

Learner Engagement in Blended Learning Environments: A Conceptual Framework

Lisa R. Halverson and Charles R. Graham
Brigham Young University

Abstract

Learner engagement correlates with important educational outcomes, including academic achievement and satisfaction. Although research is already exploring learner engagement in blended contexts, no theoretical framework guides inquiry or practice, and little consistency or specificity exists in engagement definitions and operationalizations. Developing definitions, models, and measures of the factors that indicate learner engagement is important to establishing whether changes in instructional methods (facilitators) result in improved engagement (measured via indicators). This article reviews the existing literature on learner engagement and identifies constructs most relevant to learning in general and blended learning in particular. The authors present a possible conceptual framework for engagement that includes cognitive and emotional indicators, offering examples of research measuring these engagement indicators in technology-mediated learning contexts. The authors suggest future studies to test the framework, which they believe will support advances in blended learning engagement research that is increasingly real time, minimally intrusive, and maximally generalizable across subject matter contexts.

Keywords: learner engagement, cognitive engagement, emotional engagement, blended learning, theory

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Author Note

Lisa R. Halverson completed her doctoral work from and is an adjunct instructor for and Charles R. Graham is a Professor in the Department of Instructional Psychology & Technology at Brigham Young University.

Correspondence concerning this article should be addressed to Lisa R. Halverson, Department of Instructional Psychology & Technology, 150 MCKB - BYU, Provo, UT 84602. Contact: lisa.halverson@byu.edu.

Learner Engagement in Blended Learning Environments: A Conceptual Framework

Learner engagement, defined as the involvement of the student's cognitive and emotional energy to accomplish a learning task (Astin, 1984; Schunk & Mullen, 2012), has been found to correlate with important educational outcomes, including academic achievement, persistence, satisfaction, and sense of community (Conrad, 2010; Filak & Sheldon, 2008; Hughes, Luo, Kwok,

& Loyd, 2008; Kuh, Cruce, Shoup, Kinzie, Gonyea, & Gonyea, 2008; Ladd & Dinella, 2009; Wang & Degol, 2014). Such correlations have prompted scholars to refer to learner engagement as “an educational bottom line” (Coates, 2006, p. 36) and “the holy grail of learning” (Sinatra, Heddy, & Lombardi, 2015, p. 1). Yet many students are not engaged in their own education, resulting in high attrition and in low interest, motivation, and academic outcomes (Chapman, Laird, & Kewalramani, 2011; Rumberger & Rotermund, 2012).

As educators search for ways to increase learner engagement, some have hoped that blended learning—the thoughtful integration of face-to-face and online instruction—might more fully engage students in their learning (Aspden & Helm, 2004; Graham & Robison, 2007). No single framework exists for blended learning (something discussed hereafter), but certain affordances and characteristics exist. They may include increased flexibility and personalization due to diversified learning pathways (Horn & Staker, 2015); expanded opportunities for interactivity (face-to-face as well as online and synchronous as well as asynchronous; Means, Toyama, Murphy, & Baki, 2013); technical advantages (immediate feedback, online tracking data, etc.) but potential technical difficulties (Azevedo & Bernard, 1995; Picciano, 2014; Shute, 2008); preservation of the humanness and spontaneity in face-to-face instructional activities; and increased learning time and instructional resources (Means et al., 2013). Blended learning may support improved cognitive engagement through reflection and critical discourse (Garrison & Kanuka, 2004; Nystrand & Gamoran, 1991); agentic engagement (Reeve & Tseng, 2011) via added learning pathways; and emotional engagement through the face-to-face interactions in blended learning, though this idea needs further research. Nelson, Laird, and Kuh (2005) found a strong positive relationship between use of information technology for educational purposes and indicators of engagement, as per the National Survey of Student Engagement (NSSE).

Even though scholars and practitioners show interest in the potential of blended learning to increase learner engagement (Halverson, Graham, Spring, & Drysdale, 2012), few of the top-cited authors in blended learning are seriously addressing it in their research questions and problem statements (Halverson, Graham, Spring, Drysdale, & Henrie, 2014). Thus, more research is needed to understand learner engagement in blended contexts. This paper seeks to address this gap by offering a review of the research on learner engagement, proposing a set of indicators of engagement, and showing the importance of those indicators to engagement in blended settings.

Several hurdles to researching engagement in blended settings exist, including the dynamic and evolving conception of blended learning, the lack of definitional clarity about learner engagement, and the confusion between facilitators and indicators of engagement. The first obstacle is the nature of blended learning itself. At the most basic level, blended learning involves the combination of face-to-face and technology-mediated instruction (Graham, 2013). However, *blended learning* is a high-level term that is often defined in terms of its surface features (online and face-to-face) rather than its pedagogical features (Graham, Henrie, & Gibbons, 2014). Certain authors (Laumakis, Graham, & Dziuban, 2009; Norberg, Dziuban, & Moskal, 2011) have referred to the term as a boundary object, “plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites” (Star & Griesemer, 1989, p. 393). Some are frustrated by this lack of specificity, while others see a flexibility that allows actors “to tailor the concept to maximize its potential while being responsive to a new generation of students” (Moskal, Dziuban, & Hartman, 2012, p. 16). Accordingly, engaging and effective blending can involve countless possible combinations of human- and technology-mediated instruction—neither conceived nor implemented unilaterally. Research is

needed to clarify which blended designs most effectively increase learner engagement and thus student learning.

To measure changes in learner engagement, greater theoretical and definitional clarity is required. At present, no definition for learner engagement is universally accepted. Literature on the topic has been described as weakened by the “duplication of concepts and lack of differentiation in definitions” (Fredricks, Blumenfeld, & Paris, 2004, p. 65). If research on learner engagement is theoretically ambiguous, it is no surprise that learner engagement in blended settings is a theoretically undefined and untested domain. Henrie, Halverson, and Graham (2015) found little consistency or specificity in the definitions and operationalization of engagement in literature measuring engagement in technology-mediated learning.

A final challenge in researching engagement is the not infrequent confusion of *facilitators* and *indicators* of engagement. According to Skinner, Furrer, Marchand, and Kindermann (2008), “Indicators refer to the features that belong inside the construct of engagement proper, whereas facilitators are the causal factors (outside of the construct) that are hypothesized to influence engagement” (p. 766). Personal and contextual facilitators of engagement, including learner characteristics and thoughtful learning experience design, can increase the likelihood of learner engagement (see Figure 1). When blended learning advocates speak of best practices or optimal blends, they are proposing the contextual facilitators that will encourage engagement and thus student learning. But researchers cannot evaluate the effect of those proposed interventions until they have a clear set of engagement indicators to measure. Several existing instruments to measure engagement haphazardly conflate facilitators and indicators. For example, the recently revised NSSE lists 10 *engagement indicators*, but many (especially those in the Effective Teaching Practices category) assess practices that facilitate engagement, not the indicators that engagement is occurring.

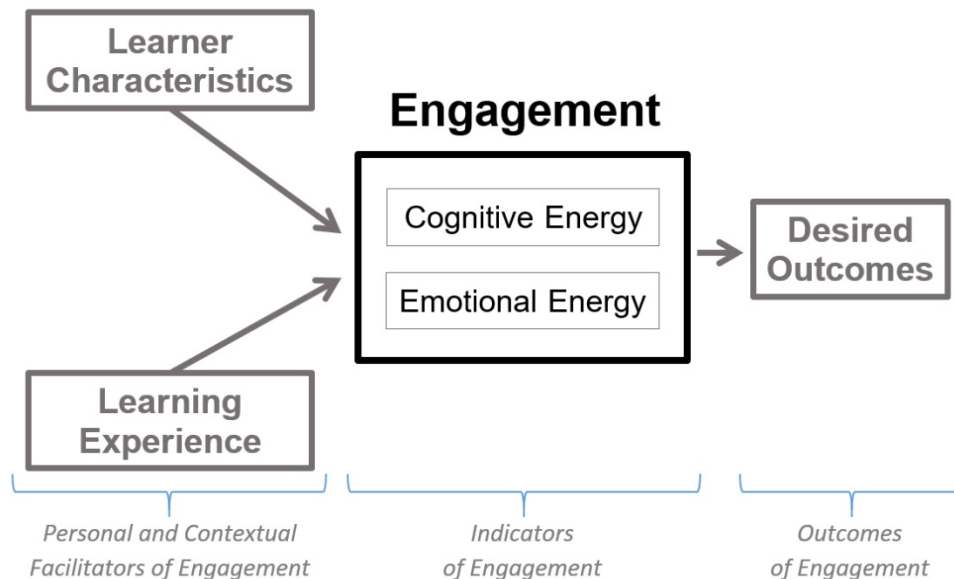


Figure 1. Relationship between *facilitators* (such as learner characteristics and learning experience), *indicators* of engagement, and learning outcomes.

The investigators reviewed the research on learner engagement from fields such as educational psychology, human development, and human–computer interaction. This paper proposes a cohesive list of engagement indicators that are applicable to the contexts of both face-to-face and technology-mediated instruction. Although factor analysis can be used to test the framework with empirical data (a process our research team has begun), this paper is not an empirical study but a conceptual one. Nor will this study attempt to enumerate all the facilitators of blended learning engagement. Research into facilitators is critical, but without clear indicators we cannot measure engagement and test the efficacy of blended interventions and designs to determine which facilitators most effectively improve engagement. By recommending a framework of engagement indicators, this study can assist future measurements of engagement.

Review of Literature

Overview

Terms like *learner engagement* or *student engagement* are used prolifically—even excessively—in educational research. Azevedo (2015) reported that a search in PsycINFO unearthed more than 32,000 articles about engagement from the previous 14 years. Standard keyword database searches for the term *engagement* turned up much that was irrelevant or too imprecisely used to guide theory and research.

Instead we propagated our review from core, grounded, and highly reputable citations, following Locke, Spirduso, and Silverman’s (2014) advice that “the writer’s task is to employ the research literature artfully to support and explain the choices made *for this study*” (p. 69, original emphasis). To give greater weight to studies committed to defining and conceptualizing learner engagement, as opposed to those just utilizing engagement as a popular buzzword, investigators first utilized Harzing’s Publish or Perish software program (2017), which retrieves and calculates academic citations from Google Scholar, to determine the most frequently cited works on engagement. With the highest average citations per year among publications relating to learner engagement, Fredricks, Blumenfeld, and Paris’s (2004) 51-page overview of school engagement was an appropriate place to start: It reviewed definitions, measures, facilitators, and outcomes of engagement; its appendix compiled 44 studies that used the term *engagement*, listing definitions, measures, methods, and key findings; its reference list held 165 citations. We looked up every study, instrument, and applicable reference. Another extensive resource was the recently published, 839-page *Handbook of Research on Student Engagement* (Christenson, Reschly, & Wylie, 2012): We reviewed the 39 chapters on learner engagement and explored the citation lists. Core figures in engagement research emerged, leading us to search for additional publications by key authors. References were added from Henrie, Halverson, and Graham (2015), who investigated how engagement has been measured in technology-mediated learning experiences and who performed a systematic database search using search terms to cover engagement, technology, measurement, and school context. Finally, we circled back to the 100 top-cited Publish or Perish results for *engagement*, *learner engagement*, and *student engagement* and reviewed the titles to ensure that no influential works on learner engagement had slipped from the collection. In this way the study eventually collected more than 1,000 articles, chapters, and instruments on engagement.

Literature was prioritized if it (1) included explicit definitions of learner engagement, (2) presented a theoretical framework for learner engagement, or (3) attempted to operationalize and measure learner engagement. With the eventual goal of measuring engagement, the researchers also

targeted research on indicators instead of facilitators of engagement. After the authors determined to focus on cognitive and emotional indicators (discussed in greater detail hereafter), special attention was paid to the subconstructs proposed in the various models and definitions of emotional and cognitive engagement. The investigators noticed that cognitive engagement and especially emotional engagement were being investigated in human–computer interaction research on cognition and emotion in learning with technology, but without the terminology common to more mainstream learner engagement research. In fact, few intersections were being made between mainstream learner engagement research and the field of human–computer interaction until Gobert, Baker, and Wixom (2015). With this realization, we enriched our thinking about emotional engagement by including human–computer interaction research on emotions during technology-mediated learning. We will present our findings on the models, definitions, and constructs in engagement research next.

Models and Definitions of Engagement

Christenson et al.’s (2012) expansive *Handbook of Research on Student Engagement* asked each contributor to consider the following: “What is your definition of engagement?” and “What overarching framework or theory do you use to study/explain engagement?” (p. vii). The diverse contributions showed, as Fredricks et al. (2004) had warned, that research still seeks a consensus on the definitions, frameworks, and constructs of engagement. The tome’s opening chapter (Reschly & Christenson, 2012) is titled “Jingle, Jangle, and Conceptual Haziness”: In psychology, *jingle* refers to the same term being used for different things, and *jangle* designates different terms being used for the same construct (see Kelly, 1927; Thorndike, 1913). Reschly and Christenson displayed a table comparing four prominent engagement models on key dimensions, such as number of types or subconstructs and definitions or indicators; we have compiled a similar but expanded table (Table 1). As these demonstrate, a plethora of constructs have been proposed for engagement research and theory.

Table 1
Comparisons of Prominent Engagement Models on Key Dimensions

Source	No. of types	Indicators of engagement
Appleton & colleagues ^a	4	<i>Academic</i> : Time on task, credit accrual, homework completion <i>Behavioral</i> : Attendance, in-class and extracurricular participation <i>Cognitive</i> : Value/relevance, self-regulation, goal setting, strategizing <i>Affective/psychological</i> : Belonging, identification, school membership
Bangert-Drowns & Pyke (2001)	7	<i>Disengagement</i> : Avoidance or premature discontinued use <i>Unsystematic engagement</i> : Unclear goals <i>Frustrated engagement</i> : Inability to accomplish goals <i>Structure-dependent engagement</i> : Pursuit of goals communicated by software <i>Self-regulated interest</i> : Creates personal goals, makes interesting to self <i>Critical engagement</i> : Tests personal understandings, limits of the software <i>Literate thinking</i> : Interprets software from multiple, personally meaningful perspectives
Finn (1989)	2	<i>Participation</i> : Task-oriented interaction, on-task behaviors, responding to requirements, expenditure of extra time on work <i>Identification</i> : Belonging and valuing success in school-relevant goals
Fredricks, Blumenfeld, Friedel, & Paris (2005)	3	<i>Behavioral</i> : Participation; positive conduct; involvement in academic, social, or extracurricular activities <i>Cognitive</i> : Investment, thoughtfulness, and willingness to exert effort <i>Emotional</i> : Appeal; affective reactions to teachers and classmates, academics and school (boredom, interest, anxiety, etc.); belonging; valuing

Table 1 (Continued)
Comparisons of Prominent Engagement Models on Key Dimensions

Source	No. of types	Indicators of engagement
Handelsman, Briggs, Sullivan, & Towler (2005)	4	<i>Skills engagement</i> : Skills practice, general learning strategies <i>Emotional engagement</i> : Emotional involvement with the class material <i>Participation/ interaction engagement</i> : Participation in class, interactions with instructors and classmates <i>Performance engagement</i> : Levels of performance in class, including confidence, performance goals, and extrinsic motivation
High School Survey of Student Engagement ^b	3	<i>Cognitive/intellectual/academic engagement</i> : “Engagement of the mind”—effort, investment in work, and strategies for learning <i>Emotional engagement</i> : “Engagement of the heart”—students’ feelings of connection to (or disconnection from) their school <i>Social/behavioral/participatory engagement</i> : “Engagement in life of the school”—actions, interactions, and participation within school community
Martin (2007)	4 higher order factors, 11 subconstructs	<i>Adaptive cognition</i> : Valuing, mastery orientation, self-efficacy <i>Adaptive behavior</i> : Persistence, planning, study management <i>Maladaptive behavior</i> : Disengagement, self-handicapping <i>Impeding/maladaptive cognition</i> : Uncertain control, failure avoidance, anxiety
Miller, Greene, Montalvo, Ravindran, & Nichols (1996)	1 higher order factor with 4 subconstructs	<i>Cognitive engagement</i> : Self-regulation, cognitive strategy use (deep vs. shallow), effort, and persistence
National Survey of Student Engagement ^c	4 “themes” with 10 “engagement indicators”	<i>Academic challenge</i> : Higher-order learning, reflective and integrative learning, learning strategies, quantitative reasoning <i>Learning with peers</i> : Collaborative learning, discussions with diverse others <i>Experiences with faculty</i> : Student–faculty interaction, effective teaching practices <i>Campus environment</i> : Quality of interactions, supportive environment
Pekrun & Linnenbrink-Garcia (2012)	1 + 5	<i>Emotional</i> : Considered the antecedent of other components of engagement <i>Cognitive</i> : Attention, memory processes <i>Motivational</i> : Intrinsic and extrinsic motivation, achievement goals <i>Behavioral</i> : Effort, persistence <i>Cognitive-behavioral</i> : Strategy use and self-regulation <i>Social-behavioral</i> : Social on-task behavior
Reeve & colleagues ^d	4	<i>Agentic</i> : Constructive contribution into flow of instruction <i>Behavioral</i> : Task involvement, effort, attention <i>Cognitive</i> : Metacognitive strategy use, self-regulation, personal application and relevance <i>Emotional</i> : Enjoyment, interest, curiosity
Skinner & colleagues ^e	4	<i>Engagement</i> <ul style="list-style-type: none"> • <i>Behavioral</i>: Action initiation, effort, hard work, persistence, intensity, attention, absorption, involvement • <i>Emotional</i>: Enthusiasm, interest, enjoyment, satisfaction, pride, vitality, zest <i>Disaffection</i> <ul style="list-style-type: none"> • <i>Behavioral</i>: Passivity, giving up, withdrawal, restlessness, inattentiveness, distraction, mental disengagement, burnout, lack of preparation • <i>Emotional</i>: Boredom, disinterest, frustration/anger, sadness, worry/anxiety, shame, self-blame

^a Appleton, Christenson, Kim, & Reschly (2006); Appleton (2012). ^b Yazzie-Mintz (2010). ^c McCormick, Gonyea, & Kinzie (2013). ^d Reeve & Tseng (2011); Reeve (2012); Reeve (2013). ^e Skinner, Kindermann, Connell, & Wellborn (2009); Skinner, Kindermann, & Furrer (2009); Skinner & Pitzer (2012).

Initially the investigators hoped to find an existing framework to modify and apply to the affordances of blended learning. Fredricks et al.'s (2004) comprehensive review of engagement has led many to adopt their tripartite model of emotional, cognitive, and behavioral engagement. However, overlapping elements for cognitive and behavioral engagement have been found in this and other models (Fredricks, Blumenfeld, Friedel, & Paris, 2005). Skinner and colleagues have been gathering data for their model of emotional and behavioral engagement and disaffection since the 1990s (e.g., Skinner & Belmont, 1993) and have some of the clearest explications of indicators versus facilitators of engagement. This combination of clarity and substance is enticing, but the absence of a cognitive measurement leaves vital aspects of learner engagement unexamined. Concentrating on blended or online learning engagement frameworks is not more productive. Bangert-Drowns and Pyke (2001) observed students in a blended setting, then proposed a seven-level taxonomy of engagement with educational software; however, no discussion of the blended nature of their engagement constructs was included. O'Brien and Toms (2008) created a list of engagement attributes to predict user-computer engagement, but conflated facilitators and indicators, as well as characteristics of the computer application and the participant (challenge, positive affect, endurance, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control). Redmond, Heffernan, Abawi, Brown, and Henderson (2018) have reviewed the literature and proposed an Online Engagement Framework for Higher Education, but in their list of 24 illustrative (though not exhaustive) indicators of engagement, only one indicator is online-specific ("upholding online learning norms"). Moreover, their discussion does little to situate their propositions in online or blended learning research. No comprehensive framework has been established to understand engagement in blended contexts.

Even if agreement had been reached on the overarching framework terminology, careful study of the construct descriptions revealed additional jingle and jangle. *Absorption* is considered by some to be an aspect of cognitive engagement, by others to be part of behavioral engagement. *Valuing* indicates emotional engagement in one framework and cognitive engagement in another (Christenson, Reschly, & Wylie, 2012; Fredricks et al., 2011). *Persistence* is a component of cognitive engagement for Miller, Greene, Montalvo, Ravindran, and Nichols (1996), but of behavioral engagement in the frameworks of Fredricks et al. (2004), Pekrun and Linnenbrink-Garcia (2012), and Skinner and colleagues. Henrie, Halverson, and Graham (2015) found particular conceptual fuzziness between cognitive engagement and behavioral engagement; some research stated the intent to measure cognitive engagement but operationalized the construct in ways other frameworks deemed behavioral.

This research found additional confusion when examining engagement definitions. Jimerson, Campos, and Greif (2003) examined 45 articles on engagement and found that 31 did not explicitly define terms. Other research skipped definitions and jumped straight to operationalization (see Table 1 in Appleton, Christenson, & Furlong, 2008). In the narrower context of technology-mediated learning, Henrie, Halverson, and Graham (2015) likewise found that the majority of articles reviewed did not clearly define engagement. They wrote, "The future success of research relating subconstructs of engagement to specific outcomes relies on consensus of definitions and measures of engagement" (p. 37). Findings from two studies on engagement may conflict simply because of differences in definition or construct conceptualization.

The investigators even temporarily bypassed theory, consulting operationalized instruments. To evaluate engagement in online college students, Sun and Rueda (2012) used Fredricks et al.'s (2005) K-12 classroom engagement scale. To measure engagement in game-based learning, Rowe,

Shores, Mott, Lester, and Carolina (2011) combined the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1998) and the Presence Questionnaire (Witmer & Singer, 1998). Coates (2007) applied the Student Engagement Questionnaire (SEQ) to online as well as more “general campus-based engagement” (p. 121) but narrowly limited online learning to the use of learning management systems. However, existing engagement instruments have numerous items that transfer poorly to blended contexts, requiring revalidation of any instrument adapted to blended learning, making this approach unsatisfactory as a method for developing a framework for engagement in blended contexts.

A focus on institutional-level engagement (Skinner & Pitzer, 2012) also limited the usefulness of several instruments including the SEQ, NSSE (Kuh, 2009; NSSE, 2014), and Student Engagement Instrument (Appleton, Christenson, Kim, & Reschly, 2006). Institutional engagement promotes retention and discourages dropout—vital educational goals. But improving blended learning design requires understanding when students are engaging with their learning and when they begin to disengage. To do this, “engagement should be measured at the same specificity level as the intervention” (Wang, Bergin, & Bergin, 2014, p. 518)—the course level and activity, or *microprocess level* (Ainley, 2012). Indeed, engagement at the institutional or school level is “a different reality than engagement in the classroom or, even more circumscribed, in learning activities. ... [T]here may be no necessary equivalence between engagement in school and engagement in specific learning activities” (Janosz, 2012, p. 698). Thus, models and scales that focus on the institutional level can tell us little about measuring engagement in specific blended learning courses and activities. If “engagement is fundamentally situational” (Kahu, 2013, p. 763) and “occurs during the actual experience of an activity or event” (Davis & McPartland, 2012, p. 516), we must understand how engagement fluctuates in varied face-to-face and online situations to improve the design of blended learning.

But merely collecting class- and activity-level case studies of learner engagement will not give us the “reasonably stable theory base ... [that] allows for a clear focus on important issues and provides sound (though still limited) guidance for the design of improved solutions to important problems” (Burkhardt & Schoenfeld, 2003, p. 6). A theoretical framework can guide research into learner engagement in settings that combine face-to-face with technology-mediated instruction. As Meyer (2014) noted regarding online learning,

It is not sufficient to rely on the research conducted in the pre-Internet era to claim that pursuing student engagement has an effect on positive outcomes of interest to institutions and students; instructors and designers involved in online learning must prove such an effect for online learning specifically. (p. 72)

Current engagement models and instruments are inadequate due to contextual affordances (course and activity level vs. institutional) and the conflation of constructs and subconstructs of engagement. A new framework, applicable to engagement in general but also suited to inform the creation of instruments to measure engagement in both face-to-face and technology-mediated contexts, is needed to guide research in blended learning settings.

Formation of the Blended Learning Engagement Framework

Janosz (2012) stated, “To develop new skills and acquire new knowledge, individuals must consciously mobilize and devote some of their physical and psychological (cognitive, emotional)

energy; they must *engage* themselves in the learning situation” (p. 695). Other research also acknowledges the primacy of emotional and cognitive engagement as the most fundamental expressions of learner engagement. Reschly and Christenson (2012) classified cognitive and affective engagement as internal processes that mediate and precede academic and behavioral engagement. Appleton et al. (2006) proposed moving beyond academic and behavioral indicators to focus on “the underlying cognitive and psychological needs of students” (p. 430). Research from human–computer interaction and educational data mining measure this energy by examining what they call “cognitive-affective states” (Baker, D’Mello, Rodrigo, & Graesser, 2010; D’Mello & Graesser, 2011). The literature suggests and the authors of this study concur that the most elemental indicators of engagement show whether learners are investing mental and emotional energy in the learning process.

In a domain that has sometimes and perhaps erroneously emphasized seat time over pedagogy in its definition of blending (Picciano, 2009), a focus on cognitive and emotional engagement reminds us that internal processes are paramount. Still some may be surprised that this framework will not include behavioral engagement as a key indicator. Henrie, Halverson, and Graham (2015), reviewing measures of student engagement in technology-mediated learning, found that 77% of the research measured behavioral indicators, while only 43% measured cognitive and 41% emotional indicators. Educational data mining techniques, for example, may measure online behaviors, such as click data, assignment submission, or time viewing videos (Kizilcec, Piech, & Schneider, 2013; Ramesh, Goldwater, Huang, Daum, & Getoor, 2013), hoping those behaviors imply emotional and cognitive engagement. Researchers may infer internal processes from external behaviors, and while those behaviors are not trivial, they still can be recognized as the outward displays of the mental and emotional energies that fuel learning.

Consequently, this study proposes that cognitive and emotional engagement are the key factors essential to understanding learner engagement. Engagement is manifest via cognitive and emotional *indicators* and contributes to desired *learning outcomes* (see Figure 1). Proceeding from the importance of cognitive and emotional engagement, this study will suggest the first-order factors that indicate cognitive and emotional engagement. These factors are those subconstructs which appeared most frequently throughout this review, were supported by the strongest argumentation and research (especially technology-mediated learning research), and worked together to form a cohesive framework that can be acceptably operationalized in blended, face-to-face, and technology-mediated contexts. In discussing each one, this study will offer some examples of why such indicators are important in and how such indicators have been measured in blended contexts.

Cognitive Engagement

Cognitive engagement—the expenditure and reception of mental energy—has long been the subject of theoretical debate (Pintrich & DeGroot, 1990; Zimmerman, 2002). This framework proposes that cognitive engagement is comprised of several first-order factors, some of which indicate the quantity of cognitive engagement, others the quality (see Figure 2).

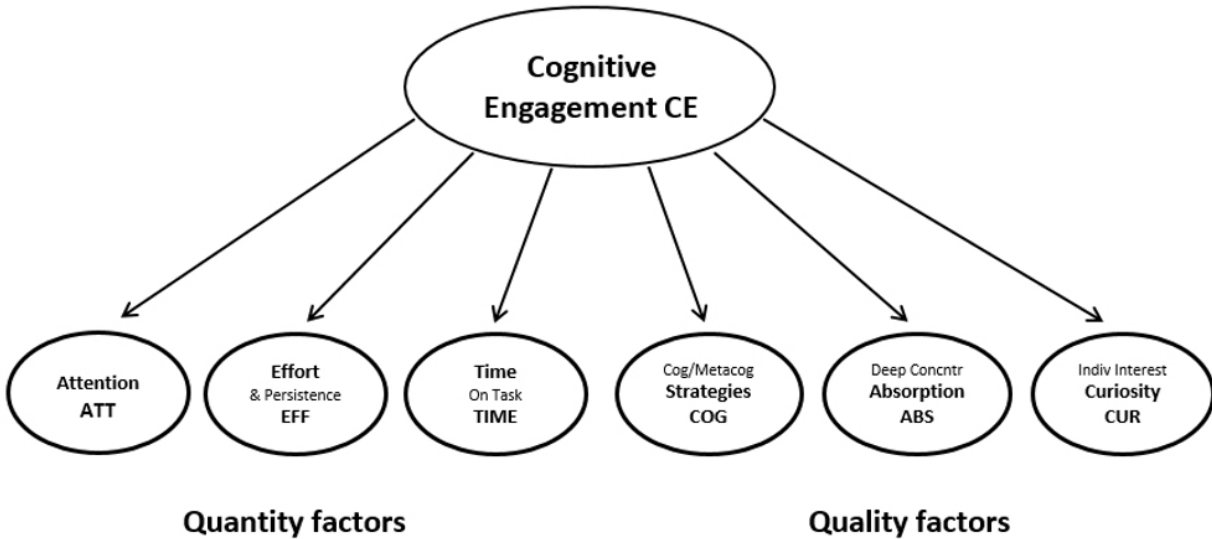


Figure 2. Cognitive Engagement Framework. Attention, effort and persistence, and time on task indicate the *quantity* of cognitive engagement, while cognitive strategy use, absorption, and curiosity indicate its *quality*.

Factors indicating quantity of cognitive engagement. The framework's first three factors include the more outwardly visible and quantifiable indicators that mental energy is being put toward learning: attention, effort and persistence, and time on task. In the literature, these variables were labeled *behavioral* in some frameworks and *cognitive* in others (Henrie, Halverson, & Graham, 2015). Pekrun and Linnenbrink-Garcia's (2012) model verbalizes the overlap: Cognitive, behavioral, and cognitive-behavioral are among their five types of engagement. While the variables incorporated here may include behaviors, this study suggests that they are behaviors reflecting the presence or absence of mental energy focused on learning. The authors hypothesize that subsequent empirical studies will find that these factors converge, together reflecting the expenditure and reception of mental energy.

Some consider *attention*, the allocation of limited perceptual and processing resources, the defining attribute of engagement (e.g., Cocea & Weibelzahl, 2011). Miller (2015), using self-paced reading and eye-tracking methodologies to measure engagement, called attention "the baseline of engagement" (p. 34). Keller's (1987, 2008) ARCS model of motivational design established attention as the first stepping-stone to other means of motivating learners (relevance, confidence, and satisfaction follow). Attention, a cognitive process (Calvo & D'Mello, 2010; Lehman, D'Mello, & Graesser, 2012), is included in Pekrun and Linnenbrink-Garcia's (2012) conceptualization of cognitive engagement. Attention is the gatekeeper for information processing (Atkinson & Shiffrin, 1968), one of the most basic indicators that learners are engaging mental effort in the learning process.

Some measure attention using classroom observation, but online aspects of a blended course may be at a distance, making such techniques impractical. Other methods for measuring attention during online instruction track eye movement (Boucheix, Lowe, Putri, & Groff, 2013; Miller, 2015; Toyama, Sonntag, Orlosky, & Kiyokawa, 2015), brainwaves (Sun, 2013), or gross body language (D'Mello et al., 2008). Already intelligent tutoring systems attempt to reengage students when they perceive waning attention (D'Mello et al., 2008), and as understanding of blended and online

learner engagement improves, data-rich systems will sense ebbing attention and provide real-time feedback to both learner and instructor (Bienkowski, Feng, & Means, 2012).

Effort and persistence and *time on task* are dimensions of cognitive engagement that manifest in outward behaviors but, more importantly, reflect expenditure of mental energy towards learning. The focus on cognitive engagement over behavior is apparent to any researcher who has tried to differentiate between time logged on a learning management system and actual time on task characterized by effort and persistence: As in face-to-face learning, time spent on task must be accompanied by cognitive effort and committed persistence to be truly effective. Miller et al. (1996) saw effort and persistence as variables that indicated cognitive engagement, and found both to be significantly related to academic achievement.

Persistence counteracts the likelihood of attrition, a factor which may be higher in online than in traditional settings (Carr, 2000; Diaz, 2002). In addition to course-level measures of persistence (often course completion), Tan, Sun, and Khoo (2014) employed activity-level measures of persistence. They used log data from the online ASSISTments Math Tutor program to map engagement levels to engagement indicators. “Persistency” was operationalized as revisiting and spending extra time on difficult tasks, using hints appropriately, and completing all tasks on time. Persistence occupied the fourth of five hierarchical levels, just lower than enthusiasm, in importance to learning.

The link between *time on task* (also called academic engaged time) and learning “is one of the most enduring and consistent findings in educational research” (Gettinger & Walters, 2012, p. 654). Consequently, some have labeled time on task as the single most influential factor in student success (Farragher & Yore, 1997) and the “most reflective of the degree of student engagement in classroom learning” (Kong, 2011, p. 1856). Nevertheless, in blended and online contexts, conceptualizing and measuring time on task can be complex. Beck (2004), studying learner interaction with computer tutors, considered time on task the most basic component of engagement, yet his model fit best when he incorporated question difficulty and response accuracy. Macfayden and Dawson (2010), mining log data to measure engagement in online courses, found that other measures of engagement—interaction with peers through discussion forums, number of optional self-test quizzes completed, and attention to administrative details—were more important than time online. Cocea and Weibelzahl (2011) also examined log data and found the most valuable factor for detecting disengagement to be the average time spent on content pages: Spending too little *or* too much time on a page could indicate disengagement.

Care must be taken if time-on-task data are drawn from diverse blended courses. Many blended courses replace seat time with online expectations (Picciano, 2009), but some instructors may consider the face-to-face activities an optional enhancement, not required work. In blended learning contexts, measuring time on task must account for policies of seat-time flexibility.

Factors indicating quality of cognitive engagement. Cognitive engagement also comprises factors indicating the *quality* of engagement—namely, cognitive and metacognitive strategy use, deep concentration or absorption, and individual interest or curiosity. These factors are supported by one of the most frequently employed theories in blended learning research (Halverson et al., 2012, 2014), Garrison, Anderson, and Archer’s (2001) Community of Inquiry framework. The framework proposes that the requirements for effective online educational transaction include cognitive presence, which is further broken down into triggering events (which

pique curiosity), exploration, integration (cognitive strategies applied to solidify understanding), and resolution.

Many existing descriptions of cognitive engagement focus either on effort and persistence or on *cognitive and metacognitive strategies*, which include strategies used to learn more successfully and processes to “actively engage in thinking about [one’s] learning” (Winne & Baker, 2013, p. 3). Because he found that metacognitive strategies cross-loaded with behavioral engagement (Reeve & Tseng, 2011), Reeve (2012, 2013) stated that cognitive learning strategies were the better indicators of cognitive engagement. Reeve’s finding confirms the previously mentioned conceptual fuzziness that Henrie, Halverson, and Graham (2015) found between cognitive and behavioral engagement and provides additional support for interpreting behavioral engagement as an outward manifestation of the more fundamental constructs of cognitive engagement (and sometimes emotional engagement).

In blended and online contexts, cognitive and metacognitive strategy use and the closely correlated ability of self-regulation (Pintrich & DeGroot, 1990; Sun & Rueda, 2012) are particularly important. Meyer (2014) wrote, “Learning self-regulation is especially important in online learning [where being successful] ... depends upon the student’s discipline, self-direction, and ability to remain motivated” (p. 24). Hypermedia use, a feature common in blended and online instruction, “greatly increases task demands and requires the learner to stretch limited processing resources across two major constraints: to-be-learned information and the hypermedia environment” (Schraw, 2010, p. 258). Fortunately, online tasks also provide new ways to measure cognitive and metacognitive strategy use and self-regulation: Winne and Baker (2013) proposed using educational data mining techniques to produce real-time data about these factors and the learning process “as it unfolds” (p. 1).

Another first-order factor that indicates the quality of mental energy in learning is *deep concentration or absorption*. Early conceptualizations defined absorption as a trait or disposition (Tellegen & Atkinson, 1974), but later research distinguished ways in which absorption functions as a state to which individual or situational factors lead (Agarwal & Karahanna, 2000). Absorption may express a deep level of attention (Keller, 2008) but is qualitatively different: “paying attention” may be associated with coercion, whereas absorption is a “state in which people are so involved in an activity that nothing else seems to matter” (Csikszentmihalyi, 1990, p. 4). Csikszentmihalyi’s theory of flow describes “states of intense concentration or absolute absorption in an activity” (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003, p. 161) accompanied by a sense of control, exhilaration, and deep happiness; in such cases mental energy is not only being expended but also created. Researchers have applied the flow theory to human–computer interaction studies (Agarwal & Karahanna, 2000; Hoffman & Novak, 1996). For example, Ghani and Deshpande (1994) evaluated enjoyment and total absorption while studying computer use in the workplace. Esteban-Millat, Martínez-López, Huertas-García, Meseguer, and Rodríguez-Ardura (2014) proposed a model of flow in online learning environments and found that focused attention (similar to our conception of absorption) was one of the two most important direct determinants of a state of flow.

Our final first-order variable of cognitive engagement, *individual interest or curiosity*, must be distinguished from the short-lived emotional experience of situational interest (Ainley, 2012). The latter “refers to enjoyment of external stimuli, such as an entertaining lecture or catchy story” (Senko & Miles, 2008, p. 567); we propose that situational interest and enjoyment are part of positive emotional engagement, to be discussed shortly. When the learner perceives the material to

be personally relevant, “situational interest may develop into individual interest, which is characterized by curiosity and self-guided exploration” (p. 567; see also Dewey, 1910). Interest research portrays cognitive and affective components as co-occurring (Hidi & Renninger, 2006; Renninger & Bachrach, 2015) but prioritizes emotion in triggering situational interest, whereas cognitive processes, such as stored learning and curiosity, have primacy in individual interest. *Cognitive curiosity* (Reio, Petrosko, Wiswell, & Thongsukmag, 2006)—also termed *scientific* (James, 1890/1950), *epistemic* (Berlyne, 1978), or *intellectual curiosity* (Dewey, 1910)—is a “deeper level of attention” stimulated by the learner’s sense of inquiry (Keller, 2008, p. 177). Berlyne (1978) posited that curiosity, resulting from subjective uncertainty, may generate “exploratory behavior aimed at resolving or partially mitigating the uncertainty” (p. 98). This exploration is one way that mental energy is expended in learning.

Some have argued that computer use can abet curiosity as the learner explores, experiments, and browses (Ghani & Deshpande, 1994), though such behaviors, if labeled *surfing the Web* may be discouraged in educational contexts. Meta-analysis showed curiosity among the discrete cognitive–affective states frequently present in technology-mediated learning (D’Mello, 2013); the analyzed studies demonstrate innovative ways to measure curiosity, such as using multichannel physiological signals to gauge learner reactions to intelligent tutoring systems (Pour, Hussein, AlZoubi, D’Mello, & Calvo, 2010; Hussein, AlZoubi, Calvo, & D’Mello, 2011) or prompting frequent self-reports via smartphone in game-based learning environments (Sabourin, Mott, & Lester, 2011). Technology-pervasive learning environments may also alter how curiosity is expressed and sustained (Arnone, Small, Chauncey, & McKenna, 2011).

The affordances of blended learning have the potential to encourage cognitive engagement, an energy indicated by attention, effort and persistence, time on task, cognitive strategy use, absorption, and curiosity. Blended learning may diversify the learning pathways available to accomplish a task; this increased flexibility and personalization abets curiosity, absorption, and attention (Esteban-Millat et al., 2014). At the same time, personalization and flexibility may require learners to employ greater effort and cognitive strategy use. When time on task is accompanied by effort (even absorption), deep learning occurs. At the same time, blended learning preserves the benefits of humanness (Graham, 2006), which encourage cognitive engagement while mediating the varied emotions that inevitably arise during learning.

Emotional Engagement

Picard, who researches technologies that can respond intelligently to human emotion (“affective computing”), has noted the increase in “findings in multiple disciplines supporting a view of affect as complexly intertwined with cognition in guiding rational behaviour, memory retrieval, decision-making, creativity, and more” (Picard et al., 2004, p. 253). Pekrun (2011) argued that emotions influence “a broad variety of cognitive processes that contribute to learning, such as perception, attention, memory, decision making, and cognitive problem solving” (p. 26), and Skinner and Pitzer (2012) labeled emotion “the fuel for the kind of behavioral and cognitive engagement that leads to high-quality learning” (p. 33). Human–computer interaction research on cognitive-affective states (Baker et al., 2010; D’Mello & Graesser, 2011) further acknowledges the intertwining of mental and emotional energy.

Even as consensus coalesces around the importance of emotions in learning, the emotions to be studied—particularly in technology-mediated learning—are still up for debate. According to Picard et al. (2004), “There is still very little understanding as to which emotions are most important

in learning, and how they influence learning. To date there is no comprehensive, empirically validated, theory of emotion that addresses learning” (p. 255; see also Lopatovska & Arapakis, 2011). Research from the fields of human–computer interaction, artificial intelligence, and computer science has found that the prominent emotions occurring during complex learning with technology are different from Ekman’s (1992) basic universal emotions: anger, disgust, fear, joy, sadness, and surprise (Graesser & D’Mello, 2011). D’Mello (2013) performed a meta-analysis tracking 17 affective states across 24 studies; he found the discrete states most frequent in technology-mediated learning to be boredom, engagement/flow, confusion, curiosity, happiness, and frustration. This framework includes five of these cognitive–affective states in our emotional engagement constructs, considering curiosity part of cognitive engagement.

In this framework the above-mentioned affective states are combined with the work of Skinner and colleagues (e.g., Skinner et al., 2008; Skinner, Kindermann, & Furrer, 2009), who divided emotional engagement into two constructs: emotional engagement and emotional disaffection; Wang, Chow, Hofkens, and Salmela-Aro (2015) similarly argued that positive and negative emotional engagement are conceptually and methodologically unique. Here the comparable constructs are called *positive emotional engagement* (POS) and *negative emotional engagement* (NEG; see Figure 3).

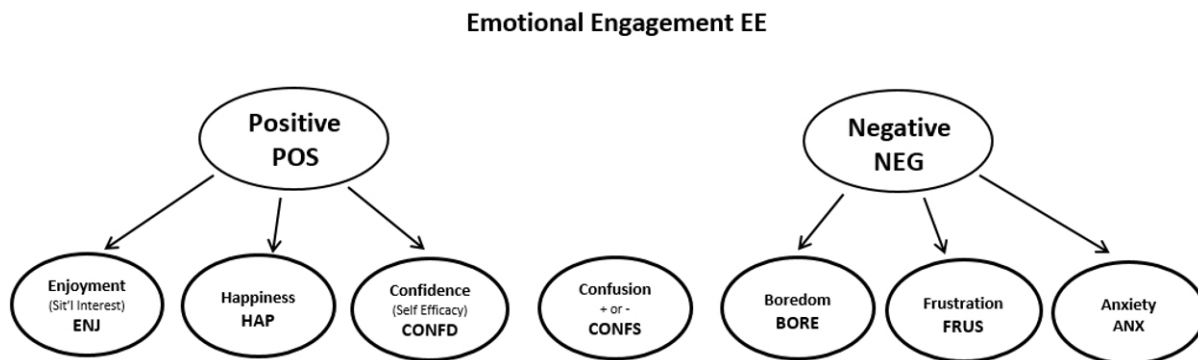


Figure 3. Emotional Engagement Frameworks (Positive and Negative). The factor of confusion is unattached for now, for confusion affects engagement and learning differently depending on contextual details.

Positive emotional engagement. Research has noted how positive emotions assist learning by broadening the scope of action, attention, and cognition, and by helping learners “to see relatedness and interconnections ... and to process material in a more integrated and flexible fashion” (Fredrickson, 1998, p. 308; see also Hazlett & Benedek, 2007). This framework further proposes that particular emotions indicate learner engagement. Skinner and colleagues do not differentiate the positive aspects of emotional engagement but focus primarily on interest or enjoyment. Representative items from their scale include “Class is fun” and “When we work on something in class, I feel interested” (Skinner et al., 2008, p. 781). Despite Patrick, Skinner, and Connell’s (1993) finding that various positive emotional items were accounted for by a single factor ($\alpha = .88$), this study suggests that additional positive emotions described in other research may indicate the expenditure and reception of emotional energy in the learning process. This framework proposes that POS includes not only the first-order factor of situational interest (Senko & Miles,

2008) or enjoyment (Skinner et al., 2008) but also happiness (D’Mello, 2013) and confidence (Arroyo et al. 2009; Keller, 2008). These subconstructs are explained below.

As stated, many conceptualizations of emotional engagement focus on *enjoyment or situational interest* (Milne & Otiemo, 2007; Furlong et al., 2003). Situational interest, or enjoyment created by external stimuli (Hidi, 1990; Senko & Miles, 2008), is a short-lived affective state that indicates emotional energy expended and created by learning efforts. Though short-lived, this interest focuses attention, enhances cognitive performance and learning, and improves integration (Hidi & Renninger, 2006). For Ainley (2012), interest functions as a “hook”: A learning activity that sparks interest easily engages students, and the learning process begins. For most instruments that we investigated, enjoyment and interest were central components of positive emotional engagement.

These factors matter in blended and online learning. Tempelaar, Niculescu, Rienties, Gijsselaers, and Giesbers (2012) found significant correlations between students’ engagement in the online component of blended learning and their self-reported levels of enjoyment. Although they reported no clear correlation between face-to-face engagement and achievement emotions (enjoyment, boredom, anxiety, and hopelessness), the proxy measure they employed to estimate face-to-face engagement was the number of clicks in the learning management system, a questionable substitute for the fidelity, synchronicity, and humanness available in face-to-face settings (Graham, 2006).

Happiness research abounds with various definitions of the constructs. Some define happiness as a relatively stable feeling towards life, noting its association with better social and marital relationships, longevity, higher income, and lower unemployment (Oishi, Diener, & Lucas, 2007). As an indicator of engagement, however, we are interested in happiness more as a momentary state expressing engagement in a learning task. This state of happiness is similar to the mild joy and contentment that Fredrickson (2001) found to be associated with increased creativity and cognitive performance.

In technology-mediated learning research, this state of happiness has been examined (D’Mello, Lehman, & Persons, 2010; Lehman, D’Mello, & Persons, 2008) and found among the more frequent affective states experienced by learners when interacting with technology (D’Mello, 2013). As an indicator of engagement, we expect happiness to occur after engagement-facilitating experiences, such as receiving positive feedback, attaining learning goals, and resolving confusion or other impasses (D’Mello, 2013; Lehman et al., 2008; Stein & Levine, 1991). D’Mello et al. (2010) found that when students using an intelligent tutoring system reacted with happiness to feedback on one problem, their performance improved on subsequent problems. This suggests that, as Figure 1 indicates, learners’ POS improved their learning outcomes. Some have argued that engagement (along with pleasure and meaning) can be a key pathway to happiness; thus, happiness may result from and indicate an engaged state (Parks, Schueller, & Tasimi, 2013; Seligman, Ernst, Gillham, Reivich, & Linkins, 2009). Future research could investigate such pathways with increasingly fine-grained and real-time tools to recognize expressions of happiness, including facial action coding, posture, and eye tracking (D’Mello & Graesser, 2012; D’Mello et al., 2010).

Confidence, or self-assurance in one’s abilities or qualities, is proposed as a third dimension of POS. Confidence provides a clear contrast to the NEG factor (suggested by Skinner and colleagues) of anxiety (Kort, Riley, & Picard, 2001); research indicates an inverse relationship between the two (Pajares, 1996; Shea & Bidjerano, 2010). It is possible that confidence may double

as both an indicator and a facilitator of engagement. Confidence may precede and facilitate engagement: Students are more likely to exert effort in academic tasks if they believe they have the capacity to succeed (Greene, 2015; Milligan, Littlejohn, & Margaryan, 2013). But confidence may also indicate engagement: Self-reports of confidence “depen[d] on events that occurred in [solving] the previous problem and not on [learners’] incoming beliefs” (Arroyo et al., 2009, p. 19). Thus, subsequent testing of this model might frame items to measure not only learners’ general confidence in a course but their confidence during or immediately after particular learning activities. Arroyo et al. (2009) used physiological sensors and frequent self-reports to create models of confidence (plus frustration, excitement, and interest) for students interacting with an intelligent tutoring system to learn math. One kind of confidence—belief in one’s ability to work with computers (called *computer self-efficacy* or *technical confidence* [Conrad & Kanuka, 1999])—may be of particular relevance in blended and online learning, where confidence in one’s technical abilities might facilitate or reflect engagement during technology-mediated activities.

Negative emotional engagement. Skinner and colleagues found emotional disengagement to be a multidimensional construct consisting of *enervated emotion* (tiredness, sadness, boredom), *alienated emotion* (frustration, anger), and *pressured participation* (anxiety; see Skinner, Kindermann, & Furrer, 2009); D’Mello (2013) noted that frustration and boredom are critical in learning with technology. We propose that NEG is comprised of three first-order factors: boredom, frustration, and anxiety. This is a narrower configuration than Skinner and colleagues employ. The emotions they group as enervated emotion—sadness, tiredness, and boredom—are considered discrete emotions by other researchers (Russell, 2003; Segura & Gonzalez-Roma, 2003). In research evaluating cognitive-affective states during technology-mediated learning, the unit of analysis is usually the discrete emotion (boredom, not enervated emotion). This study will employ the narrower unit so that this framework may be applicable to such methodologies.

Baker et al. (2010) defined *boredom* as weariness or restlessness due to lack of interest. Skinner, Kindermann, Connell, and Wellborn (2009) called boredom “a sufficient condition for lack of effortful involvement” (p. 226). Such weariness and lack of involvement indicate the absence of emotional energy towards learning. Boredom may threaten cognitive engagement “by reducing cognitive resources, undermining both intrinsic and extrinsic motivation, and promoting superficial information processing” (Pekrun, 2011, p. 31).

Baker et al. (2010) found that boredom occurred during approximately 5% of the times examined as students interacted with computer-based learning environments. Though infrequent, once boredom settled in, it was an especially persistent affective state that could “reduce learning more than other cognitive–affective states by leading students to engage in gaming behaviors which are associated with poorer learning” (p. 236). Researching intelligent tutoring systems, Lehman et al. (2008) labeled boredom “the least productive state” (n.p.); frustration and confusion at least indicated investment in the learning process. In his meta-analysis of the affective states experienced in technology-mediated learning environments, D’Mello (2013) found that boredom and frustration were more likely in laboratory studies with simple computer interfaces, while engagement was more frequent in authentic learning contexts using advanced learning technologies (such as intelligent tutoring systems, animations and simulations, and immersive educational games) with enhanced interactivity and human-like communication capabilities. Thus, preserving interaction and humanness may increase engagement and decrease boredom and frustration.

Skinner, Kindermann, and Furrer (2009) grouped frustration and anger under the heading of *alienated emotion*, whereas Pekrun and Linnenbrink-Garcia (2012) combined these two as

negative activating emotions. This framework will focus on *frustration*, the more common of the two during learning with technology (D’Mello, 2013) and situate it as another first-order factor in NEG. When Dennerlein, Becker, Johnson, Reynolds, and Picard (2003) frustrated computer users (through poor software usability), they found increased physical risk associated with musculoskeletal and cardiovascular disorders. Baker et al. (2010) noted that frustration “may lead students to use (or fail to use) learning environments in ways that reduce their learning” (p. 231). Even so, they acknowledged that frustration (and confusion—see below) “may be a natural and unavoidable part of the experience of learning when difficult material is encountered . . . a byproduct of positive learning experiences” (p. 235). They found that frustration and confusion rarely led to gaming the system at levels caused by boredom, even titling an article “Better to Be Frustrated Than Bored.”

Anxiety is the last first-order factor in the proposed NEG construct. Pekrun (2011) explained that any emotion could deplete cognitive resources, but the “resource consumption effect” was particularly bound to emotions such as anxiety “that have task-extraneous objects and produce task-irrelevant thinking” (p. 27). Pekrun noted that on simple tasks anxiety may not affect or may even enhance performance, but on complex or difficult tasks that demand cognitive resources, learning is impaired (see p. 30). Thus, anxiety may be most deleterious to emotional and cognitive energy reserves in complex learning contexts.

Regardless of the complexity of the learning task, some students may find nontraditional settings like blended or online instruction to produce anxiety. Conrad (2010) described adult learners beginning a completely online course: “Their anxiety level is universally high, even among those who have already completed many online courses” (p. 220); without a face-to-face component, “it is hard to demonstrate empathy without a facial nod or smile. Words alone, which are all online educators have at their fingertips, often fail to convey a deep sense of humanness” (p. 214). In contrast, face-to-face social connectedness strengthens the human vagus nerve, which counteracts stress responses to situations of anxiety (Bergland, 2017). Consequently, the face-to-face component in blended learning may reduce not only physical isolation but also psychological isolation (Bollinger & Inan, 2012), helping to reduce anxiety.

Researchers have debated whether *confusion*, a “noticeable lack of understanding” (Baker et al., 2010, p. 231), is a cognitive state, an emotion, or even an affective state that is not an emotion (D’Mello, Lehman, Pekrun, & Graesser, 2014). Confusion arises with cognitive disequilibrium, when incoming information does not seem to align with existing knowledge structures (Graesser, Lu, Olde, Cooper-Pye, & Whitten, 2005). This can be productive to learning, as D’Mello et al. (2014) noted: When “there is a discrepancy in the information stream and the discrepancy is identified and corrected . . . , one important form of deep learning occurs” (p. 155). D’Mello’s meta-analysis (2013) found confusion the second most frequent emotion (of 17) among students interacting with learning technologies, giving it a critical role in learner engagement. Thus far, researchers have found varied effects depending on contextual details. When accompanied by enjoyment, curiosity, or confidence, confusion spurs engagement and learning; when combined with boredom or frustration, it correlates with disengagement and lower learning outcomes (Baker et al., 2010; D’Mello et al., 2014). Future research can investigate the interplay of confusion with other first-order factors, such as frustration, boredom, and interest, and whether confusion aligns more with POS or NEG.

Emotional engagement is indispensable to the learning process, a “fuel” (Skinner & Pitzer, 2012, p. 33) for high-quality learning and the “antecedent of other components of engagement”

(Pekrun & Linnenbrick-Garcia, 2012, p. 260). The importance of emotion to cognition and learning is conveyed by findings that human tutors spend at least as much time dealing with affective and motivational goals as they do with cognitive and informational challenges (Lepper, Woolverton, Mumme, & Gurtner, 1993). The ability to deal with the emotions that arise during learning may help explain why human tutors are “unrivaled in their ability to promote deep and lasting learning” (Paul, 2014). Human actors are more adept at managing emotional engagement than are computers, but that does not mean that technology-mediated resources are not sufficient or even more expeditious to learning in certain situations. In blended learning environments, where the decisions to blend human- and technology-mediated instruction must consider the effect upon learner engagement, instructional designers need to understand when human–human interaction is necessary to maintain emotional engagement and when technology-mediated resources are desirable.

Research can investigate how the affordances of blended learning impact emotional engagement. Blended learning’s additional channels for interactivity—with asynchronous online discussions increasing flexibility and opportunity for reflection, and in-class interactions promoting spontaneity and human connection (Graham, 2006)—might result in “absolutely richer interaction” (Gedik, Kiraz, & Ozden, 2012, p. 108). Improved personalization could increase interest and confidence while curtailing boredom, frustration, or anxiety. Immediate feedback from online tools could lessen confusion, frustration, and anxiety. On the other hand, blended learning may introduce barriers, such as increased workload or technical difficulties (Gedik et al., 2012), which increase frustration, anxiety, and confusion.

Conclusion

This paper began by mentioning three challenges to researching learner engagement in blended settings. The dynamic nature of blended learning and the diverse ways of combining human- and technology-mediated instruction make the ability to measure engagement under different conditions all the more important. To do this, we need greater clarity about the definitions and constructs of engagement. This paper has critically reviewed models, definitions, and constructs of learner engagement and suggested factors for a conceptual framework grounded in existing engagement literature and contextualized for blended settings. We have tried to maintain the distinction between indicators and facilitators, for “research and intervention efforts require a clear demarcation between these two” (Skinner et al., 2008, p. 766).

Researchers have some knowledge (and need more) about factors with potential to facilitate blended learning engagement, and one limitation of this study is our focus on indicators but not facilitators. We have chosen to first establish what indicates engagement so that subsequent research can measure the impact various facilitators have upon these indicators. We hope that future research will test both the strength of this framework and the impact of various blended learning designs on facilitating engagement. In addition, here we have proposed the same indicators for engagement in face-to-face and online contexts, but this assumption must be tested: Does engagement manifest itself differently in face-to-face settings than in online settings? We suggest factor analysis research to determine whether, for example, face-to-face curiosity and online curiosity are comparable in factor loadings and estimated intercepts, or whether they are unique constructs. Factor analysis could also provide evidence for or against our proposition that indicators

labeled as behavioral elsewhere are actually outward manifestations of cognitive or emotional engagement.

At the same time, when examining blended learning engagement, researchers must think beyond the physical attributes of face-to-face and online instruction, for psychosocial relationships are core to blended learning research and design (Graham, 2013). Instructors, designers, and researchers need to better understand how engagement indicators are affected by human and by machine interaction. In the first fMRI study to compare brain responses to live interactions versus prerecorded ones, Redcay et al. (2010) found that live interaction sparked greater activity in brain regions associated with attention. What might be seen if researchers could likewise examine brain activity in regions associated with curiosity, enjoyment, or anxiety? Is face-to-face human interaction the gold standard (as often accepted) in encouraging learner engagement? Or are some engagement indicators equally propelled by technology-mediated human interaction or even by machine interaction, with its affordance of near-instant feedback in certain situations?

To answer such questions, research is needed not only at the completion of a blended course but throughout the course at the activity level. In future studies the authors' research team will use an end-of-course survey to operationalize and test this framework but will also compare the results to log data and experience-sampling surveys collected biweekly in blended courses. Possibly, engagement indicators function differently at the activity and course levels: Confusion noted in real time might be an indicator of focused engagement (D'Mello et al., 2014), but confusion recalled later (e.g., in an end-of-course survey) might indicate residual frustration and anxiety. By examining activity- and course-level engagement, we can study relationships between human- and machine-driven intervention strategies, learning pathways, and engagement (D'Mello & Graesser, 2012).

Blended contexts expand the methods for collecting data to measure engagement (Henrie, Halverson, & Graham, 2015), and this study has referenced many ways of collecting data on various engagement indicators. Due to both the complex nature of engagement and the differences inherent to measuring it in multiple contexts, research on engagement in blended settings will often require mixed methods for collecting data. Research on blended learning engagement ought to be increasingly real time, minimally intrusive, and maximally generalizable across various subject matter contexts. Yet these aims sometimes conflict with one another or with the need for scalability. Experience-sampling methods ask learners to report on both internal (thoughts, feelings, mood) and external (date, time, location, companions, activities) dimensions of specific experiences (Fleeson, 2007; Hektner, Schmidt, & Csikszentmihalyi, 2007); this method produces considerable quantitative and qualitative data but is fairly obtrusive. Collecting machine-generated log data is unobtrusive, but interpretability regarding cognitive and emotional engagement is questionable (Henry, Bodily, Larsen, & Graham, 2017). Advances in blended learning engagement research will, we hope, increasingly address these challenges.

This paper reviews current challenges in engagement research as well as core constructs important in understanding learner engagement, particularly in blended contexts. Finding much confusion in the domain, we offer a clear definition and conceptualization of learner engagement and then suggest factors that might indicate that engagement. These indicators include the cognitive and emotional energies (cognitive and emotional engagement) present when learners are engaged. Cognitive and emotional engagement are broken down into subconstructs that our review has suggested are key aspects of engagement in blended settings. Cognitive engagement, we propose, is indicated in attention, effort and persistence, time on task, cognitive and metacognitive strategy

use, absorption, and curiosity; emotional engagement through interest, happiness, confidence, and the absence of boredom, frustration, and anxiety. We encourage subjecting these factors to empirical testing using factor analysis and structural equation modeling. After being empirically tested, this framework may add conceptual clarity and direction for future research. At a time when learner engagement is considered “the holy grail of learning” (Sinatra et al., 2015, p. 1) and interventions are touted for their ability to improve engagement, this is a starting point with the potential to further our understanding of engagement in blended settings.

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