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An Exploration of Learning Environmental Factors Affecting Student Cognitive Engagement: Implications for Instructional Design Research

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As it was argued that students' cognitive engagement can be, at least in part, modified by individual or learning environmental factors, prior studies have attempted to identify the factors explaining the variability of students' cognitive engagement. This literature review has shown that students' cognitive engagement can be altered by various elements in the learning environment design such as factors related students' perceptions of teaching quality, characteristics of tasks and learning activities, teachers' behaviors during instruction, classroom goal structures, the integration of student oriented learning, action learning, problem-based learning, and constructivist learning, and academic disciplines. Based on the review, this study suggests that more studies are required to focus on understandings how the integration of instructional design principles into courses and the levels of student cognitive engagement in these courses are related. Also, an investigation of direct and indirect effect of learning environments taking into account students' personal factors would provide a more accurate picture of the relationship between learning environmental factors and students' cognitive engagement.

Keywords : Student engagement, Cognitive engagement, Learning environmental factors, Instructional design

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Introduction

The term *student engagement* is used "to represent constructs such as quality of effort and involvement in productive learning activities" (Kuh, 2009, p. 6). In literature, student engagement has been studied as one of the predictors of desired learning outcomes such as academic performance (Carini, Kuh, &Klien, 2006), intellectual skills (Pike &Kuh, 2005), attrition (Gilardi&Guglielmetti, 2011), and persistence (Kuh et al., 2008). The basic assumptions of those studies are that qualitative and quantitative differences in student engagement determine the quality of the students' school experiences and learning outcomes. Empirical studies consistently reported that student engagement is positively correlated with various learning outcomes. Overall, it is suggested that highly engaged students spend more time and participate more actively in academic activities, leading to higher levels of learning than those who are not highly engaged.

As it is argued that different students invest different levels of engagement in academic work and the same students invest different levels of engagement in different academic contexts (Astin, 1999). Thus, researchers presume student engagement is malleable as a result of the interaction between students and their learning context (Fredricks, Blumenfeld, & Paris, 2004). In other words, the quality of student engagement can be enhanced by the learning environment. Thus, Astin (1984; 1991) argued that the effectiveness of a learning environment is related to the capacity of the environment to increase student engagement.

Conjecture pointing to the role of student engagement plays in mediating the relationships between a learning environment and learning outcomes has led to a growing interest in designing learning environments that can increase students' quality of effort and involvement in learning. Therefore, researchers have attempted to explore how learning environments influence student engagement and determine whether student outcomes are indeed enhanced by improving the learning environment. An approach viewing the concept of engagement as a mediator

between students and the environment can help researchers and practitioners better understand the complexity of student's experiences and ultimately become better at designing targeted interventions that can enhance learning (Fredricks et al., 2004). Thus, a focus of interest in student learning research is in better addressing the relationship between learning environment and student engagement, and further the complex causal mechanisms among learning environment, student engagement and learning outcomes.

Since a certain amount of students' engagement in learning is thought to be reactive to the classroom environment, or the context(Eley, 1992; Nijhuis, Segers, &Gijselaers, 2005; Wilson & Fowler, 2005), researchers are concerned with identifying the characteristics of effective learning environment that lead to students' deeper levels of engagement during their learning. Thus, relationships between students' engagement in learning and a variety of learning environmental factors have been explored. Therefore, this study explores the learning environmental factors that have been covered in prior research and attempts to identify knowledge gap in the literature linking learning environment and students' engagement from an instructional design perspectives. This study would provide instructional designers with an idea of how a learning environment could be structured in a way to more engage students in a course and further allow instructional design researchers to seek an area of interest related to designing engaging instruction.

Student engagement in learning

Student engagement is a broad multi-dimensional concept related to the entire school experience. With the multifaceted nature of engagement, there have been a variety of labels, definitions and measures of engagement in the research literature (Fredricks et al., 2004). For example, Astin (1999) defined student engagement as academic activities (e.g., time allocation, pedagogical experience, and learning experience), engagement with faculty (e.g., working on a professor's research

project and hours per week spent talking with faculty), engagement with student peer groups (e.g., discussing course content with other students, working on group projects and tutoring other students), and engagement in work (e.g., working full-time or part-time). Astin (1999) argued that research should investigate the connections between particular forms of engagement and particular learning outcomes. Particular forms of engagement can be identified according to specific outcomes of interest and learning context (Axelson& Flick, 2011; Fredricks et al., 2004).

Cognitive engagement has been used to describe the student learning process in regard to academic materials and instruction itself in classroom context (Corno&Mandinach, 1983; Lyke& Young, 2006). Cognitive engagement in this literature suggests that some resources and learning processes are more effective than others in engaging learners in acquisition or construction of knowledge. Students employ different processing strategies during learning and thus expend cognitive resources in different ways. The levels of cognitive engagement are directly related to the quality of learning process and ultimately learning outcomes (Corno&Mandinach, 1983).

Concept of cognitive engagement

The term cognitive engagement has been widely used in the literature in student learning. However, the definitions vary.

Students' use of basic cognitive strategies has been considered to be one form of cognitive engagement (e.g., Dupeyrat&Mariné, 2005; Lyke& Young, 2006). Some define cognitive engagement as the cognitive strategies a student employs, and such scholars distinguish it as shallow or surface engagement when referring to students' use of rehearsal strategies and deep or meaningful engagement when referring to the use of elaboration and organization strategies. In short, it is presumed that more engaged students use deeper cognitive strategies in their learning.

However, the current view of student engagement in learning reflects a self-regulated learning perspective (Paris & Paris, 2001; Pintrich, 2004). With the self-regulated learning perspective, students are assumed to be actively engaged in their learning activities. That is, students who are deeply engaged monitor their learning progress, reflect their use of learning strategies, and modify the strategies in their learning process (Schunk, 1996; Pintrich, 2004). From this point of view, one body of literature includes students' use of self-regulatory activities as an important indicator of deep levels of engagement in learning (DeBacker&Crowson, 2006; Greene & Miller, 1996; Meece, Blumenfeld, & Hoyle, 982; Pintrich& De Groot, 1990; Pintrich& Garcia, 1991; Pintrich&Schrauben, 1992; Walker, Greene, & Mansell, 2006; Wolters, 2004). Thus, cognitive engagement in this context is described as the use of cognitive and self-regulated learning strategies. For example, Meece et al. (1982) defined active cognitive engagement by students' reported use of cognitive strategies such as relating new information to existing knowledge and self-regulated learning strategies such as monitoring comprehension, regulating attention and effort. On the other hand, superficial engagement was defined as the use of help seeking and effort-avoidant strategies.

A group of researchers taking a self-regulated learning perspective such as Pintrich and his colleagues (Pintrich& De Groot, 1990; Pintrich& Garcia, 1991; Pintrich&Schrauben, 1992) often used the term cognitive engagement and self-regulated learning interchangeably in their studies. They conceptualize learning strategies as having two components based on Weinstein's learning process model (Weinstein & Mayer, 1986): general cognitive strategies for learning and self-regulatory strategies. Weinstein and Mayer (1986) describe learning strategies as "behaviors and thoughts that a learner engages during learning and that are intended to influence the learner's encoding process. Thus, the goal of any particular learning strategy may be to affect the learner's motivational or affective state, or the way in which the learner selects, acquires, organizes, or integrates new knowledge" (p. 315). Weinstein and Mayer identified major categories of learning

strategies related to comprehending learning materials: cognitive strategies in terms of rehearsal, elaboration, and organizational strategies; and self-regulatory strategies in terms of comprehension monitoring strategies.

In addition to rehearsal, elaboration, and organizational strategies discussed by Weinstein and Mayer (1986), Pintrich and Gracia (Pintrich& Garcia, 1992) added critical thinking strategies as another indicator of cognitive strategies. Critical thinking strategies refer to "the extent to which students try to apply prior knowledge to new situations and solve problems, to analyze and evaluate information in a thoughtful manner" (Pintrich, 2004, p. 393). They believed that effective learning strategy involves applying knowledge as well as acquiring and comprehending texts. Thus, scholars regard cognitive engagement as the use of four types of cognitive strategies such as rehearsal, elaboration, organization and critical thinking, as well as the use of self-regulated strategies.

To sum up, in recent scholarship, cognitive engagement is typically described based on two common indicators: students' use of basic cognitive strategies such as rehearsal, elaboration, organization, and critical thinking; and self-regulatory strategies such as planning, monitoring, regulating (DeBacker&Crowson, 2006; Greene & Miller, 1996; Meece et al., 1982; Pintrich& De Groot, 1990; Pintrich& Garcia, 1991; Pintrich&Schrauben, 1992; Walker et al., 2006; Wolters, 2004). In light of this, cognitive engagement has been operationalized in the literature by one of these indicators or as a combined set of the indicators.

Variability of cognitive engagement

There has been a long debate over whether students' cognitive engagement is consistent or varying over time and across contexts. Some researchers argue that there is a certain consistency in students' adoption of learning strategies (e.g. Entwistle, 1991; Vermetten, Vermunt, &Lodewijks, 2002); others argue that students choose learning strategies according to their motivational orientations or

learning environments (e.g. Greene & Miller, 1996; Jang, Reeve, and Deci, 2010).

There is empirical evidence that shows a limitation to the variability in students' use of learning strategies. Vermetten et al. (2002) conducted an experimental study to compare students' use of learning strategies between a traditional course and a student-oriented course in a university context. The student-oriented course incorporated group work or activating instructions that are expected to evoke more meaningful learning. The same group of students in the Law department participated in both traditional and student-oriented courses during two consecutive years. The authors expected that students' use of deep and surface learning strategy would vary according to the different learning environment. However, there was no difference in the use of learning strategies between the traditional and student-oriented course. They concluded that the reforms made to student-oriented instructional practices hardly had any impact on learning strategies. This finding may indicate that the learners demonstrate stable learning strategies across different learning context.

Some scholars (Nijhuis, Segers, &Gijselaers, 2005; Wilson & Fowler, 2005) assume that students have a predisposition to deep or surface learning and investigated whether a general tendency in students' learning strategy use would be influenced by a specific learning context. For example, Wilson and Fowler (2005) examined students' differences in their approach to learning in two concurrent courses: a traditional course assumed to foster surface learning and a redesigned course prompting deep learning. In the beginning of the semester during the course of their study, they classified 50 undergraduate students to either surface or deep approach to learning and their approach to learning was measured again in the last week of the semester. The findings illustrate that the students in the typical deep learning group did not show any difference in their strategy use across the two courses; on the other hand, the students in the typical surface learning group reported higher levels of deep learning strategy use in the redesigned course. The authors concluded that typical deep learners are relatively consistent in their use of

learning strategies; however typical surface learners are more influenced by their learning environment.

Alternatively, a number of studies have found that students' adoption of learning strategies varies as a function of individual and contextual differences. Eley (1992) attempted to examine whether students show variability in their engageement across contexts. One hundred and fifty two undergraduate students enrolled in four concurrent course units were surveyed on their use of learning strategies and perceptions of the learning environment. The changes in individual learning strategy use were scored based on the magnitude of the changes. The scores showed that about 95% of students reported they adopted different learning strategies across courses, but the magnitude of the changes was not great. In addition, students' perceptions of their learning context also differed between courses. Eley (1992) concluded that students use different learning strategies in different learning contexts; and that the variability in learning differences is related to the perceptions of the learning environment.

Consequently, literature has shown that although students have a general predisposition to deep or surface learning strategy use, this learning strategy use can be, at least in part, modified by individual or learning environmental factors (Ramsden, 1984). This requires researchers to identify the factors explaining the variability of students' cognitive engagement. Therefore, in this study identified the learning environmental factors that have been explored in prior research. This study attempts to address the following questions.

1) What learning environmental factors have been explored in student cognitive engagement literature?

2) Are there knowledge gaps in the literature linking learning environment and student cognitive engagement from an instructional design perspective?

3) What are the implications for instructional design research?

Method

The main purpose of this study is to address a set of environmental factors that affect students' engagement in learning and identify issues related to research on engaging learning environment. This study followed a systematic literature review process suggested by Light and Pillemer (1984). Light and Pillemer argue that literature review is not about selecting and synthesizing a narrow set of studies, but it is a systematic process to structure a research review while aggregating and integrating conflicting information. Light and Pillemer's guidelines of a systematic literature review suggest: 1) identifying a question the review is trying to answer; 2) determining whether the review is exploratory or built around specific, testable hypotheses; 3) determining studies to be include; 4) determining to which population the main findings can be generalized; and 5) describing important differences in the ways the studies were done.

Based on the processLight and Pillemer suggest, this study first identified research questions and the rationale of this study. As it is argued that students' cognitive engagement depends on learning environment, various factors within the course have been explored in previous studies. In order to provide a comprehensive understanding of learning environment design, this study posed a set of questions from an instructional design perspective. Thus, three research questions were formed.

Second, as the purpose of study was to present a syntheticset of environmental factors that affect student cognitive engagement, this review approach was essentially exploratory work in order to search all learning environmental factors that have been studied in previous literature. Therefore, literature search was conducted to identify all available literature on student cognitive engagement.

Third, this review of literature attempted to cover all theoretical and empirical studies on the construct of student cognitive engagement as well as its underlying components. In addition, there are two major perspectives of student engagement

research: student approaches to learning perspective and self-regulated learning perspective. Since they share much of the basic assumptions, empirical studies from the both perspectives are reviewed when exploring the factors affecting student engagement in learning. Therefore, the theoretical and empirical studies that referred to 'student engagement in learning', 'student cognitive engagement', 'student's use of learning strategies', and 'student approaches to learning' were selected as search criteria. Then, the extensive electronic database in educational research such as Education Resources InformationCenter (ERIC) was used to identify research studies. Journals and books included in this review were published not only in instructional design field but also in other fields such as educational psychology. The selected studies were mostly published in 1983 to 2011.

Fourth, this study included studies covering all populations unless the factors are unique to a specific population. Therefore, all available studies can be replicated across multiple population were reviewed for this study. The criteria specified above formed the basis for study inclusion in this review. Finally, 22 studies were selected for the final analysis.

Lastly, the factors found in the literature review were categorized according to the properties of factors and each category was labeled with a general property. Six categories were drawn and they were reviewed by three experts in instructional design research. They were 1) perceptions of teaching; 2) academic tasks/learning activities; 3) teacher's instructional style; 4) classroom goal structure; 5) redesign of learning environment, and 6) academic disciplines. The final list of literature is presented in Table 1.

Results

Empirical studies have shown that students' engagement in learning can be altered by various elements in the learningenvironment design such as factors related students' perceptions of teaching quality (Entwislte&Tait, 1990; Prosser

&Trigwell, 1992; Ramsden, 1992; Trigwell& Prosser, 1991; Nijhuis, Segers, Gijselaers, 2007, 2008), characteristics oftasks andlearning activities (Kyndt et al., 2011; Pintrich et al., 1994),teachers' behaviors during instruction (Jang et al., 2010; Pintrich, Roeser, & De Groot, 1994), classroom goal structures (Lyke& Young, 2006; Wolters, 2004), the integration of student oriented learning, action learning, problem-based learning, and constructivist learning (Ahlfeldt, Mehta, &Sellnow, 2005; Meece et al., 1988; Nie& Lau, 2010; Nijhuis, Segers, &Gijselaers, 2005; Rotgans& Schmidt, 2011; Wilson & Fowler, 2005), and academic disciplines (Hativa&Birenbaum, 2000; Vermunt, 2005; Wolters&Pintrich, 1998). Table 1 shows a summary of the learning environmental variables that were covered in the literature.

Perception of teaching

A group of researchers has established in exploratory ways key elements of the learning environment which make significant differences in students' deeper levels of engagement. The researchers relied on students' ratings of teaching quality using course evaluation questionnaires that measure the dimensions of teaching such as good teaching, freedom in learning, clear goals, appropriate assessment and workload, and relevant content. Using these measures, researchers explored what aspects of teaching are relate to students' engagement in learning (Entwislte&Tait, 1990; Prosser &Trigwell, 1992; Ramsden, 1992; Trigwell& Prosser, 1991; Nijhuis et al, 2007, 2008). A study conducted by Entwistle and Tait (1990) found that among subscales of course evaluation individuals' perceptions of relevant content were associated with deep approaches, while the perceptions of demanding workload were associated with surface approaches. They also found that students who adopt deep approaches to learning preferred a learning environment in which understanding was encouraged, while students who adopt surface approaches preferred a learning environment in which rote learning was promoted.

Table 1. Learning Environmental Factors Explored in Literature

Environmental variables		Source
Perception of teaching	· good teaching · clear goal · appropriate assessment · appropriate workload · independent learning	Eley, 1992; Entwistle&Ramsden, 1983; Entwislte&Tait, 1990; Nijhuis et al., 2007, 2008
Academic tasks/learning activities	· interesting academic work and cooperative work	Pintrich et al., 1994
	· task complexity and perceived workload	Kyndt et al., 2011
	· small group and whole class activities	Meece et al., 1988
Teachers' Instructional style	· autonomy support and course structure	Jang et al., 2010
	· teacher effectiveness	Pintrich et al., 1994
Classroom-goal structure	· classroom goal structure (task vs. performance)	Lyke& Young, 2006; Wolters, 2004
Re-design of Learning environment	· constructivist and didactic instruction	Nie& Lau, 2010;
	· problem based learning	Nijhuis et al, 2005; Rotgans& Schmidt, 2011
	· levels of problem-based learning	Ahlfeldt et al., 2005
	· conventional and action learning design	Wilson & Fowler, 2005
	· project-based course	Kember et al., 1997
Discipline		Hativa&Birenbaum, 2000; Lonka&Lindblom-Ylanne, 1996; Vermunt, 2005; Wolters &Pintrich, 1998

Regarding students' perceptions of teaching, furthermore, the quality of instructor measured by the questions such as "teaching staff motivated me to do my best", the extent of freedom in learning, and the clarity of goals have shown to

be important aspects of teaching which affect students' deep engagement in leaning (Trigwell& Prosser, 1991; Nijhuis et al., 2007; Vermetten et al, 2002).

Academic tasks/learning activities

The design of academic tasks and learning activities is a central element of learning environments, and students' perceptions of the tasks and activities influence how they engage in their learning (Ames, 1992). As was discussed in the previous section, the workload, accompanying feelings of pressure or stress in terms of tasks and learning activities (Kember, 2000), is one of the factors affecting students' different levels of engagement. There are several studies specifying further the aspect of academic tasks or learning activities. Kyndt et al. (2011) conducted a study concerning the influence of students' perceptions of workload and task complexity on their approaches to learning. The study found that a lack of information was positively related to surface approaches to learning under all conditions, and a lack of information was also negatively related to deep approaches in high workload and high task complexity conditions as well as low workload and low task complexity conditions. Familiarity of tasks was a predictor of deep approaches with high workload and high complexity, whereas in conditions with low workload and low complexity, familiarity was a predictor of surface approaches. Workload was positively related to deep approaches only in conditions with low workload and high task complexity. Pintrich et al. (1994) also focused on the aspects of academic tasks. They investigated three classroom perception scales (productive academic work, cooperative work, and teacher effectiveness) with 100 middle school students from 14 classrooms. The researchers analyzed correlations between individual perceptions with students' cognitive and self-regulatory strategy use and between the classroom-level aggregated perceptions with the strategy use. Both individual- and classroom-level aggregated perceptions were related to students' cognitive and self-regulatory strategy use. The correlational analysis

showed that those students who perceived their work as productive and cooperative; their teacher as more effective reported higher levels of cognitive strategies and the use of self-regulated learning strategies.

Teacher's instructional style

When students are involved in classroom learning, there are some aspects of the teacher's behavior that play a role in students' learning processes. The studies focusing on students' evaluation of teaching showed that students' perceptions of teacher effectiveness or quality of teaching staff were related to deep approaches to learning or the use of deeper cognitive strategies and self-regulatory strategies (Trigwell& Prosser, 1991; Nijhuis et al., 2007; Pintirich et al., 1994). In the aforementioned study by Pintrich et al. (1994), teacher effectiveness was measured by the items regarding teacher's behaviors in a clear and interesting manner, good classroom management, and fair grading procedure. The study showed that the teacher effectiveness was positively related to students' cognitive and self-regulated strategy use.

Jang et al. (2010) investigated the effect of engagement-promoting behaviors of teachers such as autonomy support and course structure on students' engagement. First, teacher-provided autonomy support and course structure were significant predictors of the collective engagement; second, teacher-provided autonomy support was a predictor of the self-reported engagement. Course structure did not predict the self-reported engagement. The study reported that 14% of the variance in students' engagement was accounted for by classroom contextual differences.

Classroom goal structure

Perceived classroom goal structure has been studied as a significant classroom

contextual factor which leads to differences in students' cognitive engagement. In the literature, it is assumed that students may adjust their cognitive strategies in accordance with their perceptions of how the classroom environment is structured toward different goals; and depending on what the learning environment requires (Lyke& Young, 2006). Researchers have investigated students' perception of the performance versus task (or mastery) structures of their classroom and its impact on students' use of cognitive and self-regulatory strategies (Ames & Archer, 1988; Lyke& Young, 2006; Wolters, 2004). Lyke and Young (2006) analyzed the correlations between students' goal orientation and the levels of cognitive engagement, between the goal orientation and classroom goal structure, and between classroom structure and the levels of cognitive engagement. Each relationship was individually examined. The results showed that students who had higher levels of intrinsic motivation reported a greater use of deep cognitive strategies, students who had higher levels of intrinsic motivation perceived their classroom more task-structured, and when the classroom was perceived as task-structured, students' use of deep strategies were increased. Taken these findings together, they concluded that intrinsic motivation may act as a mediator of the positive relationship between classroom structure and the deep level of cognitive engagement. That is, intrinsically motivated students in task-oriented classrooms are most likely to engage in their learning at a deeper level.

Wolters (2004) conducted a study to investigate whether classroom goal structure account for students' cognitive engagement. Results indicated that both mastery-oriented classroom structure and performance-oriented structure positively predicted students' use of cognitive strategies and metacognitive strategies.

Redesign of learning environment

The effects of learning environmental factors on students' engagement are often discussed in the context of course re-design or improvement of traditional

instructor-led course through integrating approaches such as action learning (Wilson & Fowler, 2005), problem-based learning (Ahlfeldt, Mehta, &Sellnow, 2005; Nijhuis, Segers, &Gijselaers, 2005; Rotgans& Schmidt, 2011), and constructivist learning (Nie& Lau, 2010). Wilson and Fowler (2005) classified approximately fifty university students as typical deep or typical surface learners based on a baseline measurement in the beginning of the course. The learning environment included two concurrent courses: a conventional course (lectures and tutorial) and an action learning based course (which including project work and group work). The authors measured the students' learning strategy uses again in the end of the course and compared the differences observed in typical deep or typical surface students' learning strategy use across the two courses. Wilson and Fowler found that in the action learning course, the students in the typical surface learning groups reported increased use of deep learning strategies; however, the students in the typical deep learning group were not influenced by both learning environments in their use of learning strategies.

Ahlfeldt et al. (2005) examined the relationship between the levels of problem-based learning methods that instructors reported and students' self-reported learning engagement. The results showed that the reported engagement was higher in the classrooms where more PBL methods were implemented.

Nie and Lau (2010) conducted a study to investigate how different instructional methods were related to students' surface and deep cognitive strategy use. The instructional methods compared in this study were didactic and constructivist instruction. Didactic instruction emphasized drill and practice of basic skills and knowledge relying mainly on textbook, while constructivist instruction frequently used classroom discussion and extended writing, and teachers emphasize in-depth understanding and application of students' learning to everyday life. The results showed a relationship between didactic instruction and surface strategy use, and between constructivist instruction and deep strategy use. Those studies support the claim that re-designed courses have an impact on students' increased engagement

or the use of deeper cognitive strategies.

Some studies fail to establish a link between re-designed courses and students' deeper levels of engagement. Vermetten et al. (2002) used an experimental study to examine the effect of student-oriented courses aimed at prompting students' deeper levels of engagement compared to traditional courses. It was assumed that in the student-oriented courses, students would engage in their learning at deeper levels, but the results indicated that the students in the experimental group showed little differences in learning strategies from the student in the comparison group. The authors concluded that students demonstrate stable learning strategies across different learning environments.

In a study by Nijhuis et al. (2005), students' deep and surface learning strategy use were compared in two different formats of the same university business course: an assignment-based course in which clear instructions in the assignment were provided; and a problem-based course in which ill-structured authentic problems were given to the students. They examined the changes in students' use of learning strategy from pre- and post- measures. Although the authors expected that students' use of deep learning strategies would be promoted in the problem-based format, contrary to their expectations, students in the problem-based environment showed a significant decrease in deep learning and increased in surface learning.

Rotgans and Schmidt (2011) examined to what extent autonomy in problem-based learning results in cognitive engagement. They assumed that five phases of problem-based learning activities such as the problem definition, initial self-study, initial findings sharing, self-study, and the presentation and elaboration phase allowed students different levels of autonomy; then, the feeling of being autonomous would be related to the different levels of cognitive engagement. For example, the authors expected at an initial self-study phase that students would be allowed a higher level of autonomy, and then they would engage at deeper levels. However, there was no significant difference in students' engagement associated with the differing levels of autonomy.

These studies attempt to reveal the effects of the instructional design components on students' deeper levels of learning strategies used. It seems that the evidence does not effectively support the hypothesis of the authors.

Academic disciplines

Academic disciplines have been a major concern in this research area. It is assumed that the nature of disciplines requires different approaches to teaching, which in turn, may lead to different ways of learning. But there has been little research done focusing on the effects of disciplinary differences on students' cognitive engagement.

Vermunt (2005) conducted a study to clarify the associations between academic discipline and students' approaches to learning with a sample of 1,279 university students. Seven academic disciplines were included: Law, Information Science, Economics, Econometry, Sociology, Psychology, and Arts. Regression analysis with age, gender, prior education as personal predictors and with discipline as a contextual predictor showed that differences in students' learning strategy use were associated with different academic disciplines, indicating that Arts and Psychology students used deeper cognitive strategies, while Economy and Law students used more reproduction directed learning strategies.

In middle school contexts, Wolters and Pintrich (1998) examined whether students' levels of motivation and cognition vary across domains and if the relations between the motivational and cognitive components of self-regulated learning change as a function of the three domains. Results indicated that there were significant differences in student cognitive and self-regulatory strategy use between subjects. Students reported greater cognitive strategy use in social studies than in mathematics or English. The use of self-regulated strategies was similar across all subject areas.

The nature of the knowledge in different disciplines might lead to differences in

students' use of cognitive and self-regulatory learning strategies. However, few studies have examined the differences in students' use of learning strategies between different academic majors.

Discussions and Conclusions

The levels of cognitive engagement are useful indicators of how students are engaged in their learning. Successfully engaged learners are likely to be more strategic and self-regulated to learn new knowledge and skills (Fredricks et al, 2004; Pintrich& De Groot, 1990; Pintrich& Garcia, 1991; Pintrich&Schrauben, 1992). Literature on cognitive engagement attempts to better understand how the learning environment is related to different levels and types of cognitive engagement, and how cognitive engagement influences students' learning outcomes. Unpacking these relationships may help to establish a link between students' learning outcomes and learning context. As it is argued that student cognitive engagement depends on learning environment, various structures within the course promote student cognitive engagement have been explored in conjunction with a concern for the improvement of instruction. Although there was supportive evidence for the association between learning environmental design and cognitive engagement, several questions still remained. Thus, the purpose of this study is to provide a comprehensive understanding of the relationship between cognitive engagement and learning environment design by reviewing cognitive engagement literature and identify a knowledge gap in the literature for implication for instructional design research. In this section, the discussions and conclusions on the followingthree questions are presented.

1) What learning environmental factors have been explored in student cognitive engagement literature?

2) Are there knowledge gaps in the literature linking learning environment and student cognitive engagement from an instructional design perspective?

3) What are the implications for instructional design research?

First, cognitive engagement research has focused on how certain structures within the course promote student learning engagement in conjunction with a concern for the improvement of instruction. Most of the suggestions are made based on task characteristics, classroom goal structures and autonomy orientations of classrooms. Students engaged more in a course where productive and cooperative academic tasks are provided (Pintirich et al., 1994), where more autonomy is given to students (Jang et al., 2010), and where course goals are learning-oriented (Lyke& Young, 2006; Wolters, 2004). Also, action learning design integrating project and group work (Wilson & Fowler, 2005), problem-based learning course (Ahlfeldt et al., 2005), and constructivist instruction with frequent use of classroom discussion and extended writing, and teachers' emphasis on in-depth understanding and application (Nie& Lau, 2010) were found to promote deep levels of cognitive engagement. These results imply that there are several factors that affect student deep-levels of cognitive engagement, but research on a more comprehensive and clearer framework for designing engaging instruction is required.

Second, there was still a lack of knowledge regarding the relationship between instructional design principles and cognitive engagement. Cognitive engagement literature has focused on how the elements of learning environmental design influence students' levels of cognitive engagement. Many types of instructional practices were employed to prompt deep cognitive strategy use. Some of these practices appear to be effective, while others do not. Particularly, engaging learning environment designs that incorporate problem-based learning, student-oriented learning, or action learning did not appear to be effective in promoting students' deep levels of learning. In assessing these results, Vermetten et al. (2002) argue that

it could be because the learning environment design was not effective enough, although researchers attempt to design more engaging learning environments. Nijhuis et al. (2008) also note that "another explanation could be that the changes in the learning environment were not strong enough to induce changes in learning strategies" (p. 122). In fact, some of these studies based on experimental design did not assess how well intended instructional elements were implemented in actual instructional situations, and the studies failed to produce expected levels of cognitive engagement (e.g., Nijhuis et al., 2005; Rotgans& Schmidt, 2011; Wilson & Fowler, 2005).

Instructional design researchers pointed out that engaging instruction does not happen without careful application of instructional design principles which are proven to consistently facilitate effective, efficient, and engaged learning. For example, Merrill (2008) claims that "there are known instructional strategies. If an instructional experience or environment does not include the instructional strategies required for the acquisition of the desired knowledge and skill, then effective, efficient, and engaging learning of desired outcome will not occur" (p. 267). Therefore, when linking instructional design elements and students' engagement, a related area of interest might be the extent to which the instructional design principles are integrated into learning environments, and its relationship with student cognitive engagement factors.

Third, this literature review required instructional design researcher to study more in the area of student cognitive engagement and learning environment design. For example, an investigation of direct and indirect effect of learning environments would provide a more accurate picture of the contribution of learning environmental factors in explaining the variance in students' cognitive engagement. When investigating this relationship, most prior studies have focused on a direct link between the learning environmental factors and cognitive engagement. Thus, links were established separately between students' personal factors and cognitive engagement, and between classroom contextual factors and

cognitive engagement. In addition, a group of scholars concerns that students' motivational components such as individual goal adoption is also learning context dependent; thus, the links between students' motivational components and the learning environment were highlighted (e.g., Pintrich, Conley, &Kempler's review, 2003). Taken the links that have been separately established together, it seems reasonable to hypothesize a mediating relationship that learning environment exerts its indirect influence on cognitive engagement through motivational factors. In fact, researchers suggest testing both personal and learning environmental factors simultaneously (e.g., Ames, 1992; Pintrich&Schrauben, 1992; Pintrich et al., 2003), however little work has done.

In addition, reviewing previous studies reveals an important methodological issue concerning the nature and measurement of the learning environment (Ames, 1992, Entwistle, 1991; Nie& Lau, 2010; Pintrich et al., 1994; Rmasden, 1992; Wolters, 2004). Different measurements of learning environments have been used such as redesigned learning environment itself as a treatment, expert or instructor ratings of classroom, or students' perceptions of instructional environment. Prior studies have shown that student perceptions of learning environmental were associated with student cognitive engagement, not objectively assessed learning environment. It is argued that students' perception is a valid measure when studying the effects of learning environmental design because students perceive differently the influential design elements from what is expected to be effective in designing the learning environment (Ames, 1992; Koszalka, Song, & Grabowski, 2002).

Meanwhile, several studies are concerned with between-course or between-instructor variations when investigating the effects of instructional practices, since instructional practices are inherent in a course or an instructor. The studies focused on the class-level effects on individual students' cognitive engagement using the aggregated students' perceptions of the class level as a measure of contextual variable (Meece et al., 2003; Nie& Lau, 2010; Wolters, 2004). The average students' perception of the class level can be considered as "a more objective indicator of the

actual academic environment" (Entwistle&Tait, 1990, p. 190). This type of inquiry tests the assumption that at least some of the variance in the cognitive engagement is attributed to classroom differences (Raudenbush&Bryk, 2002). However, the study linking classroom context and cognitive engagement is limited.

Based on the review, several recommendations are made for future study. First, future research could focus on understandings how the integration of instructional design principles into courses and the levels of student engagement in these courses are related. Second, a study on a causal mechanism by which the integration of instructional design principles influences cognitive engagement through individual goal orientations would be necessary. Thirds, another area for future research is to use multiple sources of data such as observation data or instructor's ratings to assess learning environment and compare the extent to which each data reflects actual features of the environment. This type of study would increase the validity of a study of learning environment. Fourth, most previous studies did not link the levels of cognitive engagement to learning outcomes such as achievement. However, based on a big picture that cognitive engagement plays a mediating role in the relationships between learning environment and various learning outcomes should be further addressed to provide more meaningful implication for researchers and practitioners.

References

Ahlfeldt, S., Mehta, S., & Sellnow, TL. (2005). Measurement and analysis of student engagement in university classes where varying levels of PBL methods of instruction are in use. *Higher Education Research and Development*, *24*(1), 5-20.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*(3), 261-271.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, *80*(3), 260-267.

Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel, 25*(4), 297-308.

Astin, A .W. (1999) Involvement in Learning Revisited: Lessons we have Learned. *Journal of College Student Development*, *40*(5), 587-598.

Axelson, R. D., & Flick, A. (2011). Defining student engagement. *Change: the Magazine of Higher Learning, 43*(1), 38-43.

Carini, R. M., Kuh, G. D., & Klein, S. P. (2006). Student engagement and student learning: Testing the linkage. *Research in Higher Education, 47*(1), 1-32.

Corno, L., &Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist*, *18*(2), 88-108.

DeBacker, T.K., & Crowson, H.M. (2006). Influences on cognitive engagement: Epistemological beliefs and need for closure. *British Journal of Educational Psychology*, *76*(3), 535-551.

Dupeyrat, C. and Mariné, C. (2005). Implicit theories of intelligence, goal orientation, cognitive engagement, and achievement: A test of Dweck's model with returning to school adults. *Contemporary Educational Psychology, 30*(1), 43-59.

Entwistle, N. J. (1991). Approaches to learning and perceptions of the learning environment. Introduction to the special issue. *Higher Education*, *22*(3), 201-204.

Entwistle, N. J., & Tait, H. (1990). Approaches to learning, evaluations of teaching,

and references for contrasting academic environments. *Higher Education, 19*(2), 169-194.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concepts, state of the evidence. *Review of Educational Research*, *74*(1), 59-109.

Gilardi, S., & Guglielmetti, C. (2011). University life of non-traditional students' engagement styles and impact on attrition. *Journal of Higher Education*, *82*(1), 33-53.

Greene, B. A., & Miller, R. B. (1993). Influences on course performance: Goals, perceived ability, and self-regulation. *Paper presented as a poster at the American Educational Research Association Annual Meeting*, Atlanta, GA.

Hativa, N., & M. Birenbaum. (2000). Who prefers what? Disciplinary differences in students' preferred approaches to teaching and learning styles. *Research in Higher Education*, *41*(2), 209-36.

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, *10*(3), 588-600.

Kember, D. (2000). Misconceptions about the learning approaches, motivation, and study practices of Asian students. *Higher Education*, *40*(1), 99-121.

Koszalka, T., Song, H., & Grabowski, B. (2002). Examining learning environmental design issues for prompting reflective thinking in web-enhanced PBL. *Paper presented at the meeting of the American Educational Research Association*, New Orleans, LA.

Kyndt, E., Dochy, F., Struyven, K., & Cascallar, E. (2011). The direct and indirect effect of motivation for learning on students' approaches to learning through the perceptions of workload and task complexity. *Higher Education Research & Development*, *30*(2), 135-150.

Kuh, G.D. (2009). The National Survey of Student Engagement: Conceptual and Empirical Foundations. *New Directions for Institutional Research*, *2009*(141), 5-20.

Kuh, G.D., Cruce, T .M.,Shoup, R., Kinzie, J. & Gonyea, R.M. (2008). Unmasking the Effects of Student Engagement on First-Year College Grades and Persistence.

Journal of Higher Education, *79*(5), 540-563.

Light, R. J., & Pillemer, D. B. (1984). *Summing up: The science of reviewing research*. Cambridge, MA: Harvard University Press.

Lyke, J. A & Kelaher Young, A. J. (2006). Cognition in context: Students' percpetions of classroom goal structures and reported cognitive strategy use in the college classroom. *Research in Higher Education*, *47*(4), 477-490.

Meece, J., Blumenfeld, P. C., & Hoyle, R. (1988). Students' goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology*, *80*(4), 514-523.

Merrill, M. D. (2008). Converting e3 learning to e3 learning: an alternative instructional design method. *The E-Learning Handbook: Past Promises, Present Challenges*, 359-400).

Nie, Y., & Lau, S. (2010). Differential relations of traditional and constructivist instruction to students' cognition, motivation, and achievement. *Learning and Instruction*, *20*(5), 411-423.

Nijhuis, J., Segers, M., & Gijselaers, W. (2005). Influence of redesigning a learning environment on student perceptions and learning strategies. *Learning Environments Research*, *8*(1), 67-93.

Nijhuis, J., Segers, M., & Gijselaers, W. (2007). The interplay of perceptions of the learning environment, personality and learning strategies: a study amongst International Business Studies students. *Studies in Higher Education*, *32*(1), 59-78.

Nijhuis, J., Segers, M., & Gijselaers, W. (2008). The extent of variability of learning strategies and students' perceptions of the learning environment. *Learning and instruction*, *18*(2), 121-134.

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, *36*(2), 89-101.

Pike, G. R., & Kuh, G. D. (2005). First- and second-generation college students: A comparison of their engagement and intellectual development. *Journal of Higher Education, 76*, 276-300.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, *16*(4), 385-407.

Pintrich, P.R., Conley, A.M. & Kempler, T.M. (2003). Current issues in achievement goal theory and research. *International Journal of Educational Research*, *39*(4), 319-337.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning component of classroom academic performance. *Journal of Educational Psychology*, *82*(1), 33-40.

Pintrich, P. R., & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. *Advances in motivation and achievement: Goals and self-regulatory processes, 7*, 371-402.

Pintrich, P. R., Roeser, R. W., & De Groot, E. A. M. (1994). Classroom and individual differences in early adolescents' motivation and self-regulated learning. *Journal of Early Adolescence, 14*(2), 139-161.

Pintrich, P.R., & Schrauben, B. (1992). Student's motivational beliefs and their cognitive engagement in classroom academic tasks. *Student perceptions in the Classroom: Causes and Consequences,* 149-183.

Prosser, M. & Trigwell, K. (1999). *Understanding learning and teaching: the experience in higher education.* Buckingham, Open University Press.

Ramsden, P. (1992) *Learning to teach in higher education.* London, Routledge.

Raudenbush, S. & W. Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods.* 2nd edition. Newbury Park , CA : Sage.

Rotgans, J., & Schmidt, H. (2011).Cognitive engagement in the problem-based learning classroom. *Advances in Health Sciences Education*, *16*(4), 465-479.

Schunk, D.H. (1996). Goal and self-evaluative influences during children's cognitive skill learning. *American Educational Research Journal*, *33*(2), 359-382.

Trigwell, K. & Prosser, M. (1991). Improving the quality of student learning: the influence of learning context and student approaches to learning on learning outcomes. *Higher Education*, *22*(3), 251-266.

Vermetten, Y., Vermunt, J., & Lodewijks, H. (2002). Powerful learning environment? How do university students differ in their response to instructional measures. *Learning and Instruction*, *12*(3), 263-284.

Vermunt, J. D. (2005). Relations between student learning patterns and personal and contextual factors and academic performance. *Higher Education*, *49*(3), 205-234.

Walker, C. O., Greene B. A., & Mansell, R. a. (2006). Identification with academics, intrinsic/extrinsic motivation, and self-efficacy as predictors of cognitive engagement. *Leaning and Individual differences*, *16*(1), 1-12.

Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. *Handbook of research on teaching, 3,* 315-327.

Wilson, K., & Fowler, J. (2005). Assessing the impact of learning environments on students' approaches to learning: comparing conventional and action learning designs. *Assessment and Evaluation in Higher Education*, *30*(1), 87-101.

Wolters, C. (2004). Advancing achievement goal theory: Using goal structure and goal orientation to predict students' motivation, cognition, and achievement. *Journal of Educational Psychology*, *96*(2), 236-250.

Wolters, C., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional Science*, *26*, 27-47.

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