Test of the intervention effect on the manipulation checks and outcome measure

Before testing the hypothesized model, we first tested whether teacher participation in the AST workshop was able to (a) increase autonomy-supportive teaching, (b) decrease controlling teaching, and (c) increase autonomy need satisfaction. To create the perceived autonomy-supportive teaching latent variable, we used the six items from the LCQ as indicators. To create the perceived controlling teaching latent variable, we used the four items from the CTQ as indicators. To create the autonomy need satisfaction latent variable, we used the five items from the PAS as indicators. In all three analyses, we used a DL-ML-SEM growth curve analysis to test for a longitudinal increase (slope: T1 = 0, T2 = 1, T3 = 2) in the corresponding L2 dependent measure from T1 to T3. We used the L2 scores as the dependent measures because the experimental manipulation was applied at the L2 (whole class) level. In all three analyses, we entered experimental condition as an uncentered L2 T1 predictor (0, 1), gender as a L1 group mean-centered covariate (0, 1) and grade level (0, 1) and class size as L2 grand mean-centered covariates. In all three analyses, the critical test was for a condition $\times$ time interaction to confirm that the T1 to T3 increase (or decrease) in the L2 score was greater in the classrooms of experimental group teachers than it was in the classrooms of control group teachers. We provide the Mplus syntax for all three analyses within the OSF project site.

4. Results

4.1. Manipulation checks

We first tested whether students of teachers in the experimental condition perceived their teachers as more autonomy supportive than did students in the control condition post-intervention. If so, students of teachers in the experimental group would report higher T2 and T3 perceived autonomy-supportive teaching than would students of teachers in the control group. The DL-ML-SEM growth curve analysis fit the data reasonably well, $\chi^2(349) = 1,478.86$, $p < 0.001$, $RMSEA = 0.045$, $SRMR = 0.029$, $CFI = 0.939$, and $TLI = 0.934$. As illustrated in Fig. 3A, the key condition $\times$ time interaction was significant, $B = 0.63$, $SE = 0.13$, $p < 0.001$ ($L2 R^2 = 0.61$), as L2 perceived autonomy-

supportive teaching increased during the semester in the experimental group classrooms (T1 to T3 $M \Delta = +0.56$) while it tended downward in the control group classrooms (T1 to T3 $M \Delta = -0.04$).

We also tested whether students in the experimental condition perceived their teachers as less controlling than did students in the control condition. If so, students of teachers in the experimental group would report lower T2 and T3 perceived controlling teaching than would students of teachers in the control group. The DL-ML-SEM growth curve analysis fit the data reasonably well, $\chi^2(155) = 456.70$, $p < 0.001$, $RMSEA = 0.035$, $SRMR = 0.023$, $CFI = 0.961$, and $TLI = 0.955$. As illustrated in Fig. 3B, the key condition $\times$ time interaction was significant, $B = 0.47$, $SE = 0.18$, $p = 0.010$ ($L2 R^2 = 0.62$), as L2 perceived controlling teaching decreased during the semester in the experimental group classrooms (T1 to T3 $M \Delta = -0.25$) while it tended to increase in the control group classrooms (T1 to T3 $M \Delta = +0.15$).

4.2. Autonomy need satisfaction

We next tested whether students of teachers in the experimental condition experienced greater autonomy need satisfaction than did students in the control condition post-intervention. If so, students of teachers in the experimental group would report higher T2 and T3 autonomy need satisfaction than would students of teachers in the control group. The DL-ML-SEM growth curve analysis fit the data reasonably well, $\chi^2(243) = 1,270.97$, $p < 0.001$, $RMSEA = 0.052$, $SRMR = 0.028$, $CFI = 0.937$, and $TLI = 0.930$. As illustrated in Fig. 3C, the key condition $\times$ time interaction was significant, $B = 0.65$, $SE = 0.13$, $p < 0.001$ ($L2 R^2 = 0.65$), as L2 autonomy satisfaction increased more during the semester in the experimental group classrooms (T1 to T3 $M \Delta = +0.53$) than it did in the control group classrooms (T1 to T3 $M \Delta = +0.04$).

4.3. Test of the hypothesized model

The (unconstrained) measurement model underlying the hypothesized model fit the data reasonably well, $\chi^2(555) = 2,409.12$, $p < 0.001$, $RMSEA = 0.046$, $SRMR = 0.031$, $CFI = 0.946$, and $TLI = 0.937$. Factor loadings for the 26 indicators of the 12 latent constructs were all substantial and statistically significant ($p < .001$). We next constrained the T2 and T3 indicators for the latent variables at both the L1 and L2 levels to be invariant across level and time (using their corresponding L1 T1 factor loadings). This invariant measurement model also fit the data well, and it showed no decrement in the fit indices, $\chi^2(585) = 2,307.42$, $p < 0.001$, $RMSEA = 0.043$, $SRMR = 0.031$, $CFI = 0.950$, $TLI = 0.945$, thereby establishing measurement isomorphism across both levels (L1 and L2) and time/waves (T1, T2, and T3).

Table 1 displays the correlations among experimental condition, the

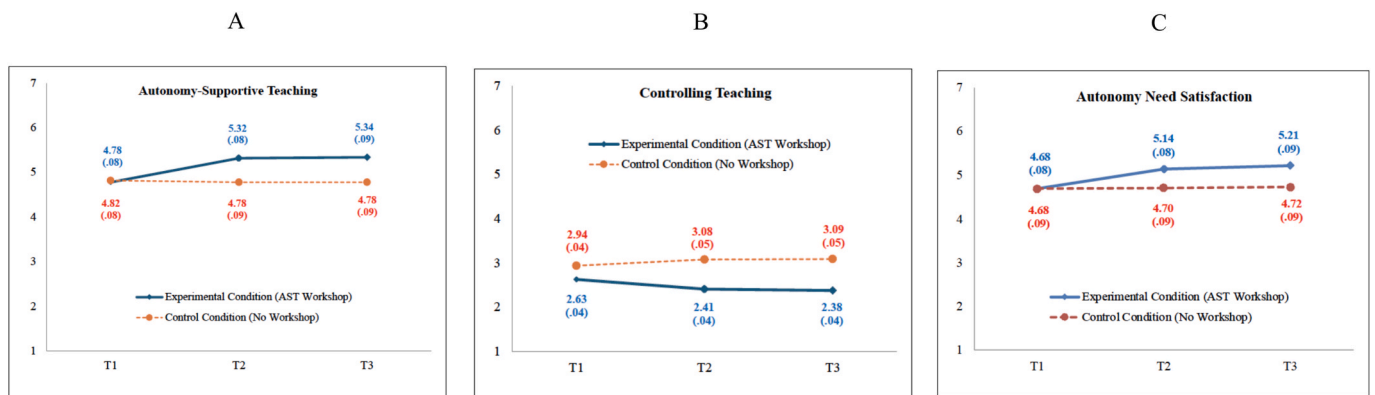


Fig. 3. Students of Teachers in the Experimental Condition Reported Greater Perceived Autonomy-Supportive Teaching (Panel A), Lesser Perceived Controlling Teaching (Panel B), and Greater Autonomy Need Satisfaction (Panel C) than Did Students of Teachers in the Control Condition (i.e., Condition $\times$ Time Interaction Effects). Note. The numbers in the figure are class-average means with standard errors in parentheses. AST = Autonomy-supportive teaching. T1 = Time 1 (begin-semester), T2 = Time 2 (mid-semester), T3 = Time 3 (end-semester).

Table 1
descriptive statistics and intercorrelations for All L2 and L1 latent variables and statistical controls.

Classroom-Level (L2)									
Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
<i>Time 1 Baseline</i>									
1. Experimental Condition	–	–0.13	–0.13	–0.21	0.63	0.64	0.66	0.16	0.53
2. Autonomy Need Satisfaction		–	0.55	0.64	0.39	0.47	0.39	–0.34	0.53
3. Teacher-Directed Agentic Engagement			–	0.90	0.48	0.40	0.28	–0.23	0.03
4. Peer-Directed Agentic Engagement				–	0.45	0.44	0.40	0.05	–0.06
<i>Time 2 Mediators</i>									
5. Teacher-Directed Agentic Engagement					–	0.97	0.82	0.21	0.41
6. Peer-Directed Agentic Engagement						–	0.90	0.19	0.37
<i>Time 3 Outcome</i>									
7. Autonomy Need Satisfaction							–	0.27	0.45
<i>Statistical Controls</i>									
8. Grade Level								–	–0.08
9. Class Size									–
<i>Descriptive Statistics</i>									
Mean	0.50	4.67	4.37	4.54	4.73	4.82	4.96	1.35	30.2
Standard Deviation	0.50	0.34	0.34	0.33	0.41	0.36	0.46	0.48	4.1
<i>k</i> = 52 classrooms. Any correlation $r > 0.28 $ is statistically significant, $p < 0.05$.									
Student-Level (L1)									
Variable	1.	2.	3.	4.	5.	6.	7.		
<i>Time 1 Baseline</i>									
1. Autonomy Need Satisfaction	–	0.62	0.58	0.42	0.40	0.47	–0.18		
2. Teacher-Directed Agentic Engagement		–	0.78	0.48	0.42	0.38	–0.02		
3. Peer-Directed Agentic Engagement			–	0.42	0.47	0.38	0.01		
<i>Time 2 Mediators</i>									
4. Teacher-Directed Agentic Engagement				–	0.78	0.48	–0.01		
5. Peer-Directed Agentic Engagement					–	0.50	–0.01		
<i>Time 3 Outcome</i>									
6. Autonomy Need Satisfaction						–	–0.08		
<i>Statistical Control</i>									
7. Gender							–		
<i>Descriptive Statistics</i>									
Mean	4.68	4.38	4.53	4.75	4.84	4.99	0.54		
Standard Deviation	1.08	1.26	1.22	1.21	1.21	1.08	0.50		
<i>N</i> = 1,569 students. Any correlation $r > 0.05 $ is statistically significant, $p < 0.05$.									

latent variables, and the statistical controls at both the L2 (upper half of the table) and the L1 (lower half of the table) levels. While the measurement model fit the data well, an inspection of the L2 correlation matrix in Table 1 showed that, at the classroom level, students could not distinguish between teacher-directed and peer-directed agentic engagement ($r = 0.90$ at T1, $r = 0.97$ at T2; see upper part of Table 1). Because of this overlap, we made the decision to create the higher-order L2 latent variable, “classroom-based agentic engagement,” by equally weighting its two indicators (L2 teacher-directed agentic engagement, L2 peer-directed agentic engagement; see the 1.0 weightings applied in Fig. 4). At the L1 individual student level, students were able to distinguish between these two constructs, so we kept these two L1 latent variables separate as originally modeled in the pre-registration document. This revised hypothesized model fit the data reasonably well, $\chi^2(689) = 2,665.33$, $p < 0.001$, $RMSEA = 0.043$, $SRMR = 0.037$, $CFI = 0.946$, and $TLI = 0.941$. Fig. 4 shows the hypothesized model’s unstandardized beta weights [B] (with standard errors in parenthesis) for the individual paths, autoregressive effects, and statistical controls.

4.3.1. L2 classroom-level effects

Hypothesized Effects. Experimental condition predicted a statistically significant increase in T2 classroom-based agentic engagement ($B = 0.48$, $SE = 0.10$, $p < .001$), which confirmed a merged H1 and H2. This mid-semester gain in classroom-based agentic engagement then predicted a statistically significant increase in T3 autonomy need satisfaction ($B = 0.94$, $SE = 0.30$, $p = .002$), which confirmed a merged H3 and H4.

Mediation Analysis. The upper part of Table 2 reports the results from the L2 mediation analysis. The indirect effect in which T2 classroom-based agentic engagement mediated the direct effect of

experimental condition on T3 autonomy satisfaction was statistically significant ($B = 0.46$, $SE = 0.13$, $p < .001$; 95% $CI = 0.20$ to 0.71). In this mediation analysis, the previously significant direct effect of experimental condition (see Fig. 3C) was reduced to a non-significant effect ($B = 0.12$, $SE = 0.20$, $p = .560$). Therefore, T2 classroom-based agentic engagement fully mediated the effect of experimental condition on class wide T3 autonomy need satisfaction.

4.3.2. L1 student-level effects

Hypothesized Effects. Students’ T1 autonomy satisfaction predicted a statistically significant increase in both T2 teacher-directed agentic engagement ($B = 0.25$, $SE = 0.04$, $p < .001$), which confirmed H5, and T2 peer-directed agentic engagement ($B = 0.24$, $SE = 0.05$, $p < .001$), which confirmed H6. Mid-semester teacher-directed agentic engagement, in turn, predicted a statistically significant increase in T3 autonomy need satisfaction ($B = 0.12$, $SE = 0.05$, $p = .011$), which confirmed H7. Likewise, mid-semester T2 peer-directed agentic engagement predicted a statistically significant increase in T3 autonomy need satisfaction ($B = 0.22$, $SE = 0.04$, $p < .001$), which confirmed H8.

Mediation Analysis. The lower part of Table 2 reports the results of the L1 mediation analysis. The indirect effects for T2 peer-directed agentic engagement ($B = 0.05$, $SE = 0.01$, $p < .001$; 95% $CI = 0.03$ to 0.08) and T2 teacher-directed agentic engagement ($B = 0.03$, $SE = 0.01$, $p = .018$; 95% $CI = 0.01$ to 0.05) were both statistically significant. In addition, the direct effect of T1 autonomy satisfaction on T3 autonomy satisfaction continued to be statistically significant even after including the two significant mediators ($B = 0.32$, $SE = 0.04$, $p < .001$; 95% $CI = 0.23$ to 0.40). Therefore, T2 peer-directed and T2 teacher-directed agentic engagement partially, but not fully, mediated the effect of T1 autonomy satisfaction on individually experienced T3 autonomy

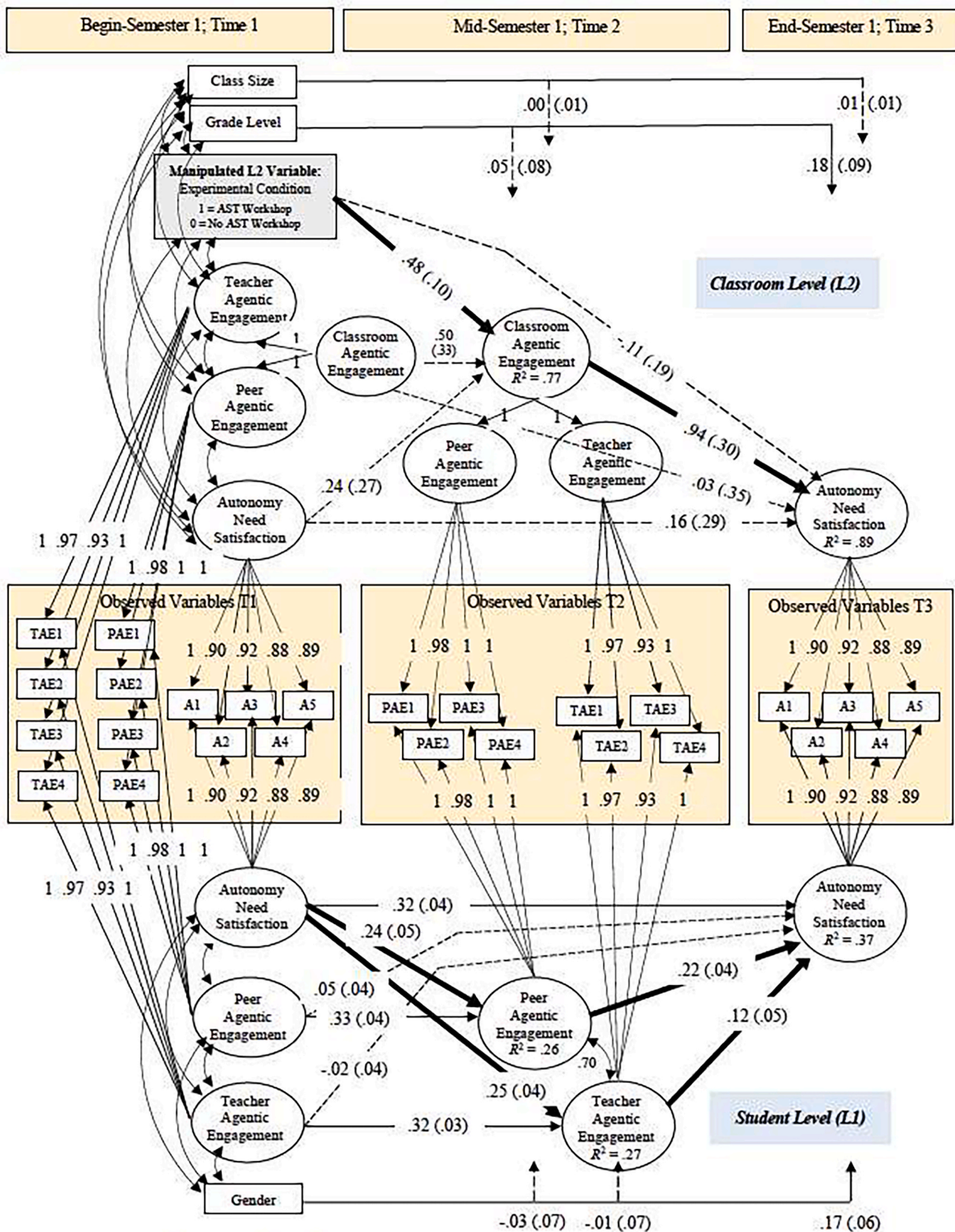


Fig. 4. Test of the DL-ML-SEM hypothesized model. Note: Thick boldfaced lines represent hypothesized paths, while thin-faced lines represent autoregression effects, statistical controls, or indicators of a latent construct. Rectangles represent indicators; ovals represent latent variables. Numbers are unstandardized beta weights (with standard errors in parantheses). R^2 = variance explained in dependent measure..

Table 2

Total, direct, and indirect (mediated) effects on T3 autonomy need satisfaction at the L2 and L1 levels.

Effects	<i>B</i>	<i>SE</i>	<i>t</i> value	<i>p</i>	95% CI
<i>L2 Classroom-Level Mediation Analysis</i>					
Experimental Condition on T3 Autonomy Need Satisfaction					
Total Effects	0.573	0.129	4.44	0.001	0.315 to 0.831
Direct Effect	0.115	0.197	0.58	0.560	−0.279 to 0.509
Indirect Effect (via Classroom-directed AE)	0.458	0.127	3.62	0.001	0.204 to 0.712
<i>L1 Student-Level Mediation Analysis</i>					
T1 Autonomy Need Satisfaction on T3 Autonomy Need Satisfaction					
Total Effects	0.399	0.044	9.15	0.001	0.311 to 0.487
Direct Effect	0.316	0.042	7.53	0.001	0.232 to 0.400
Total Indirect Effect	0.082	0.016	5.27	0.001	0.050 to 0.114
- Indirect Effect #1 (via Peer-directed AE)	0.053	0.014	3.73	0.001	0.025 to 0.081
- Indirect Effect #2 (via Teacher-directed AE)	0.029	0.012	2.38	0.018	0.005 to 0.053

Note. *B* = Unstandardized beta weight; *SE* = Standard error of the beta weight; *t* value = *t*-ratio; *p* = *p*-value; CI = Confidence interval; AE = Agentic Engagement.

satisfaction.

5. Discussion

The present study introduced the new phenomenon of peer-directed agentic engagement, and we conceptualized it as both an L2 classroom group process and as an L1 individual student process. Results revealed three new findings. First, just as students direct their agentic engagement toward the teacher, they similarly direct agentic engagement toward their classmates. In fact, the descriptive statistics in Table 1 showed that students reported a level of peer-directed agentic engagement (*M*s at T1 and T2 = 4.53 and 4.84) that was equal to or even slightly higher than their level of teacher-directed agentic engagement (*M*s at T1 and T2 = 4.38 and 4.75). This means that peer-directed agentic engagement is as commonly occurring a classroom phenomenon as is teacher-directed agentic engagement, at least in this sample of secondary students.

Second, peer-directed agentic engagement can be increased. At the L2 level, autonomy-supportive teaching increased the whole class's level of peer-directed agentic engagement. The more autonomy supportive the teacher was, the more agentially engaged the students in that class were as a group. At the L1 level, students' own baseline autonomy need satisfaction catalyzed peer-directed agentic engagement. The more personal causation (autonomy satisfaction) each student felt during classroom activities, the more agentic engagement that student reported experiencing. This means that peer-directed agentic engagement, like teacher-directed agentic engagement, can be increased, as by exposure to autonomy-supportive teaching or through one's own energizing autonomy need satisfaction.

Third, once increased, these gains in peer-directed agentic engagement tended to enrich high-quality motivation. The present study focused on autonomy satisfaction as the motivational benefit of interest (the T3 outcome measure), but other investigations have showed that agentic engagement produces additional motivational benefits, such as mindset (Patall, Kennedy, et al., 2022) and self-efficacy (Sökmen, 2019).

5.1. What do the L1 effects mean?

The lower half of Fig. 4 reported the L1 findings. Among individual students, peer-directed and teacher-directed agentic engagement were two distinguishable phenomena. The zero-order latent variable correlation between them was high ($r[1569] = 0.78$ at both T1 and T2, as reported in the lower part of Table 1), but the measurement model showed that students made a clear distinction between the two. The two types of agentic engagement correlated highly because they share the same behavioral repertoire (e.g., make a suggestion, communicate one's interests). Their key difference lies in whom the acts of agency are directed toward—one's classmates or the teacher. In addition, both types emerged out of and were energized to a higher level by students' baseline autonomy need satisfaction. And, both types were independently associated with higher late-semester autonomy need satisfaction. This latter finding shows that peer-directed agentic engagement predicts motivational satisfaction even after controlling for (partialling out) teacher-directed agentic engagement. Taken as a whole, these findings suggest the merits of expanding the study of agentic engagement to include both teacher-directed and peer-directed agentic engagement (not just teacher-directed agentic engagement).

5.2. What do the L2 effects mean?

The upper half of Fig. 4 reported the L2 findings. When a whole class of students had a teacher who completed the autonomy-supportive teaching workshop, that class reported high mid-semester levels of both teacher-directed and peer-directed agentic engagement. These two classroom phenomena were very highly intercorrelated. This means that, at the whole class level, teacher-directed and peer-directed agentic engagement coalesced into one broad classroom event—an overall pro-agentic engagement classroom ethos or culture. That is, within an autonomy-supportive teacher's classroom, students collectively (and indiscriminately) directed their agentic engagement toward the teacher, toward their classmates, and toward both the teacher and classmates in a coordinated expression of agency.

As the classroom culture became increasingly agentially engaged over the course of the semester, class wide autonomy satisfaction flourished. This predictive power of gains in mid-semester L2 "classroom agentic engagement" on autonomy satisfaction was very strong ($B = 0.94$, $p < .001$; $R^2 = 0.89$). This effect was so strong that it reduced to non-significant the otherwise direct effects of both experimental condition and baseline group autonomy need satisfaction (see the two dashed lines in Fig. 4). This full mediation effect suggests two conclusions. First, teachers have control over how agentially engaged the classroom culture becomes (i.e., by being autonomy supportive or not). Second, once created, such a classroom culture creates a strong and reliable pathway to greater class wide autonomy satisfaction.

5.3. Why focus only on autonomy need satisfaction?

We focused narrowly on the outcome of autonomy need satisfaction, rather than broadly on psychological need satisfaction (i.e., competence, relatedness, and autonomy)—for two reasons. First, interrelations among autonomy, autonomy support, and agentic engagement were already well-established—both theoretically and empirically (Reeve et al., 2020). Second, we focused on autonomy for a practical, classroom-based reason, which is that it is rather clear how a teacher can promote competence and relatedness satisfaction while it is less clear how a teacher can promote autonomy satisfaction.

For competence satisfaction, the teacher can introduce an optimal challenge (Harter, 1978), and then provide the guidance, scaffolding, and feedback the student needs to make competence need-satisfaction progress toward meeting or exceeding that challenge. For relatedness, the teacher can invite the student to pursue a prosocial goal with a classmate (e.g., create a joint answer or product; Johnson & Johnson,

2002), so that the ensuing social collaboration and altruistic behavior (i.e., helping) provides relatedness need-satisfying acceptance, warmth, and mutual concern. For autonomy, “provide choices and options” is often recommended (Waterschoot et al., 2019). But in practice teachers too often provide choices in a controlling, autonomy-frustrating way (“You can do your work now or during recess...your choice.”). Given the present findings, we can now suggest a practical two-part autonomy need-satisfying strategy: (1) Welcome and encourage students’ constructive contributions into the flow of instruction (i.e., teacher-directed agentic engagement), and (2) encourage students to speak up to communicate their interests and preferences during their in-class peer conversations (i.e., peer-directed agentic engagement).

5.4. Future research

This study introduced peer-directed agentic engagement as a new, motivationally beneficial classroom phenomenon. It revealed many new findings, but it also raised at least three unanswered questions for future research to address.

One area for future research concerns how to best assess peer-directed agentic engagement. The present study assessed peer-directed agentic engagement in a relatively context-free way. Students reported the extent to which they “let my classmates know what I want and need” without specifying any particular context in which such peer-to-peer conversational chatter occurred (e.g., during group work, during casual conversation). It is possible that students express their teacher-directed and peer-directed agentic engagement in qualitatively different contexts, such as during instruction with teachers but during informal chats with their classmates. If assessed in more context-specific ways, perhaps the two types of engagement could be distinguished as two separate phenomena at the classroom level. Future research could create a context-based AES to disentangle the two types of agentic engagement and therefore begin to identify the contexts in which each is most likely to occur. In line with this goal, we encourage future researchers to remain curious about the personal, situational, and cultural origins of high and low levels of peer-directed agentic engagement—as well as to the range and scope of its educational benefits.

Not only might the two types of agentic engagement occur under different circumstances, they may also be expressed in direct, indirect, or collective ways. For instance, Bandura (2000, 2006) suggested that agency manifests in multiple “forms” or “modes”—individual, proxy, and collective. This distinction opens up possible future research to investigate agentic engagement as a group effort. As a group, students who share a common interest or goal may act collectively (rather than individually) to orient the surrounding environment toward that common interest or goal. According to Bandura (2006, p. 166), collective agency does involve such “interactive, coordinative, and synergistic dynamics.” In a similar spirit, other research suggests that agentic engagement is a type of prosocial behavior. If so, one individual student might act as a proxy voice or representative who speaks on behalf of all the members of the class (Zambrano et al., 2022).

A final area for future research to investigate might be teacher-initiated agentic engagement. If acts of agentic engagement produce benefits for students, then perhaps acts of agentic engagement might produce parallel benefits for teachers. While students direct their agentic engagement toward their teacher and peers, teachers might direct their agentic engagement toward the principal, or head teacher, or their teaching colleagues. For instance, a teacher might speak up to express their personal interests and goals to the school principal (administrator-directed agentic engagement) or to a fellow teacher (colleague-directed agentic engagement). Perhaps teachers, like their students, can use acts of agentic engagement to recruit a more supportive environment for themselves (e.g., more empathic, supportive colleagues and administrators).

6. Limitations

Four concerns limit the conclusions that may be drawn from the present findings. First, we assessed all dependent measures via self-report. Agentic engagement is readily observable behavior, and past studies have shown that raters can reliably score agentic engagement at both the individual student level (Reeve et al., 2020) and the whole class level (Fiedler, 1975). Thus, future research could overcome the present study’s reliance of self-reported dependent measures by collecting and analyzing this sort of observational data.

Second, the generalizability of these findings remains to be determined. The present findings need to be evaluated with different age groups, in different countries, and across different subject matters and educational environments. For instance, PE classes afford frequent and recurring opportunities for peer interaction (e.g., students grouped into teams), so the findings need to be replicated in more traditional classroom settings.

Third, the analyses reported in Fig. 4 differed from those proposed in the pre-registration document in two ways. First, while the pre-registration document highlighted classroom-based group processes, the Fig. 4 model highlighted both classroom based and individual student-based processes. Second, as a group, students could not differentiate between peer-directed and teacher-directed agentic engagement. Instead, agentic engagement was high or low without a distinction between who it was specifically directed toward.

Fourth, students of teachers in the experimental versus control groups differed in their baseline levels of perceived controlling teaching (see Supplemental Table 1). The longitudinal analysis reported in Fig. 3B was able to account for this baseline (T1) group difference, but we suggest that the analysis reported in Fig. 3B needs to be interpreted more cautiously than do the other analyses that showed no baseline group differences.

7. Conclusion

This preregistered study introduced the new phenomenon of peer-directed agentic engagement. It revealed three new findings: (1) students direct their agentic engagement not only toward the teacher but also toward their classmates; (2) peer-directed agentic engagement emerges from both exposure to autonomy-supportive teaching and the student’s own autonomy need satisfaction; and (3) when increased, peer-directed agentic engagement yields motivational benefits.

CRedit authorship contribution statement

Sung Hyeon Cheon: Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Johnmarshall Reeve:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Danling Huang:** Writing – review & editing, Software, Formal analysis, Data curation, Conceptualization. **Erika A. Patall:** Writing – review & editing, Validation, Conceptualization. **Chang-Ha Im:** Writing – review & editing, Project administration, Methodology, Investigation, Data curation. **Ung Nyeon Kim:** Writing – review & editing, Project administration, Methodology, Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cedpsych.2026.102447>.

Data availability

We uploaded our data to the OSF project site, and we provide the link in the manuscript.

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