Learning and Instruction xxx (2016) 1–9

Contents lists available at ScienceDirect

Learning and Instruction

journal homepage: www.elsevier.com/locate/learninstruc

Student engagement as a function of environmental complexity in high school classrooms

David J. Shernoff [a, *], Sean Kelly [b], Stephen M. Tonks [c], Brett Anderson [c], Robert F. Cavanagh [d], Suparna Sinha [a], Beheshteh Abdi [c]

[a] Rutgers University, Center for Mathematics, Science, and Computer Education, 118 Frelinghuysen Road, Piscataway, NJ 08854, USA
[b] University of Pittsburgh, School of Education, 4308 Wesley W. Posvar Hall, 230 South Bouquet Street, Pittsburgh, PA 15260, USA
[c] Northern Illinois University, Department of Leadership, Educational Psychology, and Foundations, College of Education, Graham Hall, DeKalb, IL 60115–2854, USA
[d] Curtin University, Kent St., Bentley, WA 6845 Australia

A R T I C L E I N F O

Article history:
Received 18 March 2015
Received in revised form
16 December 2015
Accepted 23 December 2015
Available online xxx

Keywords:
Student engagement
Learning environments
Classrooms
High school
Experience sampling method

A B S T R A C T

The purpose of this study was to investigate the linkage between the quality of the learning environment and the quality of students' experience in seven high school classrooms in six different subject areas. The quality of the learning environment was conceptualized in terms of environmental complexity, or the simultaneous presence of environmental challenge and environmental support. The students ($N = 108$) in each class participated in the Experience Sampling Method (ESM) measuring their engagement and related experiential variables. Concurrently, environmental complexity and its subdimensions were observed and rated from video with a new observational instrument, The Optimal Learning Environments – Observational Log and Assessment (OLE-OLA). Using two-level HLM regression models, ratings from the OLE-OLA were utilized to predict student engagement and experiential variables as measured by the ESM. Results showed that environmental complexity predicted student engagement and sense of classroom self-esteem. Implications for research, theory and practice are discussed.

1. Introduction

Research has shown that student engagement is positively related to academic performance, and that disengagement leads to poor academic performance in a variety of subjects (Kelly, 2008; Sirin & Rogers-Sirin, 2004). In the last several decades, an increasing amount of attention has been directed toward student engagement as a framework for understanding educational concerns such as dropout, at least in part because engagement is presumed to be malleable and highly influenced by the learning environment (Christenson, Reschly, & Wylie, 2012; National Research Council and Institute of Medicine of the National Academies, 2004; Shernoff, 2013). Student engagement is widely considered to be a meta-construct with many levels of bioecological influence (Christenson et al.), but also a factor over which teachers have some control. Although the primary mechanism of this control lies in shaping student's immediate learning environments, including but not limited to their teachers' own behavior, few studies have comprehensively investigated the influence of the immediate learning environment and related proximal factors on student engagement. In the present study, we examined the extent to which student engagement and experience varied by fluctuations in the quality of the learning environment from moment to moment in public high school classrooms.

Specifically, the quality of the learning environment was conceptualized in terms of *environmental complexity*, or the simultaneous presence of environmental challenge and environmental support. Environmental challenge refers to the challenges, tasks, activities, goals, structures, and expectations intended to guide student action or thinking; they are prescriptions for desired behavior (Csikszentmihalyi, Rathunde, & Whalen, 1993; Hektner & Asakawa, 2001; Newmann, 1992). Environmental support refers to the instrumental, social and emotional resources made available to help students reach environmental challenges (Reeve & Jang, 2006; Zhang, Scardamalia, Reeve, & Messina, 2009).

* Corresponding author.
E-mail address: david.shernoff@docs.rutgers.edu (D.J. Shernoff).

http://dx.doi.org/10.1016/j.learninstruc.2015.12.003

1.1. Research on student engagement and flow

There is increasing agreement that student engagement can be conceptualized as a multidimensional construct. The view that there are three primary dimensions or subtypes of student engagement—cognitive, emotional, and behavioral—is now widely embraced (Ryu & Lombardi, 2015; See Fredricks, Wang, Schall, Hofkens, & Snug, this issue). *Behavioral engagement* refers to consistency of effort, participation, attendance, homework and other desired academic behaviors. *Cognitive engagement* refers to investment in learning, depth of processing, and/or the use of self-regulated metacognitive strategies. *Emotional engagement* refers to students' affect and emotions in schools, such as interest, boredom, or anxiety.

Scholars argue that student engagement is not only multidimensional, but also highly dynamic, fluctuating, context-dependent, and interactive (e.g., Goldin, Epstein, Schorr, & Warner, 2011). Thus, nuanced and differentiated models are needed to explain the complexities of student engagement in context, including classroom engagement *in situ*. At the same time, models are needed to organize and simplify primary constructs in order to be useful to practitioners. Research on flow and the quality of experience in learning environments has sought to capture and explain some of these complexities; the conceptual model utilized in this study is rooted in flow theory (Shernoff, Abdi, Anderson, & Csikszentmihalyi, 2014). A theoretical cornerstone of positive psychology (Seligman & Csikszentmihalyi, 2000), flow is a state of optimal experience characterized by intense concentration and heightened interest in intrinsically enjoyable activities, as when an artist or scientist summons all of his or her available skills to reach a meaningful challenge.

Rooted in flow theory, *student engagement* is conceptualized in this study as the heightened, simultaneous experience of concentration, interest, and enjoyment (Shernoff, 2013). All three components are not only central to flow experiences, but have also been related to meaningful forms of learning. For example, *concentration* has been related to depth of cognitive processing and academic performance (Corno & Mandinach, 1983). *Interest* directs attention, reflects intrinsic motivation, stimulates the desire to continue engagement in an activity, and is related to school achievement (Schiefele, 2009). *Enjoyment* is related to the demonstration of competencies, creative accomplishment, and school performance (Csikszentmihalyi et al.,1993). Similar to flow, achieving an ideal state of engagement, including both work-like (i.e., concentration) and play-like (e.g., enjoyment) aspects, can be intrinsically meaningful and also serve a preventative function with respect to disengagement and its negative consequences for learning (Shernoff, 2013). In this sense, student engagement based on flow is similar to other constructs in positive psychology believed useful for educational practice, such as optimism or hope (Furlong, Gilman, & Huebner, 2014).

Like many previous studies conceptualizing engagement from the perspective of flow, the present study makes use of the Experience Sampling Method (ESM; see Hektner, Schmidt, & Csikszentmihalyi, 2007; Zirkel, Garcia, & Murphy, 2015), a time- and context-dependent method of measuring subjective experiences at the moment of instruction. In ESM studies, participants complete brief surveys about their immediate environment, thoughts, and feelings several times in succession over the period of time studied, resulting in repeated responses per participant.

ESM and related research has contributed to the view that, as a meta-construct, student engagement is highly related to other aspects of students' overall quality of experience in classrooms. Other experiential dimensions of high school classrooms that have been identified in previous ESM studies, especially those in educational contexts, include: a) *classroom self-esteem*, b) *intrinsic motivation*, c) *potency*, and d) *academic intensity* (e.g., Csikszentmihalyi et al., 1993; Csikszentmihalyi & Schneider, 2000; Hektner et al., 2007). These major experiential dimension have been related to flow theoretically, and prior research connects them to student engagement in nationally representative samples of high school classrooms (Shernoff, 2010a). *Self-esteem*, including feeling worthy, successful, and in control, has been associated with flow and to the perception of an activity as both work and play (Csikszentmihalyi & Schneider). Previous studies have found that adolescents who pursued activities based on their *intrinsic motivation*, or desiring to do an activity for its own sake, were more likely to go on to develop their talents than less intrinsically motivated adolescents (Csikszentmihalyi et al.). *Potency* (also referred to as *activation*), or feeling active, excited, and creative, has been positively related to productive activities and negatively related to negative moods and affect in samples of adolescents (Csikszentmihalyi and Schneider). *Academic intensity*, or feeling challenged and exerting effort in the face of an activity, has been found to be highly related to engagement in meaningful and relevant challenges in high school classrooms (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

1.2. Research on the learning environment: towards a conception of environmental complexity

Research suggests that engagement in learning activities arises from the reciprocal interaction between learners and a *learning environment* (Shernoff & Bempechat, 2014; Fraser, 1998). Conceived as a nexus of historical, cultural, and more proximal influences, the immediate learning environment is likely to be among the most salient factors in children's engagement to learn (Bronfenbrenner, 1977). Vygotsky (1978) and others (Brown, Collins, & Duguid, 1989; Zhang et al., 2009) have illustrated that learning is a social and transactional process. The nature of learning is now widely believed to be situated, collaborative, and supported within authentic contexts and learning communities (Brown et al., 1989; Rogoff, 1990; Zhang et al.). If engagement with learning arises from the reciprocal interaction between learners and a learning environment, then teachers' potency to engage students lies in their ability to create, shape, and influence the whole learning environment.

We utilized a conceptual model of the learning environment that is dialectical and centers on a construct called *environmental complexity*, or the simultaneous presence of both environmental challenge and environmental support. The term "environmental" is rooted in research on the learning environment (e.g., Allodi, 2010; Fraser, 1998). "Complexity" refers to simultaneous differentiation and integration of aspects or parts of a dynamic system (Csikszentmihalyi, 1996). The model of environmental complexity is based on previous research (e.g., Csikszentmihalyi & Schneider, 2000; Shernoff, 2013) finding that engaging learning experiences foster heightened concentration and effort in skill-building activities (i.e., academic intensity), as well as spontaneous enjoyment undergirding intrinsic interest and continued motivation (i.e., a positive emotional response). In meaningful forms of engagement, both aspects of experience are frequently reported together, a combination that leads to positive developmental and academic outcomes in the short term (e.g., course grades in in the same semester; Shernoff, 2010b; Shernoff & Schmidt, 2008) and in the longer term (e.g., continuing motivation in the subject, future grades when in college, and positive youth development; Shernoff& Hoogstra, 2001; R. Larson, 2000).

Literature on student motivation to learn, student engagement, flow, learning environments, and classroom climate (e.g., American Psychological Association, 1997; Fraser, 1998; S. Larson, 2011; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Skinner & Belmont, 1993; Urdan & Turner, 2005; Zedan, 2010) collectively suggest that key features of learning environments promoting meaningful engagement include environmental challenge and environmental support, especially when present in combination. Student engagement has been associated with multiple aspects of environmental challenge, including clear goals (Dickey, 2005), clear and high expectations (Wang & Eccles, 2013), providing opportunities for exploring and solving meaningful problems (National Research Council, 1999), the mastery of new skills (Ladd, 1999), teachers' high expectations for students' success (Allodi, 2010), and relevance of school activities to students' real lives (Meece, 1991). Numerous dimensions of environmental support that have been related to student engagement include supportive relations with the teacher (Skinner & Belmont, 1993) and peers (Akey, 2006), teachers' support for autonomy (Reeve, 2006), peer acceptance (Hughes & Kwok, 2006), and immediate feedback (Dickey, 2005). Such studies have suggested a positive relationship between creating a supportive relational environment and student engagement (Roorda, Koomen, Spilt, & Oort, 2011).

1.3. Components of environmental complexity

Environmental challenge and support dimensions are proposed to include subcomponents that the literature suggests are operative in facilitating engagement in learning:

Environmental challenge includes a variety of components that are categorized into five subdimensions. First, *opportunities for conceptual and language development* includes opportunities to learn rules, abstract principles, or theory, and to apply them to specific contexts, typically requiring higher order thinking or reasoning skills. This subdimension also includes opportunities to plan and strategize, and to utilize knowledge and practice. Further, it can include learning oriented towards mastery of concepts, skills, and/or literacies (National Research Council, 2007; S. C. Larson, 2011). The second subdimension is *challenging, complex*, *and situated tasks*, which are tasks in which students solve meaningful problems and/or fashion valued products with domain-specific materials or tools, requiring the development of related skills (Csikszentmihalyi, 1996; Gardner, 1993). Ideally, the level of challenge is well matched to the students' ability levels (i.e., challenging but reachable; see Csikszentmihalyi, 1990). The third subdimension of environmental challenge is *clear goals* (Csikszentmihalyi, 1990), which are learning goals of the class that are clear and relevant to students' personal or future goals (Tomlinson, 1999). In an engaging classroom, all activities are related to these learning goals (Wiggins & McTighe, 2005). The fourth subdimension is *importance or relevance of the activity*, which means that the relevance of the learning activity to a student's self or larger community is apparent or clarified. Often this relevance is set within the context of students' life circumstances, real world issues, or service to their communities, as with experiential or problem-based learning (Damon, 2008). Finally, the fifth subdimension is *expectations and assessments for mastery*, which are clear expectations from the teacher that obtained competencies will be demonstrated, performed, or assessed according to the standards of the school, community, and professional associations (APA, 1997; Wiggins, 1993).

Environmental support also includes various components categorized into five subdimensions. The first is *motivational support*, which is teacher and classroom support of students' autonomy (Reeve et al., 2004), competence (Urdan & Turner, 2005), interest development (Hidi & Renninger, 2006), intrinsic motivation (Deci & Ryan, 1985; Sansone & Harackiewicz, 2000), flow (Csikszentmihalyi, 1990), and/or self-efficacy (Bandura, 1977). The second subdimension is *supportive relationships*, including conditions that foster them. This subdimension includes teacher—-student relations and rapport (e.g., the teacher shows concern for student welfare, is emotionally responsive, and shows interest in individual students), supportive peer relations (e.g., students show mutual positive regard, collegiality, and cooperation), valuing of individuality and diversity, the absence of negative interactions, and freedom from fear of negative consequences (Roorda et al., 2011). The third subdimension of environmental support is *interactivity and transactional learning*. This includes interactivity among teacher and students, as when each student has a role in projects and/or are working towards a common goal. Other markers of this subdimension include opportunities to make valued contributions, distributed expertise, knowledge building and creation, active negotiating and consensus-building, and community construction of knowledge (Lave & Wenger, 1991; Rogoff, 1990; Zhang et al., 2009). *Performance feedback* is the fourth subdimension, and includes feedback from the teacher or peers on targeted competencies. Performance feedback can also be embedded into the activity. Importantly, feedback should be timely, specific and accurate (Csikszentmihalyi, 1990), as well as positive and constructive (Kluger & DeNisi, 1996), as with effective scaffolding (Meyer & Smithenry, 2014). Finally, the fifth subdimension, *Active and "hands-on" learning* denotes the presence of physical activity and/or "hands on" learning activities in the classroom (Prince, 2004).

1.4. Engagement and environmental complexity

The proposition that optimal learning environments promoting student engagement (see Shernoff, 2013) may be characterized by the combination of environmental challenge and environmental support has been supported by a variety of studies utilizing detailed classroom observations (e.g., Dolezal, Welsh, Pressley, & Vincent, 2003; Skinner & Belmont, 1993). For example, teachers who effectively engage their students might assign more challenging problems, or ask questions for higher order understanding, but also support the competence necessary for independent problem solving through scaffolding, feedback, and encouragement felt to be emotionally supportive (Dolezal et al.; Skinner & Belmont). Using the ESM with a sample of 121 German 8th and 11th graders, Goetez, Ludtke, Nett, Keller and Lipnevich (2013) investigated the relations between characteristics of teaching (e.g., understandability, illustration, enthusiasm) and students' academic emotions (e.g., enjoyment, pride, anxiety) across four academic domains (mathematics, physics, German, and English). They found that eight teaching characteristics represented two factors, labeled as lesson demands and supportive presentation style, having much overlap with the environmental challenge and supports components of environmental complexity investigated in this study. Lesson demands and supportive presentation style were predictive of students' academic emotions in the classroom across the four academic domains.

Fig. 1 illustrates a conceptualization of environmental complexity. Environmental complexity is defined by the simultaneous presence of environmental challenge and support. Environmental challenge and environmental support are, in turn, each defined by five components of the learning environment suggested by the literature.

1.5. The current study

Although the previous literature suggests a link between student engagement and environmental complexity, no studies have proposed and tested such a comprehensive model explicitly. Several other limitations can be identified from the literature on student engagement and learning environments. First, the majority of studies, if not entire literatures, focus on components within the environmental challenge (e.g., conceptual learning, assessments) or

Please cite this article in press as: Shernoff, D. J., et al., Student engagement as a function of environmental complexity in high school classrooms, *Learning and Instruction* (2016), http://dx.doi.org/10.1016/j.learninstruc.2015.12.003

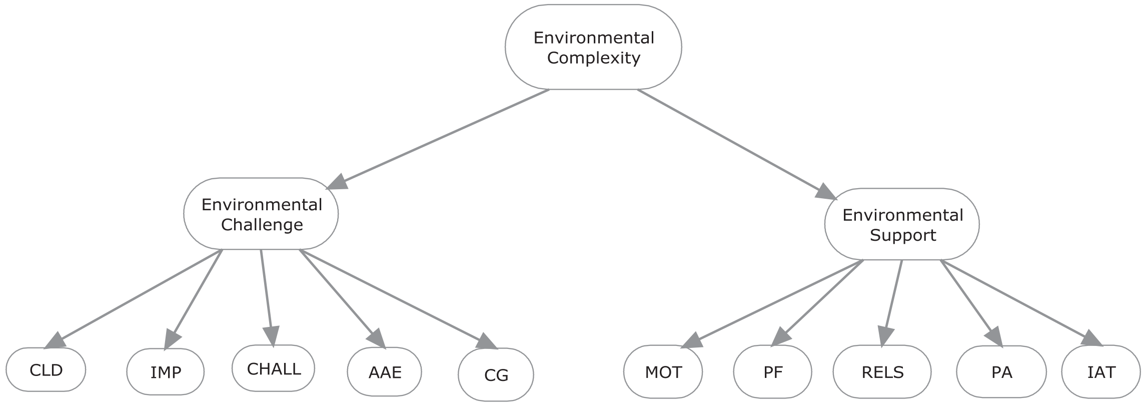

Fig. 1. Conceptualization of environmental complexity as a function of environmental challenge and environmental support. *Note.* CLD = Conceptual and Language Development; IMP = Importance of the Activity; CHALL = Complex and Challenging Tasks; AAE = Assessment and Expectations; CG = Clear Goals; MOT = Supports for Motivation; PF = Performance Feedback; RELS = Positive Relationships; PA = Physical Activity; and IAT = Interactive and Transactional Learning.

the environmental support dimension (e.g., motivation, constructivist/transactional learning), with few studies testing the importance of their integration or simultaneous presence. Second, despite widespread agreement among educational psychologists of the situated, interactive nature of learning, few studies bring rich observational data to bear capturing the nature of classroom interactions, and test for their impact by relating them with self-reported measures of student engagement. Third, and relatedly, there remains an overreliance on survey and self-report methodologies that can exaggerate effect sizes due to confounded method variance when independent and dependent variables are from the same or similar instruments and completed by the same participants. Fourth, few studies have examined the immediate impact of fluctuations in the classroom learning environment on in-the-moment measures of student engagement that fluctuate as instruction unfolds and are not reliant on recall.

Finally, no studies exist that have coded observational data by instruments designed to comprehensively reflect aspects of the learning environment that research suggests engages students. Therefore, the present study made use of a newly designed observational instrument designed specifically for this purpose — the Optimal Learning Environments — Observational Log and Assessment (OLE-OLA). The OLE-OLA was utilized in this study in order to assess environmental complexity and measure its subcomponents.

In the study, we investigated the following research questions:

1) *Does environmental complexity (based on observational measures) predict student engagement and related experiential variables (based on subjective ESM measures captured in the same instructional episodes as the observational methods) in a variety of high school classrooms after controlling for a variety of student background variables?*
2) *Do the primary sub-dimensions of environmental challenge and environmental support predict student engagement and related experiential variables after student background variables are controlled?*

Based on the aforementioned review, we expected that environmental complexity and both of its subdimensions would predict student engagement and related experiential variables.

2. Method

2.1. Participants

Seven 9th–12th grade class sessions in two Midwestern U.S. high schools were observed. Student participants ($N = 108$) were taught by teacher participants ($N = 5$) of the following subjects: English, Math, Science, Social Studies (one class in geography, and one class in sociology), and Spanish. Classrooms were selected based on school principal nominations and teacher volunteerism. One or two classes were observed for each of the volunteering teachers in order to obtain a sample of general education classes in major school subjects. All students in each of these classes participated in the study following an informed consent and assent procedure. Thirty-six percent of the student sample were in the 9th grade, with 11% in 10th grade, 37% in 11th grade, and 16% in 12th grade; 60% were female; 86% were Caucasian, 6% Hispanic, 5% Asian, and 3% African American; and 13% received free or reduced lunch.

2.2. Procedures

In this study, measures of the learning environment from the OLE-OLA (as rated from classroom videos) were treated as predictors of student engagement and experience (as measured by the ESM at multiple time points in the seven class sessions).

2.2.1. Experience Sampling Method (ESM)

The ESM was used in each class session observed. Students were prompted approximately every 25 min by a signal from the alarm on a pre-programmed wristwatch worn by a researcher-observer to complete a Record of Experience (RoE). In the RoE, taking four to 5 min to complete, participants rated their engagement, perceptions of the activity, and their subjective mood in the moment in time just before being signaled. Depending on the length of the lesson, 50 min or 86 min, students completed two or three surveys, respectively, regarding their experience in the preceding instructional episode. Each class was divided into two groups that were signaled in an alternating pattern (i.e., first Group A, then Group B, repeated two or three times). The group not completing the survey fully participated in class activities so that instruction never ceased; no issues with disruptiveness were observed or reported. Participating students were observed in either one or two class sessions, completing one to four RoEs each (only fifty-min classes were observed twice). A total of 332 RoEs were completed.

2.2.2. Videoed observations

Each class session was videoed in its entirety by two video cameras. One was focused on the teacher and the other on a focus group of four to five conveniently located students who had consented to participate in the study.

Please cite this article in press as: Shernoff, D. J., et al., Student engagement as a function of environmental complexity in high school classrooms, *Learning and Instruction* (2016), http://dx.doi.org/10.1016/j.learninstruc.2015.12.003

After the footage was taken from all class sessions, the first and fourth author rated dimensions of the learning environment from the classroom videos using the OLE-OLA. The period of time leading up to the ESM signal, starting at the previous signal or the beginning of class, was the "instructional episode" that was rated for each of the 32 signals given throughout the experience sampling. One rating for each of the OLE-OLA dimensions was made per each instructional episode.

2.3. Measures

2.3.1. Experience sampling variables

On the RoE, fifteen items measured students' perceptions of the activity being performed at the time of the signal; and 9 items measured participants' cognitive and emotional states on 5-point Likert-type response scales ranging from *not at all* to *very much*.

Based on flow theory, *student engagement* was a composite of three items (α = .75 with variable responses conforming to a normal distribution): *enjoyment* (i.e., "Did you enjoy what you were doing?"), *concentration* ("How hard were you concentrating?"), and *interest* (i.e., "Was it interesting?"), as utilized previously (See Shernoff, 2013; Shernoff et al., 2003). Other experiential dimensions were identified based on the ESM and flow literature, and the factorial structure emerging from the RoE data (i.e., factors with Eigenvalues over 1) as revealed by Exploratory Factor Analysis (EFA). Identified factors were: *Classroom self-esteem* (six items: feeling successful, cooperative, in control, accepted by others, living up to teacher's expectations, and perceiving clear goals; α = .79), *Intrinsic motivation* (four items: feeling curious, not bored, wishing to do the activity, and perceiving its importance; α = .83); *Potency* (four items: feeling creative, active, excited, and happy; α = .79); and *Academic intensity* (three items: perceived competence, perceived task challenge, and perceived effort; α = .80). These reliability coefficients are consistent with those from other studies supporting the reliability and overall construct validity of each factor (See Hektner et al., 2007).

2.3.2. Optimal Learning Environments — Observational Log and Assessment (OLE-OLA)

Thirteen ratings of the learning environment during each instructional episode were provided by two coders of the video data on a 7-point scale from the OLE-OLA.[1] The 7-point scale included qualitative descriptions of the prevalence of each dimension or subdimension during the interactions of the episode. The dimensions included a global rating for *environmental complexity*; a global rating for the two components of environmental complexity (*environmental challenge* and *environmental support*)[2]; 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*, *supportive relationships*, *interactivity/transactional learning*, *performance feedback*, and *physical activity*). After several iterations of coding 25% of the video footage, followed by coding interpretation discussions and revisions to coding instructions, inter-rater reliability based on Cohen's Kappa of .80 or above was reached for all coding categories. Subsequently, functional ratings were made by the two coders for all video data and averaged for each instructional episode.

Because the OLE-OLA is a new instrument, its scales were assessed through a Rasch analysis, Classical Test Theory (CTT) analysis, and confirmatory factor analysis (CFA). The Rasch analysis yielded ample preliminary evidence of the validity of the OLE-OLA measures (Messick, 1998). For example, the individual item residuals for OLE-OLA items showed good item-to-model fit ($M = -.10$ and $SD = 1.58$; ideally .00 and 1.00), and the proportion of variance in the data accounted for by the Rasch measure was 86%. Eleven of the 13 items had good fit to the Rasch model (individual item residuals < 2.5 logits, the RUMM2030 default), and the remaining two items were less than 2.6 logits (i.e., marginally beyond the criteria for good fit). A CTT analysis indicated that the 13 items composing the OLE-OLA demonstrated strong internal reliability (α = .91). CFA analysis of the second-order latent model revealed expression of two-factor model (environmental support and environmental challenge) with adequate fit: CFI = .93, SRMR = .074 and $\chi^2(13) = 19.52$, p = .108. The current study was the first significant test of the validity of the newly created OLE-OLA measures (see Results).

2.3.3. Measures from school records

The following student information was obtained from school records: grade level, gender, race/ethnicity, low SES (free/reduced lunch), student track level (regular, advanced, and honors student), and end-of-term grades in the course observed. Further details including coding information is provided in the Technical Supplement document (point #1).

2.4. Analytic approach

Our analytic goal was to investigate the association of environmental complexity in episodes of high school instruction with student engagement and related experiential dimensions (e.g., academic intensity). We begin by presenting descriptive statistics on the level and dispersion of student engagement/experience and the classroom environment measures. We then report covariance statistics for the student engagement and experience measures in order to assess if different experiential dimensions should be considered as separate dependent variables. Next, we report covariance statistics for the classroom environment measures in order to inform the use of global versus composite scales in analyses. We then report summary statistics on the extent to which environmental complexity varied across episodes. Finally, we used two-level HLM regression models to examine the association between instructional environment and engagement, adjusting for student covariates. In the multilevel models, instructional episode serves as level two, and RoE data from students within each episode serves as level one (See further detail in the Technical Supplement, point #2). Student background covariates (i.e., gender, race/ethnicity, poverty, track level, and course grade) were controlled at level one; thus students were treated as groups of experiential reporters by episode.

3. Results

3.1. Structure of the data

After several episodes were combined for similarity (e.g., the same activity in the same class), our data consist of 270 observations of student engagement (RoEs) from 108 students nested within 27 instructional episodes. Each episode was associated with fluctuating, average student experience ratings as well as changes in the learning environment at different time points. Further information including a decomposition of student engagement variance may be found in the Technical Supplement (point #3).

[1] We regret that the full version of the instrument could not be included in this article due to space restrictions.

[2] These global ratings were made by the coders as instructed by the OLE-OLA; they were not averages of the subordinate items.

Please cite this article in press as: Shernoff, D. J., et al., Student engagement as a function of environmental complexity in high school classrooms, *Learning and Instruction* (2016), http://dx.doi.org/10.1016/j.learninstruc.2015.12.003

3.2. Descriptive statistics

Means and standard deviations for the experiential variables measured with the Record of Experience survey were as follows: For *student engagement*, $M = 3.21$, $SD = 1.00$; for *classroom self-esteem*, $M = 3.49$, $SD = .86$; for *intrinsic motivation*, $M = 3.00$, $SD = .96$; for *potency*, $M = 2.41$, $SD = .92$; for *academic intensity*, $M = 2.67$, $SD = .99$. The numeric range of all measures was 1–5. Descriptive statistics on dimensions of the learning environment as rated on the OLE-OLA are presented in Table 1. The coding of classroom observation videos consisted of ratings of 10 sub-domains for environmental challenge and support (five sub-domains each). Descriptive statistics are also shown for an Environmental Complexity Scale (ECS), which was a composite of the 10 dimensions of the learning environment measured by the OLE-OLA, as well as for an Environmental Challenge Scale (5 items) and Environmental Support Scale (5 items).

3.3. Intercorrelations of RoE variables

Table 2 reports correlations among dimensions of classroom experience reported by students. In general, while these dimensions of positive classroom experience are associated, they are also substantially distinct as indicated by moderate to weak intercorrelations. Thus, in the remainder of the analysis, we consider each of the dimensions of positive experience as separate dependent variables.

3.4. Intercorrelations of OLE-OLA variables

Although the OLE-OLA provided global ratings of environmental complexity, challenge, and support in addition to the 10 individual items pertaining to these constructs, a covariance matrix (not shown) revealed high multicollinearity among three global ratings. Subsequently, global ratings were dropped and only the composite scales of the individual items were utilized in the analyses. The 10 individual item ratings were combined in an overall Environmental Complexity Scale, or ECS ($\alpha = .83$), and were also separated into a 5-item environmental support subdomain composite ($\alpha = .68$) and five-item environmental challenge subdomain composite ($\alpha = .74$). The correlation between the composite scale for the environmental challenge and environmental support subdomains was moderate ($r = .67$), supporting the hypothesis that they are related but separate dimensions of environmental complexity. In the remaining analyses we therefore utilize the 10-item ECS to represent environmental complexity due to its internal consistency and subscales that effectively discriminate between challenge and support.

Table 1
Central tendency and dispersion in summary measures and sub-indicators of environmental complexity across instructional episodes. N = 27.

Instructional measure	Mean	SD	Min, Max	Skewness
Ratings of Environmental Challenge Items[a]				
Conceptual/language development	4.76	1.35	2, 6.5	−.51
Authentic & challenging tasks	3.85	1.24	2, 6.5	.24
Clear goals	3.89	1.56	1.5, 6.5	.29
Importance of activity	4.63	1.03	2.5, 6	−.38
Assessment/expectations	4.59	1.31	1.5, 6	−.84
Ratings of Environmental Support Items				
Motivational support	4.15	1.32	2, 6	−.17
Supportive relationships	4.00	1.61	1.5, 6	−.07
Interactivity/transactional learning	5.17	.60	4, 6.5	.00
Performance feedback	2.09	1.01	1, 4.5	.97
Physical activity	4.20	1.58	1.5, 6	−.36
Composite Measure of Standardized Items				
Environmental Complexity Scale (ECS)	0	.62	−1.1, .96	−.21
Environmental Challenge Scale	0	.66	−1.4, 1.1	−.28
Environmental Support Scale	0	.70	−1.5, 1.2	−.33

[a] Measures are averages of two ratings on 7-point scale; 1 (low) to 7 (high).

Table 2
Correlation coefficients for the association among student reports of the quality of classroom experience. N = 270.

	(1)	(2)	(3)	(4)	(5)
Student Engagement	1.0				
Classroom Self-Esteem	.537	1.0			
Intrinsic Motivation	.692	.479	1.0		
Potency	.606	.416	.558	1.0	
Academic Intensity	.456	.463	.342	.272	1.0

3.5. Variation in environmental complexity across instructional episodes

There was evidence of substantial variability in environmental complexity across instructional episodes, a product both of variation from one episode to the next within classes as well as variation among classrooms with different teachers. Although we use standardized measures in subsequent analyses, for descriptive purposes, here we examined the episode ratings on the original 7-point rating scale. Of the 27 episodes, four were scored less than 3.0 on environmental complexity (meaning that, of all of the interactions rated in the episode, indicators of environmental complexity were present rarely or not at all); and five episodes scored between 3.0 and 4.0 (meaning that indicators were present sometimes but less than half of the time); eighteen episodes scored between 4.0 and 5.0 (meaning that the indicators were present more than half the time but not frequently); five episodes were scored greater than a 5.0 (meaning that indicators were frequently present). Of the other experiential variables, only potency did not show substantial variability across episodes; therefore, it was subsequently dropped from the analyses.

3.6. The association between environmental complexity and the quality of classroom experience

Table 3 presents results from multi-level regression models explaining variation in the quality of classroom experience within and between instructional episodes. We report results for environmental complexity as the single episode-level predictor, as well as sub-domain estimates for environmental support and environmental challenge, in separate models with those variables replacing environmental complexity. Further information regarding the technical specifications of the models are reported in the Technical Supplement (point #4).

At the between-episode level, environmental complexity was positively associated with three of the four variables of quality of classroom experience. It was significantly correlated with student engagement and classroom self-esteem at the $p < .05$ level, and with academic intensity only at the $p < .10$ level. The estimated coefficients in Table 3 indicate that a one-standard deviation increase in environmental complexity increases the classroom mean of student engagement by approximately .207 units (a .253 SD increase in student engagement), and the classroom mean of self-esteem by .145 units (a .209 SD increase in classroom self-esteem). For further interpretation, see the Technical Supplement (point #5).

We also considered the environmental support and challenge variables as separate predictors. Support and challenge were entered separately into different models due to their relatively high

Please cite this article in press as: Shernoff, D. J., et al., Student engagement as a function of environmental complexity in high school classrooms, *Learning and Instruction* (2016), http://dx.doi.org/10.1016/j.learninstruc.2015.12.003

Table 3
The quality of classroom experience as a function of environmental complexity.

	Measures of the quality of classroom experience			
	Student engagement coefficient (S. E.)	Classroom self-esteem coefficient (S. E.)	Intrinsic Motivation coefficient (S. E.)	Academic intensity coefficient (S. E.)
Within-Episode Model				
Female	−.209 (.102)*	.004 (.087)	−.103 (.091)	−.044 (.099)
Black	−.491 (.312)	−.215 (.259)	−.401 (.278)	−.100 (.304)
Hispanic	.385 (.215)+	.405 (.182)*	.030 (.192)	.518 (.209)*
Asian	.128 (.239)	.088 (.199)	.074 (.213)	.180 (.233)
Other Race	−.033 (.213)	−.021 (.181)	.038 (.191)	.233 (.208)
Grade Level	−.008 (.067)	.191 (.040)***	.164 (.055)**	.017 (.066)
Poverty/Free Lunch	−.109 (.149)	−.264 (.127)*	−.051 (.133)	−.212 (.145)
Track Level	−.163 (.111)	−.084 (.057)	.060 (.086)	.085 (.109)
Course Grade	.068 (.053)	.094 (.045)*	.006 (.047)	.001 (.052)
Between-Episode Model				
Intercept	−.134 (.774)	−2.46 (.455)***	−1.82 (.613)**	−.556 (.723)
Environmental Complexity (ECS)[a]	.332 (.160)*	.233 (.086)*	.022 (.125)	.278 (.157)†
Variance Components				
Level-1 (Null model)	.56814	.07889	.09093	.13872
Level-2 (Null model)	.09869	.40612	.43027	.51897
Deviance Parameters	641.601	535.664	578.719	625.313
Deviance Parameters (dropping ECS)	645.872	547.987	577.903	631.200
Sub-Domain Estimates				
E. Support	.361 (.136)*	.179 (.081)*	.084 (.111)	.162 (.142)
E. Challenge	.160 (.152)	.199 (.075)*	−.054 (.112)	.293 (.140)*

Note. N = 270 observations nested within 27 instructional episodes. †p < .10, *p < .05, **p < .01, ***p < .001.
[a] Scales were composed of standardized items.

correlation (r = .67) and the small episode-level sample size. Results showed that only the environmental support component had a significant effect on engagement; environmental challenge did not. Like environmental complexity, both challenge and support components exerted a significant effect on classroom self-esteem, but not intrinsic motivation. Environmental challenge was a significant predictor of academic intensity, but environmental support was not.

4. Discussion

4.1. Summary of study purpose and goals

The purpose of this study was to investigate the linkages between environmental complexity and student engagement in high school classrooms. Specifically, we tested the proposition that a comprehensive framework based on *environmental complexity*, or the simultaneous presence of environmental challenge and environmental support, predicts student engagement and related experiential factors. Filling a void in the literature with respect to capturing the nature of interactions in the whole learning environment that can impact students' engagement, a new observational instrument, the OLE-OLA, was constructed to measure aspects of environmental complexity from videos of classroom interaction. Student engagement and experience was then measured by a version of the Experience Sampling Method adapted to classroom research.

4.2. Findings and interpretations

Overall, findings from this study support the proposition that student engagement varies from one instructional episode to the next, partly as a function of variation in environmental complexity. Environmental complexity had a significant effect student engagement as well as classroom self-esteem, and a marginal effect on academic intensity. This suggests that the learning environment is an important factor influencing student engagement and the quality of other, related aspects of student experience in public high school classrooms. Furthermore, this influencing aspect of learning environments can be partially characterized by the simultaneous presence of environmental challenge and support. The lack of significant effect of environmental complexity and its subcomponents on intrinsic motivation was unexpected, possibly owing to lack of greater statistical power.

The global measures for both environmental challenge and environmental support were highly correlated with their corresponding composite measures, as well as the global and composite measures of environmental complexity. However, environmental challenge and environmental support were only moderately correlated with each other. Furthermore, environmental support showed a stronger relationship with student engagement in these data than did environmental challenge. This finding suggests that engagement may be significantly boosted by supportiveness in the environment alone. For all the attention given to environmental challenges with respect to standards and assessments, a critical, underappreciated aspect of engaging environments may include support for motivation, performance feedback, and the quality of interpersonal relationships. On the other hand, environmental challenge showed a stronger relationship with academic intensity than did environmental support. Consistent with flow/ESM literature (Shernoff, 2013), both results support the proposition that meaningful engagement may include interactive but independent processes facilitating perceived academic intensity and positive emotional responses.

Environmental complexity was conceptualized as a condition whereby students are significantly but appropriately challenged with clear goals that guide student action with clarity, and are also provided the supports to build their skills and be successful, including competency, motivational, relational, and social/emotional supports. Complex learning environments create several simultaneous conditions including clear and important learning goals; support for student autonomy, competence, interest development, and self-efficacy; teacher monitoring/scaffolding; and feedback from multiple sources including students.

4.3. Implications for practice

Educators and researchers have focused on curriculum and assessment to a fuller extent than features of and forces in the learning environment that are proximally related to engagement and learning (Kelly, 2012). Identifying environmental dimensions that promote engagement is an important preventative measure to mitigate increasing distractions such as participation in social media that has been related to disengagement and lower grades (Junco, 2012), as well as larger level concerns about chronic disengagement and high school dropout.

The long-range goal of this research is to inform teacher professional development. Although educational psychologists have discovered many factors influencing student motivation, engagement, and learning, including a variety of both student and teacher perceptions, orientations, and beliefs (Dolezal et al., 2003), much of the knowledge amassed has little utility value to teachers, who might struggle to apply a variety of empirically-based principles to a class of 20 or more students even if they knew the principles well. The present research may be helpful to teachers by providing a conceptual frame that unifies the important function of these principles into the simultaneous presence of two comprehensive factors – environmental challenge and environmental support. That is, the various principles influencing student engagement can be seen as serving either a broad challenge function helping to guide student action through clear goal setting, or a broad support or resource function helping students reach these goals. The present study is also consistent with the research literature in suggesting the importance of the simultaneous presence of environmental challenge and environmental support, a proposition that should continue to be tested.

4.4. Implications for research

This study, while modest in terms of sample size, represents some important methodological advancements on which to build. Video footage contains a large amount of information allowing for the testing of numerous hypotheses. The combination of the ESM with video techniques can be an effective approach for accounting for the dynamic nature of the classroom and uncovering the relationships among student engagement, the learning environment, and potentially, a variety of instructional and student variables. Future research with larger sample sizes will be helpful to identify specific dimensions of the learning environment that are most salient for influencing engagement. We recognize that the relative salience of environmental factors depends on many student, teacher, and contextual factors including the subject, grade level, instructional format, and purpose. It will be important that the OLE-OLA be adapted to those more specific contexts. Equally important is the need for future research to examine the influence of person and environment characteristics and interactions.

For research moving forward, the high correlation between the composite and global scales of environmental complexity and its subscales suggests that global ratings from well-trained observers may be just as reliable as scales constructed from the multiple dimensions of the learning environment that take more time and effort to rate. If so, expert rater-observers may be able to use further developed versions of the OLE-OLA protocol to provide reliable and immediate feedback to teachers on the quality of the classroom learning environment without extensive statistical manipulation. Both further development and research on the OLE-OLA is needed, however.

4.5. Limitations

Readers should bear in mind several important limitations, including but not limited to those here identified. First, this is a correlational study, which severely limits inferences that can be made with respect to causality or directionality. Second, data from this study come from a small sample in terms of the number of classes, teachers, and instructional episodes observed, which can make parameters difficult to estimate with precision and small effects undetectable. Furthermore, this study was unable to tease out the relative contribution of within-classroom and between-classroom components of variation across instructional episodes. Increasing classroom sample size in future studies would allow the modeling of classrooms as its own level within multi-level models. Third, the use of school principal nominations and voluntary teacher participation for a classroom video study likely led to a response bias favoring relatively strong and confident teachers. Fourth, the inclusion of many school subjects increased the generalizability of findings across subjects, but at the same time may have introduced error variance by applying a more general rubric of the learning environment to specific subjects. Fifth, lack of significant ethnic/racial diversity in the sample limits the generalizability of findings to the population of U.S. high school students.

5. Conclusion

Designing learning environments to promote concentration, focus, enjoyment, interest, self-esteem, and intrinsic motivation is a worthy aspiration. In this study, we introduced a framework for conceptualizing learning environments that engage students in learning. The primary feature of optimal learning environments for promoting student engagement was *environmental complexity*, or the simultaneous presence of environmental challenge and support (Shernoff, 2013). Beyond their direct role in delivering educational content, shaping and creating supportive and challenging classroom environments may be a chief way that teachers can foster engagement in learning.

Acknowledgement

We thank Northern Illinois University, Deptartment of Leadership, Educational Psychology, and Foundations, for a Chair's grant to enable data collection.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.learninstruc.2015.12.003.

References

Akey, T. M. (2006). *School context, student attitudes and behavior, and academic achievement: An exploratory analysis*. New York, NY: MDRC. Retrieved from http://www.mdrc.org/publications/419/full.pdf.

Allodi, M. W. (2010). The meaning of social climate of learning environments: some reasons why we do not care enough about it. *Learning Environments Research, 13*(2), 89–104. http://dx.doi.org/10.1007/s10984-010-9072-9.

American Psychological Association. (1997). *Learner-centered psychological principles: A framework for school redesign and reform*. Retrieved from http://www.apa.org/ed/governance/bea/learner-centered.pdf.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. http://dx.doi.org/10.1037//0033-295X.84.2.191.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*(7), 513–531. http://dx.doi.org/10.1037//0003-066X.32.7.513.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32–42. http://dx.doi.org/10.3102/0013189X018001032.

Christenson, S. L., Reschly, A. L., & Wylie, C. (2012). *Handbook of research on student*

engagement. New York, NY: Springer.
Corno, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist, 18*(2), 88–108. http://dx.doi.org/10.1080/00461528309529266.
Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper Perennial.
Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York, NY: HarperCollins.
Csikszentmihalyi, M., Rathunde, K., & Whalen, S. (1993). *Talented teenagers: The roots of success and failure*. New York, NY: Cambridge University Press.
Csikszentmihalyi, M., & Schneider, B. (2000). *Becoming adult: How teenagers prepare for the world of work*. New York, NY: Basic Books.
Damon, W. (2008). *The path to purpose: How young people find their calling in life*. New York, NY: Free Press.
Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum.
Dickey, M. D. (2005). Engaging by design: how engagement strategies in popular computer and video games and inform instructional design. *Educational Technology Research and Development, 53*(2), 67–83. http://dx.doi.org/10.1007/BF02504866.
Dolezal, S. E., Welsh, L. M., Pressley, M., & Vincent, M. M. (2003). How nine third-grade teachers motivate student academic engagement. *Elementary School Journal, 103*(3), 239–267. http://dx.doi.org/10.1086/499725.
Fraser, B. J. (1998). Classroom environment instruments: development, validity and applications. *Learning Environments Research, 1*, 7–33.
Furlong, M. J., Gilman, R., & Huebner, E. S. (2014). *Handbook of positive psychology in schools* (2nd ed.). New York: Routledge.
Gardner, H. (1993). *Creating minds: An anatomy of creativity seen through the lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi*. New York, NY: Basic Books, Inc.
Goetez, T., Ludtke, O., Nett, U., Keller, M. M., & Lipnevich, A. A. (2013). Characteristics of teaching and students' emotions in the classroom: Investigating differences across domains. *Contemporary Educational Psychology, 38*(4), 383–394. http://dx.doi.org/10.1016/j.cedpsych.2013.08.001.
Goldin, G. A., Epstein, Y. E., Schorr, R. Y., & Warner, L. B. (2011). Beliefs and engagement structures: behind the affective dimension of mathematical learning. *ZDM Mathematics Education, 43*, 547–560. http://dx.doi.org/10.1007/s11858-011-0348-z.
Hektner, J. M., & Asakawa, K. (2001). Learning to like challenges. In M. Csikszentmihalyi, & B. Schneider (Eds.), *Becoming adult* (pp. 95–112). New York, NY: Basic Books.
Hektner, J. M., Schmidt, J. A., & Csikszentmihalyi, M. (2007). *Experience sampling method: Measuring the quality of everyday life*. Thousand Oaks, CA: Sage.
Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111–127. http://dx.doi.org/10.1207/s15326985ep4102_4.
Hughes, J. N., & Kwok, O. M. (2006). Classroom engagement mediates the effect of teacher-student support on elementary students' peer acceptance: a prospective analysis. *Journal of School Psychology, 43*(6), 465–480. http://dx.doi.org/10.1016/j.jsp.2005.10.001.
Junco, R. (2012). The relationship between frequency of facebook use, participation in facebook activities, and student engagement. *Computers & Education, 58*, 162–171.
Kelly, S. (2008). Race, social class, and student engagement in middle school English classrooms. *Social Science Research, 37*(2), 434–448. http://dx.doi.org/10.1016/j.ssresearch.2007.08.003.
Kelly, S. (2012). Understanding teacher effects: market versus process models of educational improvement. In S. Kelly (Ed.), *Assessing teacher quality: Understanding teacher effects on instruction and achievement* (pp. 7–32). New York: Teachers College Press.
Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*(2), 254–284. http://dx.doi.org/10.1037//0033-2909.119.2.254.
Ladd, G. W. (1999). Peer relationships and social competence during early and middle childhood. *Annual Review of Psychology, 50*(1), 333–359. http://dx.doi.org/10.1146/annurev.psych.50.1.333.
Larson, R. W. (2000). Toward a psychology of positive youth development. *American Psychologist, 55*(1), 170–183. http://dx.doi.org/10.1037/0003-066X.55.1.170.
Larson, S. C. (2011). *The effects of academic literacy instruction on engagement and conceptual understanding of biology in ninth grade students* (Unpublished doctoral dissertation). Aurora, IL: Aurora University.
Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, England: Cambridge University Press.
Meece, J. L. (1991). The classroom context and students' motivational goals. In M. L. Maehr, & P. R. Pintrich (Eds.), *Advances in motivation and achievement* (Vol. 7, pp. 261–285). Greenwich, CT: JAI Press.
Messick, S. (1998). Test validity: a matter of consequences. *Social Indicators Research, 45*(4), 35–44.
Meyer, D. K., & Smithenry, D. W. (2014). Scaffolding collective engagement. In D. J. Shernoff, & J. Bempechat (Eds.), *Engaging youth in schools: Evidence-based models to guide future innovations*. New York, NY: NSSE Yearbooks by Teachers College Record.
National Research Council. (1999). In J. D. Bransford, A. L. Brown, & R. R. Cocking (Eds.), *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
National Research Council. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Washington, DC: The National Academies Press.
National Research Council and Institute of Medicine of the National Academies. (2004). *Engaging schools: Fostering high school students' motivation to learn*. Washington DC: The National Academies Press.
Newmann, F. M. (1992). *Student engagement and achievement in American secondary schools*. New York, NY: Teachers College Press.
Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223–231. http://dx.doi.org/10.1002/j.2168-9830.2004.tb00809.x.
Reeve, J. (2006). Teachers as facilitators: what autonomy-supportive teachers do and why their students benefit. *Elementary School Journal, 106*(3), 225–236. http://dx.doi.org/10.1086/501484.
Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology, 98*(1), 209–218. http://dx.doi.org/10.1037/0022-0663.98.1.209.
Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion, 28*(2), 147–169. http://dx.doi.org/10.1023/B:MOEM.0000032312.95499.6f.
Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in a social context*. New York, NY: Oxford University Press.
Roorda, D. L., Koomen, H. M. Y., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher-student relationships on students' school engagement and achievement: a meta-analytic approach. *Review of Educational Research, 81*(4), 493–529. http://dx.doi.org/10.3102/0034654311421793.
Ryu, S., & Lombardi, D. (2015). Coding classroom interactions for collective and individual engagement. *Educational Psychologist, 50*, 70–83.
Sansone, C., & Harackiewicz, J. M. (2000). *Intrinsic and extrinsic motivation: The search for optimal motivation and performance*. San Diego, CA: Academic.
Schiefele, U. (2009). Situational and individual interest. In K. R. Wenzel, & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 197–222). New York, NY US: Routledge/Taylor & Francis Group.
Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: an introduction. *American Psychologist, 55*(1), 5–14. http://dx.doi.org/10.1037/0003-066X.55.1.5.
Shernoff, D. J. (2010a). *The experience of student engagement in high school classrooms: influences and effects on long-term outcomes*. Saarbrucken, Germany: Lambert Academic Publishing.
Shernoff, D. J. (2010b). Engagement in after-school programs as a predictor of social competence and academic performance. *American Journal of Community Psychology, 45*, 325–337.
Shernoff, D. J. (2013). *Optimal learning environments to promote student engagement*. New York: Springer.
Shernoff, D. J., Abdi, B., Anderson, B., & Csikszentmihalyi, M. (2014). Flow in schools revisited: cultivating engaged learners and optimal learning environments. In M. Furlong, R. Gilman, & S. Heubner (Eds.), *Handbook of positive psychology in the schools* (2nd ed, pp. 211–226). New York: Routledge, Taylor & Francis.
New York: NSSE Yearbook, National Society for the Study of Education. In Shernoff, D. J., & Bempechat, J. (Eds.). (2014), *Engaging youth in schools: Evidence-based models to guide future innovations, 113 (1)*. Columbia University. by Teachers College Record.
Shernoff, D. J., Csikszentmihalyi, M., Schneider, B., & Shernoff, E. S. (2003). Student engagement in high school classrooms from the perspective of flow theory. *School Psychology Quarterly, 18*, 158–176.
Shernoff, D. J., & Hoogstra, L. (2001). Continuing motivation beyond the high school classroom. *New Directions for Child and Adolescent Development, 93.*, 73–87.
Shernoff, D. J., & Schmidt, J. A. (2008). Further evidence of an engagement-achievement paradox among U.S. high school students. *Journal of Youth and Adolescence, 37*, 564–580.
Sirin, S. R., & Rogers-Sirin, L. (2004). Exploring school engagement of middle-class African American adolescents. *Youth & Society, 35*(3), 323–340. http://dx.doi.org/10.1177/0044118x03255006.
Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85*(4), 571–581. http://dx.doi.org/10.1037/0022-0663.85.4.571.
Tomlinson, C. A. (1999). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: Association for Supervision and Curriculum Development.
Urdan, T. C., & Turner, J. C. (2005). Competence motivation in the classroom. In A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 297–317). New York, NY: Guilford.
Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
Wang, M., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: a longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction, 28*, 12–23.
Wiggins, G. (1993). Assessment: authenticity, context, and validity. *Phi Delta Kappan, 75*(3), 200–214.
Wiggins, G., & McTighe, J. (2005). *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.
Zedan, R. (2010). New dimensions in the classroom climate. *Learning Environments Research, 13*(1), 75–88. http://dx.doi.org/10.1007/s10984-009-9068-5.
Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2009). Designs for collective cognitive responsibility in knowledge-building communities. *Journal of the Learning Sciences, 18*(1), 7–44. http://dx.doi.org/10.1080/10508400802581676.
Zirkel, S., Garcia, J. A., & Murphy, M. C. (2015). Experience sampling research methods and their potential for educational resaerch. *Educational Researcher, 44*(1), 7–16.