Article

School Psychology International

School Psychology International
2017, Vol. 38(2) 201–218

DOI: 10.1177/0143034316666413
journals.sagepub.com/home/spi
SAGE

The influence of the high school classroom environment on learning as mediated by student engagement

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Abstract

Classroom learning environments are frequently assumed to exert their influence on learning indirectly, via student engagement. The present study examined the influence of environmental challenge and support on learning in high school classrooms, and the potential for student engagement to act as a mediator in this relationship. Data were collected in seven classrooms in six different subjects in several US high schools. The 104 students in these classes participated in the Experience Sampling Method (ESM) and reported records ($N = 254$) of engagement, learning, and related experiential variables. Measures of the learning environment were also rated from video footage. Variations in the learning environment observed and rated from video were linked to students' real-time reactions to instruction synchronously. Results indicated that environmental support, but not environmental challenge, was significantly related with perceived learning. Multi-level path analyses revealed that the association between environmental supports and learning was mediated by student engagement. This mediating relationship held specifically for two components of environmental support: Motivational supports and supportive relationships. Implications are discussed for the benefit of practicing school psychologists, including strategies for facilitating motivational and relational support to enhance student engagement.

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Keywords
classrooms, high school, learning, learning environments, student engagement

Pervasive school disengagement has proven to be a global, international problem (Willms, 2003). At the same time, it is a problem over which educators have some control. For example, a key influence on a student's engagement to learn is the quality of the learning environment (D. J. Shernoff et al., 2016). In fact, student engagement has received increasing international attention both because it is considered to be malleable and potentially influenced by the learning environment (i.e., teacher controllable), and because of its observed or assumed influence on learning (Fredricks, Blumenfeld, & Paris, 2004; Willms, 2003). Few studies, however, have examined whether engagement is both influenced by the learning environment and influences learning within the same study. That is, student engagement – perhaps more so than any other educational construct – is presumed to be a mediator of the impact of the learning environment on student learning, yet this mediating relationship is seldom tested explicitly, especially in the context of secondary education.

The present study addresses this gap in the literature by investigating whether or not supportive and/or challenging learning environments exert a positive indirect influence on student learning in high school classrooms through student engagement. Secondly, it investigates the specific features or components of supportive or challenging environments that are most likely to exert an indirect effect on learning via engagement. Focusing on the specific features of learning environments that stimulate learning via the facilitation of engagement can be of maximum benefit to school psychologists as they work with teachers, parents, and administrators to improve student outcomes (Prendergast & Kaplan, 2015). Indeed, focusing on the learning environment and its effect on students' engagement illuminates the black box between teacher behaviors (which school psychologists may influence) and student outcomes (which school psychologists may assess).

The quality of the learning environment has been associated with students' propensity to learn (National Research Council, 2004). Viewed from the perspective of students, it is not merely procedural engagement (i.e., students doing what is generally expected of them; Nystrand & Gamoran, 1991), but rather the quality of learning environment that influences student experiences and subsequent classroom learning (Shernoff, 2013; Shernoff & Bempechat, 2014). In this study, we utilized a combination of the experience sampling method (ESM; see Method section, and Hektner, Schmidt, & Csikszentmihalyi, 2007) and coded video observations of interactions in high school classrooms in order to capture the relationship between the quality of the learning environment and student engagement, as well as the relationship between engagement and perceived learning.

The association of learning environments with learning

In addition to historical and cultural influences, the immediate learning environment is considered to be among the most salient factors in children's ability to learn (Bronfenbrenner & Ceci, 1994). For example, school contexts supporting students' autonomy, relatedness, and competence have been shown to predict favorable learning and achievement outcomes (Allen, Pianta, Gregory, Mikami, & Lun, 2011).

We conceptualize the quality of the learning environment with a dialectical model centering on a construct we have labeled, *environmental complexity*, or the simultaneous presence of both environmental challenge and environmental support (D. J. Shernoff et al., 2016). Environmental challenge refers to the challenges, tasks, activities, goals, and expectations intended to guide student action or thinking; these are prescriptions for desired behavior (Hektner & Asakawa, 2001). When environmental challenge is present in the context of academic disciplines, learning goals are clear (Csikszentmihalyi, 1990), and are typically accompanied by opportunities for conceptual and/or language development (including academic literacies) consistent with such goals (National Research Council, 2007). Learning tasks involve a level of challenge that is appropriate for the learner's skills and the use of domain-specific tools in the process of fashioning products (as in the arts) or solving problems (as in the sciences). In addition, expectations for competency or mastery can be facilitated by clearly communicated assessments of skills or learning.

Environmental support refers to the instrumental, social and emotional resources made available to help students reach environmental challenges (Zhang, Scardamalia, Reeve, & Messina, 2009). Two features are particularly important to environmental support. The first is *motivational support*, which is teacher and classroom support of students' intrinsic motivation (Sansone & Harackiewicz, 2000), autonomy (Reeve, 2006), interest development (Hidi & Renninger, 2006), competence (Urdan & Turner, 2005), and self-efficacy (Bandura, 1977). In sum, the classroom environment is responsive to students' background and interests, and provides the autonomy necessary for students to express themselves and feel competent. The second is *supportive relationships* and the relational environment. This sub-dimension includes teacher-student relations and rapport (Roorda, Koomen, Spilt, & Oort, 2011). For example, the teacher is emotionally responsive, shows concern for student welfare, and shows interest in individual students. Just as important, however, are peer relations (e.g., students demonstrate to each other mutual positive regard, collegiality, and cooperation; Ruzek et al., 2016).

Environmental support also includes opportunities for activity and interactivity in which respected members have roles and occasions to make contributions (Lave & Wenger, 1991; Zhang et al., 2009); for receiving performance feedback or instructional scaffolding (Meyer & Smithenry, 2014); and for physical as well as mental activity (Prince, 2004). See D. J. Shernoff et al. (2016) for more detail about the environmental complexity model and components.

Associations between the quality of the learning environment and student engagement

Substantial research supports the relationship between the quality of the learning environment and student engagement (see National Research Council, 2004). Rich and diverse learning environments, ranging from the skillful curricular implementation of educational video games (Coller, Shernoff, & Strati, 2011) to academic and arts enrichment during school-based after-school programs (Shernoff & Vandell, 2007) to collaborative group work (Sinha, Rogat, Adams-Wiggins, & Hmelo-Silver, 2015) have been shown to increase students' engagement in learning activities.

Teachers cannot control students' engagement directly, but they may influence it indirectly by creating conditions in the learning environment facilitating it. Key dimensions of learning environments that promote meaningful engagement include a combination of environmental challenge and environmental support (APA, 1997; Fraser, 1998; Goetz, Ludtke, Nett, Keller, & Lipnevich, 2013; Hospel & Galand, 2016; D. J. Shernoff et al., 2016; Skinner & Pitzer, 2012; Urdan & Turner, 2005; Zedan, 2010). Multiple aspects of environmental challenge have been associated with student engagement, including opportunities for experimenting and solving meaningful problems (Bransford, Brown, & Cocking, 1999), classroom structure (Hospel & Galand, 2016), lesson demands (Goetz et al., 2013), high expectations for student accomplishment (Rubie-Davies, Peterson, Sibley, & Rosenthal, 2015) and relevance of school activities to students' lives and goals (Shernoff, 2013). Numerous dimensions of environmental support that have been related to student engagement include the teacher's emotional support (Cooper, 2014), supportive relations with the teacher (Skinner & Pitzer, 2012) and peers (Ruzek et al., 2016), teachers' autonomy support (Hospel & Galand, 2016; Reeve, 2006), peer interactions (Allen et al., 2011), and a supportive relational environment (Roorda et al., 2011). A combination of high expectations and high responsiveness in parenting has been associated with children's positive developmental outcomes (Darling & Steinberg, 1993). The same combination in teaching has predicted positive academic outcomes like school performance and social behavior (Wentzel, 2002).

Associations between student engagement and learning

Flow is a psychological state of optimal experience characterized by intrinsic interest, complete absorption, and enjoyment in a task (Csikszentmihalyi, 1990). Based on flow theory, we conceptualized *student engagement* as the heightened, simultaneous experience of concentration, interest, and enjoyment (Shernoff, 2013). Thus, this conceptualization is rightly qualified as students' *subjective engagement*. While distinct from purely cognitive, affective, or behavioral subtypes of student engagement (Fredricks et al., 2004), the subjective experience of engagement generally includes an affective (e.g., enjoyment) and cognitive (e.g., concentration or absorption) element.

Student engagement has been shown to function as a pathway leading to valued educational outcomes such as learning, academic progress, and achievement

(Ladd & Dinella, 2009). Specifically, the extent of students' concentration, enjoyment, and interest in learning activities has been shown to predict learning and achievement outcomes (Reeve, 2013). For example, learning is dependent on focused *concentration* in the present moment (Heutte, Fenouillet, Kaplan, Martin-Krumm, & Bachelet, 2016). Numerous studies including those from neuroscience relate *interest* to learning, including attention, curiosity, continuing inquiry, and school achievement (Renninger & Hidi, 2015). *Enjoyment* is related to the one's disposition towards a learning experience, perception of skill acquisition, and the salience of learning for future goals (Blundson, Reed, McNeil, & McEachern, 2010).

In the current study, we examine the association between engagement and perceived learning. In keeping with prior phenomenological research on flow and engagement utilizing the ESM (see Shernoff, 2013), both are conceptualized and measured in terms of participants' subjective ratings 'in the moment'. Because the ESM probes many aspects of subjective experience, studies focusing on learning environments and engagement would be remiss not to probe students' perceptions of learning. This study is one of the first ESM studies to utilize such a measure and to examine its relationship with engagement and environmental variables. Few studies have examined the relationship between perceived learning and learning measured more objectively; however, one such study found that undergraduate students' perceived learning during a large lecture course was significantly related to course grades at the end of the semester (Shernoff, Sannella, Sanchez-Leal, Ruzek, & Schorr, 2016).

Despite prior research indicating an association between the quality of the learning environment and student engagement, and between student engagement and greater learning, studies have seldom explicitly tested the indirect relationship between the learning environment and student learning as mediated by engagement. In doing so, we designed and utilized a new observational instrument called the Optimal Learning Environments – Observational Log and Assessment (OLE-OLA; D. J. Shernoff et al., 2016). The OLE-OLA was utilized to assess environmental complexity and measure its subcomponents (See Methods).

The following research questions were investigated:

1. In US high school classrooms across multiple subjects, is there an indirect influence of the quality of the learning environment (i.e., the presence of environmental challenge and support) on perceived learning as transmitted through engagement?
2. If this indirect effect exists, what specific features of challenging and supportive learning environments influence learning as transmitted through engagement?

Method

Participants

We observed seven 9th to 12th grade class sessions in two US high schools in the Midwest. Teacher participants ($N = 5$) were observed teaching the following subjects: Mathematics, science, English, social studies (one class in sociology, and one class in geography), and Spanish. Principals nominated participating teachers who then volunteered as the basis for study selection. We observed one or two classes for each of the volunteering teachers. Following an informed consent procedure, all students in each of these classes ($N = 104$) participated. Forty percent of the student sample was male; 36% were in the 9th grade, 11% in 10th grade, 37% in 11th grade, and 16% in 12th grade; 86% were Caucasian, 6% were Hispanic, 5% were Asian, 3% were African American; and 13% received free or reduced-price lunch.

Procedures

Experience Sampling Method (ESM). We implemented the ESM in each of the observed class sessions. A researcher-observer wore a pre-programmed wristwatch prompting students to complete a Record of Experience (RoE) approximately every 25 minutes. Completing the RoE in approximately four to five minutes, participants rated their engagement, subjective perceptions, and affective states in the preceding 'instructional episode.' An instructional episode was defined as the period of time leading up to the ESM signal, beginning at the previous signal or the start of class. Students completed two or three RoEs depending on the length of the lesson – either 50 minutes or 86 minutes, respectively. We divided each class into two groups that we signaled in an alternating fashion (i.e., first Group A, then Group B, repeated two or three times). Participating students completed one to six RoEs each while observed during one or two class sessions. Student participants completed a total of 332 RoEs.

Video-taped observations. Two researchers video-taped each entire class session with one video camera each. One camera was focused on the teacher and the other on a focus group of four to five proximally located students who had consented to participate in the study.

Following the video-taping, two researchers rated dimensions of the learning environment from the classroom videos with the OLE-OLA. They made ratings for each of the 32 instructional episodes occurring throughout the experience sampling. Raters made one rating for each of the OLE-OLA dimensions in each instructional episode.

Measures

Experience sampling variables. Participants' perceptions of the activity were measured with 15 items on the RoE; and students' emotional and cognitive states were measured with nine items on a five-point Likert scales ranging from *not at all* to *very much*.

Based on flow theory (Shernoff, 2013; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003), s*tudent engagement* was a composite of three items: *Interest* (i.e., 'Was it interesting?'), *concentration* ('How hard were you concentrating?'), and *enjoyment* (i.e., 'Did you enjoy what you were doing?'). The reliability of this scale was good ($\alpha = 0.74$).

Perceived learning was derived from the single item, 'How much were you *learning*?'.

Optimal Learning Environments – Observational Log and Assessment (OLE-OLA). Two coders of the video data provided 13 ratings of the learning environment during each instructional episode on a seven-point scale from the OLE-OLA.[1] The seven-point scale included qualitative distinctions regarding the interactions within the episode aligned to the ratings of each OLE-OLE dimension and sub-dimension. The dimensions included: One global rating for *environmental complexity*; one global rating for each of the two components of environmental complexity (*environmental challenge* and *environmental support*); five subcomponents of environmental challenge (*conceptual/language development*, *authentic and challenging tasks*, *clear goals*, *importance of the activity*, and *assessment/expectations*); and five subcomponents of environmental support (*motivational supports*, *positive relationships*, *interactivity/transactional learning*, *performance feedback*, and *physical activity*). For example, higher ratings were given for positive relationships for episodes in which frequent gestures of empathy between the teacher and students were observed; and the prevalence of student choice in activities precipitated higher ratings for motivational supports. The raters engaged in several iterations of coding 25% of the video footage followed by discussions to form coding consensus and revisions to coding instructions. Following this, the raters achieved an inter-rater reliability of 0.80 or above based on Cohen's Kappa for all coding categories. Subsequently, the two coders completed functional ratings for all video data; the two ratings for each instructional episode were then averaged.

The scales of the OLE-OLA were assessed through a Classical Test Theory (CTT) analysis, confirmatory factor analysis (CFA), and a a Rasch analysis,. Results demonstrated ample evidence of multiple forms of validity. These results and further evidence of predictive validity were reported in D. J. Shernoff et al. (2016).

Measures from school records. School records provided the following student information: gender, race/ethnicity, grade level, and low socioeconomic status, or SES (free/reduced-price lunch).

Analytic approach

After list-wise deletions for observations with mostly missing data, the total analytic sample included was 254 Records of Experience (contributed by the 104 student participants) nested within 23 instructional episodes. Full-information maximum likelihood estimation was utilized to recover missing data determined to be missing at random. To test the research questions, we utilized multilevel path analyses computed in MPlus 7.2. In the multilevel models, the level-two unit was the instructional episode, and the level 1 unit was the RoE completed by students within each episode. Student-level covariates (gender, grade level, low SES)[2] were controlled at level 1 in all models. Because of the likelihood that class ID (representing different teachers and school subjects) would be a large contributor to any significant indirect effects, all models were tested with and without the class ID variable controlled at level 2. Indirect effects were non-normally distributed; accordingly, we used a Monte Carlo method for assessing mediation (Selig & Preacher, 2008). We report the 95% confidence intervals around the observed value of the indirect effect using the upper and lower values from the generated distribution.

Results

Environmental support influenced learning as transmitted by engagement

Results from multilevel models testing the indirect effect of environmental challenge and support model are shown in Figure 1. Significant direct effects were found between environmental support and engagement ($\beta = 0.37$, $p < 0.05$) as well as between engagement and learning ($\beta = 0.53$, $p < 0.001$). However, the direct effect between environmental challenge and engagement was not significant ($\beta = -0.25$). The indirect pathway of environmental support to learning through engagement was significant, indirect = 0.20 [CI = 0.04, 0.47]; but it was not significant after accounting for class. The indirect effect for the pathway from

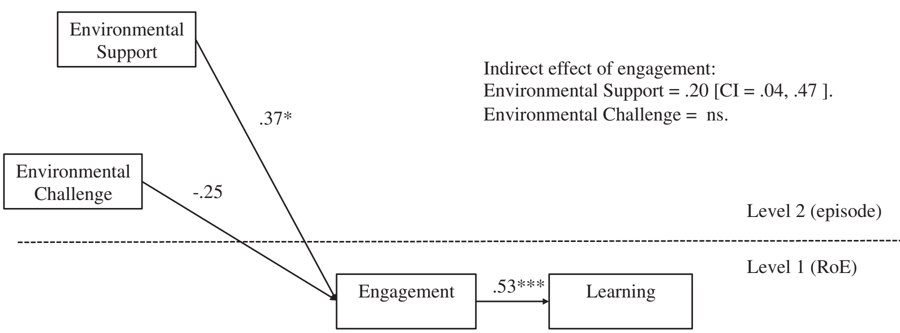

Figure 1. Indirect effect of environmental support and environmental challenge on learning as transmitted by engagement: Multilevel path model results.
Note: Records of Experience (level 1, $N = 254$) were nested in episodes (level 2; $N = 23$).
$^{*}p < 0.05$, $^{***}p < 0.01$. Controls include gender, low SES (free/reduced-price lunch), and grade level. The indirect path through Environmental Support was not significant after controlling for class. Only the direct path between Engagement and Learning remained significant after controlling for class.

environmental challenge to learning through engagement was not significant with or without controlling for class.

Positive relationships and motivational support influenced learning as transmitted by engagement

Because environmental support exerted a significant indirect effect on learning via engagement, we next tested for the indirect effect emanating from all five subdimensions of environmental support: a) motivational support, b) positive relationships, c) performance feedback, d) interactivity and transactional learning, e) and physical activity. Given the limited sample size at level 2, we tested each model separately. Significant indirect effects on learning through engagement were found for two predictors: Motivational support and positive relations. As depicted in Figure 2, direct effects to engagement were significant both for motivational support ($\beta = 0.14$, $p < 0.05$) and positive relationships ($\beta = 0.44$, $p < 0.05$), but not for performance feedback, physical activity, and interactivity and transactional learning ($\beta = 0.11$, -0.04, and 0.03, respectively). The direct effect of engagement on learning was also significant ($\beta = 0.52$, $p < 0.001$). The complete indirect pathway was significant for both the positive relationships and motivational support predictors, indirect = 0.23 [CI = 0.04, 0.57] and 0.07 [CI = 0.001, 0.15], respectively. Neither indirect effect remained significant after controlling for class at level 2. The indirect effects for performance feedback, physical activity, and interactivity and transactional learning as predictors were not significant with or without controlling for class.

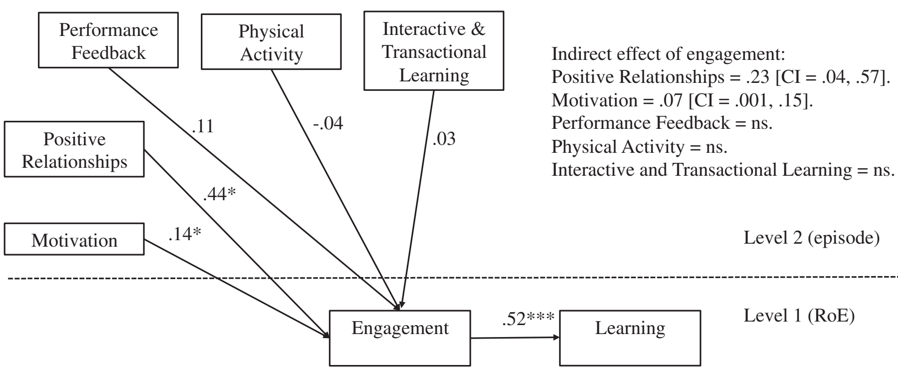

Figure 2. Indirect effect of environmental support subdimensions on learning as transmitted by engagement: multilevel path model results.
Note: Records of Experience (level 1, $N = 254$) were nested in episodes (level 2; $N = 23$). $^{*}p < 0.05$, $^{***}p < 0.01$. Controls include gender, low SES (free/reduced-price lunch), and grade level. Models were run separately by OLE-OLA predictor. The indirect paths through Positive Relationships and Motivation were not significant after controlling for class. Only the direct path between Engagement and Learning remained significant after controlling for class.

Discussion and conclusions

The goal of this study was to examine the indirect influence of environmental challenge and support on learning in high school classrooms as transmitted by student engagement in high school classrooms. We found that environmental support had a positive effect on student engagement, and that engagement had a positive effect on perceived learning. However, environmental challenge did not have a significant direct or indirect effect on learning. We also investigated which specific sub-dimensions of environmental support had an indirect effect on learning. We found that environmental support of student motivation and positive relationships each exerted an effect on learning as transmitted by student engagement. In this study, support for motivation was rated highly when the learning environment was responsive to students' background, goals, interests, and needs. The positive relationship sub-dimension indicated that students were respected and well regarded; student-teacher and student-student rapport was positive; and praise, positive regard, empathy, and encouragement were evident in communications. Such conditions allowed students to perceive activities as interesting and enjoyable, increasing concentration. When students felt engaged in this way, they also reported higher degrees of learning. This indirect relationship is consistent with much research and theory, such as self-determination theory (Selfdeterminationtheory.org, 2016) and the research on which it is based. Many studies have supported the theory that self-perceptions of autonomy or intrinsic motivation, relatedness, and competence are associated with greater engagement and satisfaction across activities and domains, leading to outcomes such as higher levels of conceptual learning compared to when these perceptions are not present (Deci & Ryan, 2012). All of these significant indirect relationships were partially accounted for by the influence of the class, which overlapped with teacher and subject in the present study. This is consistent with a great deal of research suggesting that the teacher plays a vital role in facilitating engagement, including the motivational and relational support of students (Furrer & Skinner, 2003; Reeve, 2006).

Results suggest that motivationally supportive communications and a collaborative classroom climate are vitally important factors in high school students' ability to engage with learning. While it would be inconsistent with a great deal of research to infer that components of environmental challenge such as instructional relevance, clear goals, high expectations, and appropriately challenging tasks are not important for student engagement and learning, a more sensible implication is that the environmental support is likely to be essential especially when environmental challenge is present or high (Shernoff, 2013). Consistent with flow theory, high challenges combined with lack of support for student competence and autonomy would be predicted to lead to anxiety and frustration (Csikszentmihalyi, 1990). Thus, clear prescriptions for desirable behavior and performance may be a necessary structure for learning to occur; but when the bar is raised on student performance, so too are supports needed to sustain engagement and successfully reach the bar.

Implications for practice

Pervasive disengagement is evidenced not only in the United States, where this study took place, but also globally. In 2000, the Program for International Student Assessment (Willms, 2003) investigated representative samples student engagement in 43 countries and found a high rate of students who are disaffected (approximately 25%) in terms of students' sense of belonging and participation, and who are regularly absent (approximately 10%) internationally. The report concludes, 'virtually all schools need to deal with problems associated with disaffection' (p. 25). The primary implications for supporting student engagement in schools suggested by the current study are also not confined to the United States. Nearly universally, supportive relationships are fundamental to positive youth development (Eccles & Gootman, 2002); and increasing evidence, including from an international meta-analysis of 99 studies (Roorda et al., 2011), persuasively suggests the importance of student-teacher relationships in school engagement and achievement. Peer relations have also been found to play a vital role in students' classroom engagement (Ruzek et al., 2016).

Research and theory also suggest that student motivation plays an important role in academically-related perceptions, feelings, and behaviors, as a great deal of international work on self-determination theory illustrates (see selfdeterminationtheory.org, 2016). For example, being self-motivated is consistently associated with feelings and perceptions of self-worth, perceived ability, persistence, and social relatedness across studies, cultures, and contexts – and has been found to influence outcomes such as deep learning, adaptive growth and high performance (Deci & Ryan, 2012). In addition, positive relationships and human motivation have consistently been found to be important predictors of student engagement and many other psychological and educational outcomes internationally (Roorda et al., 2011). Adaptive learning environments internationally thus appear to require the integration of positive social relationships with support for student motivation.

This study is suggestive that school psychologists can increase their effectiveness with an expansion and diversification of their roles, consistent with practice standards of the National Association of School Psychologists (NASP, 2010; E. S. Shernoff et al., 2016). By supporting teachers to build their skills in promoting students' social skills and emotional sensitivity, school psychologists can positively impact the learning environment so that it is optimally conducive to engagement and perceived learning. School psychologists are uniquely qualified and positioned to help teachers to build these skills through empirically-based interventions, consultation, and assessment. A variety of interventions school psychologists can consider have focused on improving student motivation (Lazowski & Hulleman, 2016), self-regulation (Cleary & Platten, 2012), and relationships in the classroom (Hamre et al., 2012; Ruzek et al., 2016). In terms of consultation, school psychologists can also work with teachers and administrators at the school level to examine relational norms, and to ensure that district and school policies support positive relationships and student motivation in classrooms and throughout the school. Finally, school psychologists may consider expanding their assessment repertoire to help illuminate the black box between what teachers do and student learning outcomes. For example, the quality of the learning environment and students' engagement in the classrooms may be two key proximal outcomes relative to learning; they may be considered *academic enablers* (DiPerna & Elliot, 1999) that can be periodically assessed (see Shernoff & Anderson, 2014) relatively more quickly and easily than can academic achievement.

This study suggests that such conditions include a learning environment that is *responsive* to student motivation and positive relationships. Just as responsiveness has long been considered the key to strong attachment relationships (Ainsworth & Bell, 1970) and parenting styles (Darling & Steinberg, 1993), school psychologists can work with teachers to improve their responsiveness to the needs of students. Importantly, this includes their adaptation of instruction and pedagogy as conditions in the learning environment change. Dimensions of the learning environment captured by the OLE-OLA and student engagement fluctuate significantly across instructional episodes, owing to variation both within and between classrooms (D. J. Shernoff et al., 2016). Learning to gauge fluctuations in student engagement and to make necessary adaptations are undoubtedly higher order and complex teaching skills, but skills worthy of attention by school psychologists.

Study limitations

There were several limitations of the study that should be considered. First, inferences with respect to causality or directionality should be made with caution due to the correlational nature of the study. Second, we were restricted to a measure of perceived learning derived from a single ESM item. We acknowledge that perceived learning is not the same as an 'objective' measure of content learning such as test scores; at the same time, we suggest that high quality *learning experiences* might be considered a proximal outcome or academic enabler relative to learning as measured objectively. The use of single-item measures is supported by an increasing number of studies demonstrating their utility and acceptable psychometric properties (Gogol et al., 2014; Grice, Melissa, & Badzinski, 2011), but remains debatable. It would be useful for future work to additionally utilize performance-based measures of learning. A third limitation relates to the potential for observer bias or error, as well as the Hawthorne effect (i.e., reactivity in which participants may alter their behavior due to being observed or video-taped). Also, teacher recruitment through school principal nominations and voluntary participation in a video study may have led to a participation bias favoring relatively confident teachers. Fourth, class and teacher sample sizes were small, which can compromise the precision of parameter estimation. Relatedly, we lacked the sample size at the class level to tease apart the effects of class, teacher, and school subject – all of which were confounded in this study.

Conclusion

This study shows that support for student motivation and positive relationships in the classroom have an impact on student engagement, which in turn impacts perceived learning. Thus, it is crucial to design high school classrooms as learning environments to scaffold students' engagement in learning. This can be achieved by a) honoring the interests and needs of individual students, b) allowing students to participate in the co-creation of learning activities, and c) structuring the learning environment for authentic collaborations in which each student has an essential role and intellectual input is valued.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Data collection for this study was made possible by a Chair's grant from the Department of Leadership, Educational Psychology, and Foundations at Northern Illinois University.

Supplemental Material

Supplementary material for this paper can be found at http://journals.sagepub.com/doi/suppl/10.1177/0143034316666413.

Notes

The data in this article were previously published by Shernoff et al. (2016). The present article investigates a different topic with an original analysis of the data.

1. Readers interested in the full instrument are encouraged to contact the first author.
2. Race/ethnicity was not included due to a negligible relationship to the model variables and effect on results.

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