The effects of higher order thinking on student achievement and English proficiency

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This quantitative study investigates the effect of urban teacher (N = 18) use of higher order thinking on language arts achievement and English development. Using Bloom's (1956) original six level hierarchy of higher order thinking, teachers were designated as high (levels 3 to 6) or low (levels 1 or 2) users of higher order thinking. Findings demonstrate statistically significant gains in coached teachers' use of higher order thinking, and simultaneous gains in their students' language arts achievement. Regardless of coaching status, when teachers used higher order thinking, their students made significant gains in both language arts achievement and English proficiency. Implications point to the value of increasing, not decreasing, the level of cognitive challenge when teaching culturally, linguistically, and economically diverse students.

Key Words: Cognitive Challenge, Achievement, English proficiency, Instructional coaching; Professional development; Urban Elementary Teachers.

INTRODUCTION

In 2014 the number of African-American, Latino, and Asian students was estimated to surpass

non-Hispanic White students for the first time in the U.S. (Maxwell, 2014). There is general consensus, however, that U.S. teachers are inadequately prepared to serve the needs of these diverse learners (Leland & Murtadha 2011; Sleeter, 2008). Simultaneously, teachers are being challenged by Common Core State Standards in language arts and mathematics to create productive learning environments that are collaborative and dialogically rich in developing complex thinking for all learners (Hiebert & Stigler, 2004; Porter, McMaken, & Yang, 2011). These new demands are juxtaposed against a culture that often relegates higher order thinking activities to high achieving students (Weinstein, 1996; Zohar, Degani, & Vaaknin, 2001).

As noted by Guskey (2000), instructional innovation and increases in student achievement require systematic and sustained professional learning. This study focuses directly on teacher use of higher order thinking activities with culturally and linguistically diverse elementary students from an urban school setting. The school was part of a U.S. Department of Education Title III National Professional Development Grant, where some teachers were instructionally coached in use of the Six Standards for Effective Pedagogy or Six Standards (Teemant, Leland, & Berghoff, 2014; Tharp, Estrada, Dalton, & Yamauchi, 2000). The pedagogy encourages constructivist learning and teaching in line with Common Core expectations. Coached teachers were supported in moving away from behaviorist practices toward practices that were collaborative, language rich, contextualized, cognitively challenging, and dialogic while also using school knowledge to address real world challenges.

For this study, teachers were designated as high (levels 3 to 6) or low (levels 1 or 2) users of higher order thinking using Bloom's six-level hierarchy of higher order thinking. This study contributes to understanding the impact of higher order thinking on culturally and linguistically diverse students' language arts achievement and English language proficiency.

LITERATURE REVIEW

To situate the current study, this literature review highlights definitions of higher order thinking and briefly describes the Six Standards professional development.

Defining Higher Order Thinking

In 1956, Bloom published the seminal piece defining a taxonomy of higher order thinking from low to higher levels: Know, comprehend, apply, analyze, synthesize, and evaluate. Higher order thinking is organized around analyzing and constructing relationships (Lewis & Smith, 1993; Resnick, 1987; Bloom, 1956) and is contrasted with recall and comprehension tasks on the lower end of Bloom's taxonomy. More recently, Anderson and Krathwohl (2001) have published a revised version of Bloom's taxonomy, arguing that synthesis, as a process of creating, is more difficult than evaluation. In one form or another, Bloom's well-known and seemingly accurate hierarchy of complexity has served as an organizer for planning instruction (Anderson & Krathwohl, 2001; Krathwohl, 2002).

A key tenet of the Common Core standards is the use of higher order skills in application of knowledge in teaching and learning, (Porter, McMaken, & Yang, 2011; Zweirs, O'Hara, & Pritchard, 2014). With respect to English Language Arts and Literacy, key shifts include the need for students to practice with complex texts and to use evidence from texts to support thinking (Zwiers et al., 2014). In mathematics, shifts include a deeper focus on fewer topics, stronger linkages with other topics, and deeper conceptual engagement (Porter et. al., 2011). Such shifts represent an expectation of higher order thinking and learning, and in essence a shift towards what Ritchhart (2015) describes as *cultures of thinking*.

While cognitively challenging activities have generally been reserved for high achieving students (Zohar et al., 2001), high stakes test-based accountability has resulted in a narrowed,

often scripted and skill-based, curriculum for marginalized student populations (Tucker, 2014). Smagorinsky (2013) has highlighted the "importance of inclusive treatment of diverse students" (p.195), noting that Vygotsky's emphasis on improving diverse students' outcomes centered on their participation in cultural activities of learning. Weinstein (1996) has argued that there is "compelling evidence that when students are placed higher *and given appropriate supports*, they rise to the challenge with no detriment to the higher achieving students" (p.17).

Zohar and Dori (2003) affirmed this finding when they found that all students, high achievers and low achievers alike, made considerable progress in higher order thinking scores when exposed to processes that were designed to nurture higher order thinking skills. Zweirs et al. (2014) have argued that higher order skills in the application of knowledge offer diverse students a better understanding of content. Therefore, using Bloom's original and more familiar taxonomy, this study seeks to provide evidence that higher order thinking not only improves language arts achievement but impacts English language development for non-native speakers of English.

The Six Standards for Effective Pedagogy

Data collection for this study took place within the context of a larger mixed methods study of professional development using the Six Standards to improve teacher pedagogy for English Language Learners (ELLs). The Six Standards attend to critical theory (Freire, 1994) and sociocultural theory (Vygotsky, 1978) as pedagogical principles. See Tharp, Estrada, Dalton, and Yamauchi (2000), Teemant (2014), and Teemant et al. (2014) for detailed descriptions of the instructional and coaching models relying upon the Six Standards.

Broadly, the Six Standards promote use of Joint Productive Activity (collaboration), Language and Literacy Development (language use), Contextualization (meaning making),

Challenging Activities (higher order thinking), Instructional Conversation (dialogic learning), and Critical Stance (civic engagement). These principles have been researched extensively (e.g., Estrada, 2005; Saunders & Goldenberg, 1999; Tharp, 1982; Teemant et al., 2014). Using an observation rubric called the Standards Performance Continuum Plus (e.g., Teemant et al., 2014), teacher use of the Six Standards has been found to positively influence elementary student achievement for culturally, linguistically, and economically diverse students (e.g., Doherty & Hilberg, 2007; Doherty, Hilberg, Pinal, and Tharp, 2003; Estrada, 2005; Saunders & Goldenberg, 1999; Teemant & Hausman, 2013). Therefore, the Six Standards constitute "powerful forms of teaching" (Doherty et al, 2003, p.6).

In particular, Challenging Activities focuses on teaching complex thinking. With instructional coaching, coached teachers are supported in designing and enacting cognitively challenging activities which must be focused on higher order thinking and provide three additional components: (a) clear expectations for performance, (b) opportunities for feedback on performance, and (c) assistance during learning that supports accomplishment of complex tasks (Tharp, 1997). From a Vygotskian perspective, teachers learn to work within a student's Zone of Proximal Development (ZPD) when teaching complex thinking. The ZPD represents the difference between what learners can do without any help, and what can be learned with assistance from an influential other, such as a teacher, parent, or peer (Vygotsky, 1978; Wink & Putney, 2002). Cognitively challenging activities should meet the threshold of "productive tension" (Tharp et al., 2000, p. 30), where activities are not too easy or difficult. Arriving at correct answers is not always the goal of cognitively challenging activities, but rather the goal is to encourage students to consider alternatives in their thinking (Langer, 1995). Therefore, cognitively challenging activities tend to set high expectations for learning.

Teemant et al. (2014) reported teachers coached in the Six Standards demonstrated significant growth in their use of Challenging Activities, and that 50% of the variance was accounted for by simultaneous growth in teacher use of Critical Stance. Teemant and Hausman (2016) also provide correlational evidence that teacher use of Challenging Activities significantly contributes to improving non-native speakers' English proficiency. Therefore, this study uses a simple rating on Bloom's original taxonomy to explore the direct impact of teacher use of higher order thinking on English/language arts achievement and English language development.

Research Questions

The following research questions (RQ) guide this investigation:

RQ 1. Are there differences in use of higher order thinking between teacher participants and non-participants in Six Standards instructional coaching?

RQ2. Controlling for student grade level, are there differences in state criteria referenced language arts scores between English Learners served by teachers grouped as coached and not coached in the Six Standards?

RQ3. Controlling for student grade level, are there differences in state criterion referenced language arts scores between students served by teachers grouped as high or low in use of higher order thinking?

RQ4. Controlling for student grade level, are there differences in English language development scores between students served by teachers grouped as high or low in use of higher order thinking?

Given the positive effects of Challenging Activities, one of the Six Standards, on student achievement and English development (Teemant & Hausman, 2013), it is hypothesized that

teacher ratings on Bloom's hierarchy will have a positive influence on student outcome measures.

METHODS

This quantitative study used teachers' pre- and post-intervention scores on use of complex thinking based on Bloom's taxonomy. In addition, post-intervention Bloom's taxonomy scores were utilized to explore the effects of teacher use of higher order thinking strategies on student achievement and English proficiency as dependent variables. For RQ1, an ANOVA was run comparing coached and not coached groups of teachers with the dependent variable being the change score on Bloom's rating, calculated by subtracting the pre-intervention rating on Bloom's from the post-intervention rating to obtain a change score. For RQ2, an ANCOVA controlling for student grade level was run with student achievement on the English/Language Arts portion of the Indiana Statewide Testing for Educational Progress—Plus (ISTEP+) as the dependent variable. The independent groups included students served by teachers coached in the Six Standards and those who were not.

For RQ3, the ISTEP+ English/Language Arts portion again was used as the dependent variable. An ANCOVA controlling for differences in student grade level was used to test for differences in English/Language Arts scores between students served by one group of teachers who scored low on the Bloom's taxonomy scale (less than 3 points) and teachers who scored high on the Bloom's Taxonomy Scale (over 3). Regardless of coaching, teachers are grouped as either low or high users of higher order thinking. For RQ4, the overall score on LAS Links was used as a measure of English language learner (ELL) English proficiency. An ANCOVA controlling for differences in student grade level was used to test for differences in LAS Link scores between students served by low or high teacher users of higher order thinking.

Context and Participants

The teacher and student data for this study were collected during Spring 2009 from an urban elementary school in the Midwest participating in a longitudinal and federally funded professional development grant focused on instructional coaching (Teemant, 2014; Teemant et al., 2014). The entire school staff voted to participate (90% agreement). Participation was voluntary, with some teachers electing to be coached in Six Standards (n = 21) and the remaining teachers serving as control group teachers (n = 15).

As described in Teemant (2014) and Teemant et al. (2014), teachers were on average 45 years old, with 16.5 years of experience. ELLs with low levels of English proficiency (i.e., levels 1 and 2) were pulled out of the general education classroom and provided a 90-minute sheltered language arts block with a certified English language specialist. Therefore, the average language arts class size across the school was small with an average of 13.3 students. The school had 18 regular classrooms and 40 teachers. Teachers were predominately White (88%) and female (88%). Among the 422 students, 75% were Hispanic and 16% African American, with small populations of White, Asian, and multiracial students. Ninety-five percent of students were on free/reduced lunch, and 35% were Limited English Proficient (LEP) students.

RQ1 focused on teacher change in use of higher order thinking as measured by Bloom's taxonomy ratings. Teachers (N = 25) with pre- and post-intervention Bloom's ratings were included and were grouped by being coached (n=18) or not coached (n=7) in use of the Six Standards. RQ2 and RQ3 focused on teacher effects on English/Language arts achievement. Teachers were included in the database if they had post-intervention Bloom's taxonomy ratings and served grades 3 to 6. For RQ2, students were placed in two independent grouped based on whether their teacher participated in coaching. For RQ3, two independent groups of students

were formed based on whether their teacher was a high or low use of higher order thinking, regardless of participation in coaching. RQ4 focused on teachers' post-intervention Bloom's effects on English language development. Two independent groups of ELLs were formed based on whether their teacher was a high or low use of higher order thinking, regardless of participation in coaching. Ninety-nine percent of these students were Spanish speaking, with 1% Vietnamese.

Instruments

This study relied on teachers' ratings on Bloom's taxonomy of higher order thinking and student data from the ISTEP+ English/Language Arts exam and the overall LAS Links assessment score. A brief description of these instruments follows.

1. Bloom's Taxonomy. Bloom's (1956) original taxonomy was a hierarchy of six levels, representing low to high levels of complex thinking. For this study, values were assigned to each level: know = 1, comprehend = 2, apply = 3, analyze = 4, synthesize = 5, and evaluate = 6. Observers completed five 30-minute observations of language arts instruction, rating the level of complex thinking for each individual activity observed. At the end of the observation, the observer recorded the highest level of Bloom's observed. The three baseline (Spring 2008) and two post-intervention (Spring 2009) Bloom's ratings were then averaged. Using these averages, teachers were divided into high and low groups for analyses, where low was defined as less than 3 on the 6-point scale.

Three raters established inter-rater reliability. Classroom raters had six years of experience as instructional coaches and external evaluators. Case 2 Intraclass Correlation Coefficients (Shrout & Fleiss, 1979) were calculated using a two-way (Rater x Bloom's Levels) mixed effects ANOVA model (McGraw & Wong, 1996), where rater effects were considered

random and Bloom's rating effects were considered fixed. Intraclass Correlation Coefficient using Bloom's ratings (levels 1 thru 6) was .92, and when using high/low designations, Bloom's was .90. These were considered high and appropriate for high stakes decisions (Walsh & Betz, 1990).

2. Measure of English/language arts achievement. In Spring 2009, elementary students in grades 3 to 6 were administered a new version of the ISTEP+. This paper-and-pencil criterion-referenced test had both multiple-choice and open-ended applied skills questions (Indiana Department of Education, 2011). For this study, the English/Language Arts exam results were used as a measure of student achievement based on associated Indiana Academic Standards, which were adopted in 2000. The cooperating district provided the researchers with student level ISTEP+ data for each participating teacher.

3. Measure of English proficiency. The Language Assessment System (LAS) Links is a standardized K-12 assessment of English language proficiency used as an accountability measure by districts. The reliability and validity of LAS Links has been established and reported by CTB McGraw-Hill (Website at www.ctb.com). The assessment provides information on non-native speaker's proficiency in four domains of English development: reading, writing, speaking, listening. A comprehension score is derived from combining listening and reading scores. The individual scores combine into an overall score. The overall score provides a level of proficiency for a student, where one represents the lowest level and five represents fluency. Results can be reported as raw or scale scores, which account for the level of question difficulty from year to year.

LAS Links is administered to newcomers for program placement, and then yearly in January or February as an annual measure of English development. The tests are either

administered individually (speaking for all grade levels) or in groups depending on grade level and domain. For the speaking domain, students identify, describe, or tell a story based on the use of objects in pictures. For the listening domain, students listen to and then answer questions based on directions, expository passages, or narrative stories. For reading, students read and answer questions on three reading passages, as well as questions focused on word analysis and usage. For writing, students write sentences and an essay, and respond to multiple-choice questions about writing conventions. For the current study, student's overall LAS Links scores were used to assess teacher effects on English language proficiency.

Instructional Coaching Intervention

During 2008-09, teachers were instructionally coached as part of a yearlong instructional coaching intervention focused on Six Standards pedagogy. The growth targets for coaching were the Six Standards. Coached teachers participated in a two-phase professional development intervention, which began with a five-day, 30-hour summer workshop on the Six Standards. Next, teachers were individually coached seven times across the year during their language arts block. The instructional coach was an expert in the Six Standards with over six years of coaching experience. For a complete description of the Six Standards instructional coaching model, see Teemant (2014) and Teemant et al. (2014).

Data collection and analysis

To understand the effects of teacher use of higher order thinking on student outcomes measures, this study analyzed the impact of teachers' ratings on Bloom's taxonomy on language arts achievement and English development. An analysis of variance (ANOVA) was run to compare differences in coached and not coached teachers' growth in use of higher order thinking during the coaching intervention year. Controlling for student grade level, one-way analyses of

covariance (ANCOVAs) were calculated to explore group differences in student achievement on the I-STEP language arts and overall LAS Links score. Analyses included calculating unadjusted and adjusted means (*M*), standard deviations (*SD*), and standard errors of the mean (*SE*) by group, which represent students served by coached and non-coached teachers and teachers scoring high or low on Bloom's taxonomy. The ANCOVA *F* statistic ($p \leq .05$ level) and effect sizes using partial eta-squared are reported.

FINDINGS

For RQ1, pre- (Spring 2008) and post-intervention (Spring 2009) scores of teacher use of higher order thinking were analyzed. Prior to Six Standards coaching, 76% of all teachers used activities that averaged as low-level activities (know or comprehend) on Bloom's taxonomy (*Mean/M* = 2.29; *Standard Deviation/SD* = 1.07), with 86% of language arts instruction being conducted in whole class configurations. There was no statistically significant difference between the experimental ($M = 2.46$; $SD = 1.57$) and control ($M = 2.00$; $SD = 0.83$) group teachers prior to coaching: $F(1, 28) = 1.29$, $p = .27$. Instruction in the school was teacher dominated, with predominant focus on student compliance, individual work, artificial tasks, knowing facts, copying, and following procedures with minimal student talk.

Post-intervention ratings demonstrated statically significant differences between the control and experimental (or coached) teachers use of higher order thinking. Approximately 75% of all activities for post-observation required higher order thinking (3 and above) with an overall mean of 3.58 on the six-point taxonomy, with 81% of instruction being in small group configurations. However, it was coached teachers who grew in use of higher order thinking ($M = 1.87$; $SD = 1.43$) while control group teachers did not change ($M = 0.00$; $SD = 1.37$) when using

change scores (i.e., post-intervention rating minus pre-intervention) This difference was statically significant: $F(1, 24) = 8.81$, $p = 0.007$.

Table 1 presents the adjusted and nonadjusted means and variability with grade level as a covariate for each independent group for research questions 2-4. Effect sizes using partial eta-squared effect sizes are also reported.

Table 1

The Effect of Coaching and Bloom's Taxonomy and Measures of Student Learning

RQ/Test	Groups	Students		Nonadjusted		Adjusted		Effect Size
		n	N	M	SD	M	SE	
RQ2 ISTEP+	Coached	109		462.18	53.95	459.12	4.52	0.03
	Not coached	19		417.58	50.85	435.14	11.11	
		=	128					
R3 ISTEP+	High Use	128		463.25	51.45	460.51	4.03	0.03
	Low Use	19		417.58	50.85	436.04	10.78	
		=	147					
R4 LAS Links	High Use	178		503.88	53.98	500.79	2.91	0.06
	Low Use	32		455.53	73.58	472.70	6.93	
		=	210					

Note: *n* = sub-group participants, *N* = total number of participants, *M* = Mean, *SD* = Standard Deviation, *SE* = Standard Error*; Effect Size* = Partial Eta Squared

For RQ2, an ANCOVA was run to determine the effect of coached and not coached teachers on students ISTEP+ language arts achievement after controlling for grade level. Prior to

adjusting for grade level as the covariate, there was a significant group difference between groups, $F(1, 125) = 3.92$, $p = .050$. Coached teachers had higher students performance on the ISTEP+ language arts exam ($M = 462.18$ vs 417.58), with an effect size of .030. The effect held after mean scores were adjusted for student grade level. Specifically, students who were taught by coached teachers outscored peers taught by teachers who were not coached on the ISTEP+ ($M = 459.12$ to 435.14), a difference representing a medium effect size.

Designating teachers as low (below 3) or high (3 or higher) on the Bloom's taxonomy scale allowed the formation of two independent groups. The ANCOVA for RQ3 determined the effect of teacher use of higher order thinking on students' ISTEP+ language arts achievement after controlling for grade level. Teachers who used higher order thinking served students' who performed significantly higher on the ISTEP+ language arts exam ($M = 463.25$ vs 417.58) compared to students served by teachers using low levels of higher order thinking: $F(1,144) = 4.44$, $p = .037$, with an effect size of .030. These results hold when student grade level is used as a covariate. Specifically, teachers in the high Bloom's group served students with higher adjusted mean ISTEP + scores ($M = 460.52$ vs 436.04), which equates to a medium effect size.

Using high and low Bloom's group designations to group 18 teachers, the ANCOVA for RQ4 determined the effect of higher order thinking on students' LAS Link proficiency. Prior to adjusting for grade level, students served by teachers in the high Bloom's group outscored their peers taught by teachers scoring low on Bloom's scale by a mean difference of 48.53 points on the LAS Link (M=503.88 vs 455.530), $F(1, 207) = 13.86$, $p < .0005$, with an effect size of .063. These results hold when student grade level is used as a covariate. Specifically, teachers using higher order thinking, defined on Bloom's hierarchy as levels 3 to 6, had higher student

performance on the overall LAS Links (M = 500.79 vs. 472.69), which equates to a large effect size.

DISCUSSION

Two major findings are captured in this paper. First, the findings make clear (RQ1), as Guskey (2000) predicts, that teacher growth and gains in student achievement only occur as a result of intentional professional development. Second, according to the findings (RQ2-4), teachers who design activities that require higher order thinking positively influence students' learning outcomes. Student gains are present in both language arts achievement and English language development. Furthermore, the effect of higher order thinking on non-native speakers' English development is twice as large as for gains in language arts achievement. Given the cultural, linguistic, and economic diversity of the student population studied, the findings corroborate Zohar's and Dori's (2003) conclusion that use of higher order thinking activities benefits marginalized student populations. As Zwiers et al. (2014) argue, students appear to understand academic content better when engaged in higher order learning activities.

Several practical, theoretical, and research implications can be drawn from these findings. First, teachers of ELLs, as well as other marginalized students, need to be exposed to the empirical evidence supporting use of higher order thinking, countering the tendency to shield students from grade level curricular expectations. While the focus on Bloom's taxonomy was situated within the more complicated Six Standards professional development, the findings suggest that simply focusing on higher order thinking can yield positive achievement gains. Although the effect sizes on learning were generally small, this is in line with other educational research on student achievement, where so many other factors influence outcomes. Use of higher order thinking contributes significantly to student learning.

Second, rather than lowering expectations for students, teachers need to engage in more sophisticated and nuanced professional learning focused on understanding what Weinstein (1996) described as "appropriate supports" (p. 17). Theoretically, a focus on appropriate supports captures Vygotsky's (1978) concept of the more knowledgeable other—in this case a teacher—working productively within the student's Zone of Proximal Development. When learning is not too easy or difficult, Tharp et al. (2000) argue it is the teacher who assists students to take the next step in their cognitive development because of the productive tension presented by the activity. Tharp (2012) details eight types of responsive assistance supported extensively by research: Task structuring and restructuring, propping or nudging, modeling, contingency management, instructing, questioning, cognitive structuring, and feeding-back against a standard. Such mediation in the learning process constitutes the dynamic interactions that make the space between the teacher and student active (Vygotsky, 1997). Lantolf and Poehner (2008) describe a dynamic assessment process where teachers are able to "uncover the source of their [students'] difficulties" tailoring "an appropriate" support, which requires the teacher—as assessor of learning—to "abandon his/her traditional role as a dispassionate observer in favor of collaborating with learners to actively intervene in development" (p. 16).

Finally, assisted learning is theoretically rich, yet requires much more research to understand how to translate theory into rich practice. Further research is needed to understand the benefits that accrue to students as teachers move from simply providing learning activities that require higher order thinking to actually assisting students through complex tasks as more knowledgeable others. Certainly, the aspirations of dynamic assessment are theoretically clear while the implementation of such practice is more challenging from a professional learning perspective as well as a financial one, where time and resources for teacher learning are limited.

CONCLUSION

Teachers face challenges in learning to educate an increasingly diverse student population and to realize the aspirational elements of Common Core in classroom instruction. This study presents corroborating evidence that teacher use of higher order thinking skills, as measured by Bloom's familiar hierarchy, increases both academic achievement and English proficiency. This finding directly undermines the argument that low-achieving, multicultural, or multilingual students need more drill on basic skills. When teachers intentionally engage students in higher order thinking, students learn more. While the Six Standards pedagogy and coaching result in student achievement gains, this study points to an essential first step for any teacher to consider in improving learning outcomes: Use higher order thinking.

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