Negotiating a Shared Definition of Curriculum Integration:
A Self-Study of Two Teacher Educators from Different Disciplines

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It is generally agreed that making connections across subject areas in school is good teaching practice. Backed by essentially every major reform effort in recent years (e.g., National Council of Teachers of English, 1996; National Council of Teachers of Mathematics, 1989, 2000; National Research Council [NRC], 1996, 2012; National Science Teachers Association, 1996), interest in curriculum integration in teacher education has been renewed and promoted as an instructional practice that is supported by both cognitive science and neuroscience (Beane, 1996; Cohen, 1995; Victor, Kellough, & Tai, 2008). Advocates also suggest that integration improves student learning, academic achievement, problem-solving ability, and motivation (Berlin & Hillen, 1994; Guthrie, Wigfield, & VonSecker, 2000; Hurley, 2001), while inspiring students to discover relevance in their education (Hargreaves & Moore, 2000). Research also indicates that most teachers, particularly those in the earlier grades, have positive attitudes toward integration (Czerniak, Lumpe, & Haney, 1999), although they may find it challenging (Basista & Matthews, 2002; Kysilka, 1998; Meier, 1996).

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One of the major challenges associated with teaching novice and practicing teachers how to plan

and enact curriculum integration may be that there continue to be differing notions of what it means to integrate academic subjects during instruction (Hurley, 2001) despite appeals for a common definition (Davison, Miller, & Metheny, 1995). Davison et al. stated,

> Few educators would argue about the need for an interwoven, cross-disciplinary curriculum, but to many, the nature of the integration in many interdisciplinary projects is not readily apparent. A more pervasive problem is that integration means different things to different educators. (p. 226)

This difficulty is underscored by the wide array of terms used when discussing the construct: "inter-disciplinary, multidisciplinary, transdisciplinary, thematic, integrated, connected, nested, sequenced, shared, webbed, threaded, immersed, networked, blended, unified, coordinated, and fused" (Czerniak, 2007, p. 542).

Victor et al. (2008) account for the conceptual differences concerning integration, explaining that there are multiple *levels* of integration. Traditional subject matter separation (subject-specific instruction at different times during the school day, when what is being taught in one subject has little or no connection with content taught in another) lies at one end of this continuum. At the other end, discipline boundaries become "blurred during instruction" (p. 14). This *cross-curricular or thematic instruction* (Martin, Sexton, Franklin, & Gerlovich, 2005) revolves around a central concept or theme (*e.g*., pollution), which guides the selection of learning activities and texts in multiple subject areas.

Other authors suggest that integration brings concepts from different disciplines together in ways that they are mutually reinforcing (Alvermann, Swafford, & Montero, 2004; Wellington & Osborne, 2001). From this perspective, making connections across the curriculum brings about deeper understanding (Mason, 1996), while "staying true to the key ideas of each [discipline]" and without giving "primacy to one of the disciplines, to the detriment of the other" (Weiss, 2006, p. 369). In this way, different subject areas do not merely bump up against each other around a common theme; nor is a skill in one discipline merely practiced during instruction or used to assess understanding of another subject (*e.g*., organizing data to create a graph, reading a paragraph, writing a summary). Instead, students are taught skills and/or knowledge from at least two different academic subjects in ways that reinforce the learning of each and occur in natural, unforced teaching/learning situations. This instruction also includes assessment of the skills and/or knowledge from each subject taught. While multiple subject areas may be integrated in this way, the focus of this paper is on the links between science and literacy (see Alvermann et al., 2004; Gunel, Hand, & McDermott, 2005; Klein, 1999).

When considering the natural links between literacy and science, some literature describes language as a tool that can be used to develop and reinforce understandings about science and that science provides an authentic context in which literacy is learned and practiced. Alvermann and her colleagues (2004), for example, main-

tain that it is "absurd" to think that "traditional ways of knowing—reading, writing, speaking, and listening—[could] be considered in isolation, away from content area teaching" (p. 196), a contention that is supported by some science educators (*e.g.*, Wellington & Osborne, 2001). Additionally, research suggests that meaningful reading and writing experiences in science encourage critical thinking and engender learning (Gunel, Hand, & McDermott, 2005; Holiday, Yore, & Alvermann, 1994; Klein, 1999) while helping students to become better communicators (Klein, 1999).

Although connections between the two disciplines seem clear, we contend that teaching both science concepts and literacy skills in an integrated way becomes more challenging and conceptualizations of what this might look like in practice differ. Indeed, descriptions of integrated science and literacy instruction often depict literature (either narrative or expository) as a means of enhancing children's science experiences (*e.g.*, Martin, 2009). In these cases, a poem, story, book chapter, or picture book may be used as a springboard for a science learning activity. Other integrated instruction describes instances of reading and/or writing during science activities as a way to practice literacy skills (*e.g.*, Bass, Contant, & Carin, 2009), seeming to assume children already know how to read and write science text. Often missing in these descriptions and in discussions about integrating science and literacy are explanations of specific ways to *teach* both science concepts *and* the appropriate literacy skills required to read and communicate about those concepts.

As we contemplated our initial conceptions of and expectations for integration and our isolated attempts to teach curriculum integration in our respective preservice methods courses, we began to explore the possibility of a meaningful "interdisciplinary collaboration" (see Bullough, 2006). Like Samaras and her colleagues (2006), we noted that while we, as teacher educators, promote critical and collaborative reflective inquiry amongst both intending and practicing teachers so that they might learn from each other (Calderhead & Shorrock, 1997), we do not typically engage in collaborative inquiry across disciplinary boundaries ourselves; nor do we model this practice for our preservice teachers. Rather, we teach in our individual, isolated disciplines, while ignoring the possibilities of collaboration that we require our students to consider, even as novice teachers.

It seemed reasonable, then, that a 'collaborative' or 'interactive' self-study (LaBoskey, 2007) of a literacy teacher educator and a science teacher educator could lead to shared understandings and transformed practice in the teacher preparation courses we teach. At the same time, we anticipated that the critical discourse requisite to collaborative self-study could lead to a shared, operationalized definition of curriculum integration that would enable us to effectively help preserivce teachers understand the principles and practicalities involved in planning and enacting integrated instruction in our university methods courses. Specifically, the purpose of this self-study was two-fold: (a) to critically examine our own individual understandings of curriculum integration as teacher educators from two different disciplines (literacy and science) and (b) to explore how our

thinking and practice evolved as we moved toward a shared conceptualization of curriculum integration.

Theoretical Framework

This collaborative self-study is informed by the work of Dewey (1916, 1938), who conceptualized knowledge as a process of learning and knowing through social interaction within different situations or contexts. This social interaction manifests itself through communication, "a process of sharing experience until it becomes a common possession" and "modifies the disposition of both the parties who partake in it" (1916, p. 9). The goal of our work was to better educate our individual selves through a shared experience as teacher educators. Indeed, context, process, and relationship were critical to this study (Bullough & Pinnegar, 2001).

We also draw upon Samaras' (2002) concept of *learning zones*, adapted from Vygotsky's (1978) conception of zones of proximal development. Learning zones are defined as "joint activity between individuals in a learning context with effort to present perspectives and construct knowledge" (Samaras et al., 2006, p. 44). According to Samaras, these learning zones occur where learners negotiate meaning and socially construct an understanding of a shared task. In this study, our task was to articulate differing perspectives and to negotiate a shared conceptualization of curriculum integration and how best to convey this joint understanding to prospective teachers in our methods courses.

Finally, we view Lyons and LaBoskey's (2002) notion of reflective practice as critical to this study. It is through reflection on our thinking and our practice that we, as teacher educators, are able to improve teacher preparation and to develop as educators.

Context

We work within a sizeable teacher preparation program (approximately 190-200 graduates a year in Elementary and Early Childhood Education) at a large, private university in the western part of the United States. The program is based in a long-standing public school partnership and emphasis is given to the moral dimensions of teaching (Goodlad, 1994). The university and department administration value and encourage collaboration among faculty members and support is given to those who wish to work together, especially when the collaborative work is cross-disciplinary.

Our mutual interest in curriculum integration began approximately six years ago, as we began to collaborate on research projects where our diverse expertise and experience were necessary. For example, in one study, where fifth grade classroom teachers developed and implemented integrated science units during a professional development experience, we examined the effects of this experience on participating teachers' thinking about integration and its impact on students' understanding

of science and literacy. As a result of this and similar studies, it became very clear to us that curriculum integration and its enactment is not uniformly understood by either intending or practicing teachers. Moreover, as teacher educators from disparate disciplinary backgrounds, we also discovered that while we valued curriculum integration, our individual conceptions of it and our understandings of how it could or should be implemented differed. Perhaps more importantly, these early experiences required each of us to tentatively, but publicly, articulate our individual perspectives and pushed us to begin to think more deeply about the enactment of integration and its importance in teaching and learning. These were our first attempts at making sense of this complex construct.

Through these experiences, we also learned that while our individual disciplinary focus prompted each of us to value the *idea* of integration, it was also what limited our ability to clearly describe how to combine both subject areas during instruction in rich and meaningful ways. Kendra, as an early childhood literacy educator, viewed integration as a means for creating meaningful curriculum for young children. However, she was limited by her emphasis on literacy skills without appropriate attention to the science concepts. Leigh, as a science teacher educator, also viewed integration as a way of enhancing learning experiences, but promoted it primarily as a means of using literacy (reading, writing, speaking) to support children's understanding of science content. She thought little of how science might strengthen their ability to negotiate informational texts, struggled to understand how to explicitly teach literacy skills in the context of an integrated science lesson in appropriate ways, and was unsure which literacy skills might best support children's conceptual understanding depending upon the science concept(s) being taught. Not surprisingly, our individual instruction in our separate methods courses relative to curriculum integration reflected these disparate emphases.

While we had discussed our common interest in the links between science and literacy and our individual views of integrated curriculum, the real catalyst for the current study occurred when Leigh was asked to teach science methods courses for the early childhood teacher preparation program, for which Kendra primarily taught literacy methods courses. At the time of this study, the students in the program were required to take a curriculum integration course early in their program; however, the ideas taught during this course were not explicitly connected to our methods courses, which were taught much later in the program, just prior to student teaching. Thus, although we anticipated that our students should have developed an emerging understanding of curriculum integration by the time they enrolled in our courses, we felt compelled to ensure their understanding and ability to enact it before they went out into the schools to teach. At the same time, we recognized that sharing and promoting a common understanding of the construct would very likely minimize confusion on the part of our students.

Self-Study Methodology

Self-study is a form of qualitative research that allows educators to contribute to educational research through studying and improving their practice, while in the process making their personal experiences and analyses of them public (Bullough & Pinnegar, 2001; Hamilton & Pinnegar, 1998; LaBoskey, 2004). In this self-study, we examined our practice in the context of our role as teacher educators from different disciplines in preservice methods courses. The purpose was to investigate our individual and shared conceptions of curriculum integration and the ways in which an interdisciplinary focus changed our thinking and improved our ability to prepare intending teachers for classroom practice (Whitehead, 2000). Because of this emphasis, we elected to engage in a 'collaborative' or 'interactive' self-study, wherein we could obtain "alternative perspectives on what we are doing and finding from [a] colleague" (LaBoskey, 2007, p. 841). These interactions would then serve as the primary data set for the study (LaBoskey, 1998).

Data Sources

Because the focus of this self-study was specifically on our perspectives as teacher educators, student response to our instruction was not the emphasis. Rather, data were derived primarily from transcriptions of multiple, recursive conversations (both formal and informal) around topics and classroom incidences related to curriculum integration (*e.g.*, what curriculum integration is, literacy skills and science content instruction, literature vs. scientific literacy, students' response to instruction, instructional planning). These critical conversations, which occurred over four semesters (two academic years), focused on our evolving conceptions of integration, resulting changes in our classroom instruction relative to integration, and how we perceived our students were coming to understand it. During this time, we planned and co-taught lectures designed to explain curriculum integration and provide examples, and engaged our students in learning activities during selected class periods of our methods courses. As is true of action research, our ongoing dialogue allowed us to employ cycles of inquiry that incorporated almost "immediate practical application and testing of insights gained" (LaBoskey, 2007, p. 850). Additional data sources included co-developed classroom lecture notes and PowerPoint presentations, jointly created assignments and test questions designed to give us a sense of our students' understanding of and ability to enact curriculum integration as a result of our instruction, and our individual written reflections on the process.

Data Analysis

In a manner similar to that of constant comparative methodology (Strauss & Corbin, 1990), data production/collection and the first phase of analysis occurred as a simultaneous and recursive process. Following each critical conversation, we

examined the changes in our conceptualization of curriculum integration and collaboratively made decisions about altering our instruction in our co-taught lectures. In this way, we used dialogue as a process of coming to know (Pinnegar & Hamilton, 2009): first, representing our individual ways of thinking and then analyzing and representing those ideas through our team-teaching experiences. The cycle of dialogue, practice, and reflection offered the space to try new ideas and to 'bump up' against areas of misunderstanding. Indeed, dialogue provided a way to check the trustworthiness of our data, expand our ideas, and move them forward (Pinnegar & Hamilton, 2009). Ultimately, the recursive nature of our critical reflections enabled us to explore our individual thinking and delve more deeply into the complexities of curriculum integration; reach a tentative, but shared understanding of what it means in terms of actual classroom practice; and begin to address the issues and challenges associated with teaching preservice early childhood teachers how to effectively link science and literacy in the classroom.

At the conclusion of the four semesters, the second phase of analysis began. During this stage, we each individually and then collaboratively reexamined the transcripts of conversations, personal reflections, lecture notes, and PowerPoint presentations in order to identify common patterns, themes, or 'recurring regularities' (Guba, 1978) relative to our evolving conceptualizations of curriculum integration and how these understandings influenced our instructional practices. As each of these themes were identified and coded, they were linked to representative quotes, incidences, or classroom artifacts. We refer to these themes later as the outcomes of our collaborative self-study.

Evidence/Results

Through a cyclic process of dialogue, reflection and analysis, and planning and instruction, we came to better understand and to be able to more clearly articulate our individual conceptions of curriculum integration and what it might look like in practice. Simultaneously, each of us came to better understand the construct from the other's perspective. Negotiating a shared understanding was, then, a recursive process of personal and shared reflection and negotiation. In this section of our paper, we share representative excerpts from this process.

Negotiating A Shared Definition of Integration

As we began our collaborative self-study, our conceptions of integration were clearly grounded in our own personal experience. Our understandings emanated, in part, from our teacher preparation programs and from our experience as classroom teachers. They were also influenced by our current individual disciplinary focus as teacher educators.

Articulating Initial Conceptions of Integration

During our first formal conversation, we articulated our individual conceptualizations of integration. Kendra spoke comfortably and confidently about her understanding of the purposes and practices involved in integration; Leigh was more tentative and unsure about her definition and description.

As an early childhood literacy educator, Kendra had long seen integration as an effective instructional strategy wherein two or more objectives are taught in a single lesson. She saw this as a strategy that was used in order to help make learning more meaningful and authentic because it highlights the connections between the disciplines. This was, she explained, a "focus of my early childhood education program" (K-9/1/06).

> When I was a classroom teacher I sought to integrate because I believed that it was an effective way of organizing curriculum so that it more closely mimicked real-life learning. I think I believed that because it is what I had been taught in my preservice program. I think I even had a course that was titled, 'Integrated Curriculum.' Integration was something I thought of as good practice. (K-9/1/06)

As Kendra left the classroom and focused her graduate studies on early literacy, she continued to value integration and saw the importance of considering how to integrate literacy across the curriculum in order to make reading and writing more meaningful for young children.

> My feeling is that whenever you are planning a reading or writing lesson there is always some content—you have to read and write about something. So, when it makes sense, you might as well take advantage of that and teach an integrated lesson. (K-9/1/06)

Leigh, on the other hand, began our work together with the perception that literacy is a collection of skills that might be used to enhance science teaching and learning, although she admitted that she was not absolutely certain how that might be accomplished. She also felt that while integration was an effective way to teach, her introduction to the notion of integration during her elementary teacher preparation program had been vague.

> To be honest, I don't remember ever being told or shown what integration would actually look like in the classroom. [During my preservice program] we were told that it was an "unqualified good," but I did not come away from teacher preparation with a clear notion of how to integrate…what it actually looked like in practice. I suppose my conception of it really came from observing what other, more experienced classroom teachers were doing. At this point, I'm not really sure. (L-9/1/06)

She recalled that during her experience as an elementary teacher she had often used literature as a lead-in or springboard to science lessons.

> I remember using the book, *There's an Owl in the Shower* (George, 1995) as a

> read-aloud when teaching about the potential conflicts that exist between nature and human industry. The students were then divided into groups to do additional research and debate the issues from different perspectives. Would that be considered integration? (L-9/1/06)

In contrast with Kendra's experience, integration was never a significant topic of discussion in Leigh's teaching or university experiences.

Examining Existing Definitions and Interpretations of Integration. Particularly challenging was the task of negotiating and reaching an *operationalized* definition or conceptualization of curriculum integration, one that was satisfying to both of us and would enable us to support our early childhood preservice teachers' understanding of and capacity to enact it in a classroom of young children. We specifically wanted to be able to offer concrete and clear examples as we explained integration to our intending teachers.

As part of this process, we visited and revisited a variety of definitions and descriptions of integration found in the literature, finding them to be incomplete or dissatisfying because they did not, in one way or another, adequately and appropriately attend to each of our disciplines. For example, educators often define integration as what Parker (2005) refers to as *infusion*, or the use of one subject area to help the learner gain deeper understanding of another subject. While this definition satisfied Leigh's initial conception of integration, it clearly did not match Kendra's.

In practice, infusion is enacted in several different ways: (a) the teacher "*uses* literature (typically a picture book, short story, or poem) as a 'springboard' into teaching and learning a science concept, but no literacy skill is intentionally taught" (L-9/27/06); (b) the students are asked to "read a story or short text about a science topic—say, frogs—during literacy instruction and the purpose of reading is not really to teach anything about frogs…nor are frogs related in any way to the science concepts addressed during science time" (L-10/30/07); (c) the "students' understanding of a science concept is assessed by asking them to write a summary or a compare/contrast paragraph, but no instruction is given on how to summarize; nor are the children taught the appropriate language to use when making comparisons" (K-10/30/07). We eventually came to agree that these and other, similar examples trivialized one or both academic subjects (see Mason, 1996), that both subject areas were not necessarily mutually reinforcing (Alvermann et al., 2004), or that one was given priority to the possible detriment of the other (Weiss, 2006). And, although we described this type of instruction as acceptable classroom practice, we also questioned whether it was actually integration (Class Lecture, 11/15/07).

Although we examined and discussed an array of definitions (*e.g.*, Berlin, 1994; Czerniak, 2007; George, 1996; Mason, 1996), we were unable to find a published description of integration that was satisfying to both of us. However, using these definitions as a talking point, along with interpretations of integration that were

taken from our own practice and the practice of other educators, we sought to make our thinking explicit and to articulate our sense of this complex construct.

Identifying Points of Dissatisfaction

As a result of our discussions and shared instruction, we identified three main points of shared dissatisfaction with definitions and examples of practice often designated as integration. For us, the process of identifying these points forced us to clearly articulate our thinking and served as a catalyst for ongoing conversation, negotiation, and altered practice. Using illustrative examples from our own perspectives as well as those we came to share as we co-taught our preservice teachers in their literacy and science methods courses, these points are outlined in the following sections. It is important to note that although we describe them separately, these points are often interrelated in actual practice.

Intentionality: Explicitly teaching both subjects. The first point of dissatisfaction emerged from our perception that in many integrated lesson examples, whether offered in the literature or observed first-hand in the classrooms we visited, it was unclear whether there were actually learning objectives for *both* subjects (in this case, science and literacy) because they were not explicitly taught. In these lessons, it was unclear whether the subjects were intentionally integrated because one subject was simply *used in the service* of the other, while the other concept (in the case of science) or skill or strategy (in the case of literacy) was actually *taught*. This left one of us feeling that our particular discipline was not adequately addressed. In short, we agreed that emphasis and attention must be paid to both. We noticed that most often, in these instances, it was the literacy skill or strategy that was used during a science lesson (*e.g.*, children are asked to compare and contrast types of leaves, but not taught the key words used when comparing and contrasting). Examples of how our discussions impacted one another's thinking relative to this issue are provided below.

After working with Leigh over the first semester of our collaborative inquiry, Kendra began to see that she had a tendency to emphasize the literacy skill or strategy over the science content when thinking about integration.

> Before working with you [Leigh], I always taught the preservice teachers how to use informational texts during guided reading or a read aloud because I thought it was important to teach literacy with more than just narrative texts. I would clearly model a particular literacy strategy for them and then often times they would ask me if what I had modeled was an 'integrated' lesson. I told them the particular example I had used wasn't, but it certainly *could* be if they chose a content objective and then taught it along with the literacy objective. In these examples, the content was more of an afterthought. But I thought I was giving it [the content] the necessary attention as long as both objectives were taught. (K-2/21/07)

Kendra acknowledged that considering Leigh's perspective that a science content

objective did not just need to be taught, but also needed to be based on an age-appropriate "big idea" (*e.g.*, patterns, cause and effect, or stability and change) in science changed the way she approached examples like this. She began to think more carefully and intentionally about selecting a science objective based on one of these ideas rather than having the book or targeted literacy skill, alone, dictate the science topic and objective that was chosen. And Leigh's continued reminders helped Kendra keep this in the forefront of her mind when generating examples of integrated lessons.

Like Kendra, Leigh's perspective on teaching two objectives during an integrated lesson also changed through our interactions. Because she had initially viewed literacy as a tool to be used in learning content subjects, such as science, her tendency was to identify a science concept and then determine what literacy skill might be used to enhance children's understanding of that concept. However, in response to Kendra's argument that transfer of learning may not occur without explicit instruction, Leigh began to understand why it was also critical to teach the literacy skill during an integrated lesson. An example of how this change occurred in Leigh's thinking about teaching both subjects during an integrated lesson occurred during an instructional planning session.

> So, after the children make a different shape with the clay (a physical change), we'll ask them to write a sentence comparing the clay before and after the change (compare and contrast). But then we would need to teach or re-teach the key words we might use as we compare…ask them to explain how it is the *same* and *different* after the change, right?" (L-3/1/07)

As Kendra shared her conception of integration from a literacy perspective during an earlier classroom planning session, Leigh admitted, "I had never really thought about integration from a literacy perspective. I had generally thought about it in terms of strengthening instruction in the content areas: science, social studies" (L-9/27/06). That science instruction might also improve students' ability to negotiate informational texts (i.e., help children to be able to read and write expository text) was something she had not consciously considered. During the same planning session, Kendra introduced comprehension strategies designed to help students attend to the internal structure of text in order to help them access meaning (*e.g.*, contrasting the organizational structures of informational text and narrative text). This conversation helped Leigh understand how teaching and learning particular literacy skills or strategies could be coupled with instruction about particular science concepts to support students' ability to simultaneously access science knowledge (learn science) and negotiate science-related texts (learn literacy).

Authentic practice: Staying true to the discourse and the discipline. The second point of dissatisfaction proved to be more applicable to science than to literacy. Certain practices common in early childhood and elementary classrooms and described as integration were troubling to Leigh because they fail to appropriately

represent the nature of science; they do not stay true to the goals of science education (NRC, 1996, 2012). Instead, these practices distort or trivialize it (Mason, 1996; Roth, 1994).

From Leigh's perspective there are two aspects of authentic practice. The first is ensuring that the integrated lesson actually engages children in scientific discourse; the second is staying true to the discipline of science. An example of disregarding the discourse of science would occur when students are asked to write a poem about one of the planets while studying the solar system. Although this assignment requires children to write about the planets, poetry is not the type of text that is typically used in the natural discourse of science (Class Lecture, 10/11/07). This notion of science discourse proved to be an ongoing part of our discussions about authentic practice. Even in very early conversations, Leigh noted its importance in science education:

> What children are asked to read and write should also be true to science. It should promote scientific literacy in the sense that the children are actually learning the 'language of science' (see Wellington & Osborne, 2001). A teacher might ask the children to write a Haiku about the weather during winter, but scientists don't typically communicate about science topics through poetry. Instead, teachers should help children negotiate expository texts in science. (L-9/27/06)

Although Kendra and Leigh agreed that the texts and content that are used in an integrated lesson should be true to both disciplines, this issue is viewed differently in our respective fields. That is, literacy educators do not often talk about being true to literacy in the same way that science educators do. For example, a teacher might use a particular science topic (*e.g*., the rock cycle) while teaching students creative writing and ask the students to "Write a story about a day in the life of a rock." This assignment, which attributes human characteristics or behaviors to inanimate objects (anthropomorphism), would not be true to the discipline of science; rocks do not have a "life" (Class Lecture, 10/11/07). However, from a literacy perspective, the assignment could still be considered legitimate; teaching students how to write a story as a mode of creative writing is true to literacy. Indeed, literacy educators, like Kendra, suggest that children should be taught to read and write a variety of texts, although they are concerned with creating writing assignments (such as this example) that may place an over emphasis on narrative texts.

From Leigh's perspective, as a science educator, staying true to the discipline of science also means that science should not be taught as isolated facts. Doing so reinforces the misconception that science in school is different from *real science*. "It is difficult, if not impossible, to teach the big ideas of science in isolated lessons, unless the objective is chosen with that purpose in mind" (L-2/20/08). Instead, Leigh explained, science instruction that is true to the discipline typically requires a series of developmentally appropriate lessons designed to teach a core idea or major concept, such as *matter and its interactions* or *cause and effect*, respectively, with each lesson designed to teach an aspect of the larger idea or topic [see NRC,

2012]. Although this was not something Kendra had considered before, she began to see how important it was to be sure that a science concept was not only explicitly taught, but also worth teaching in terms of what the children are learning about science. "I can see how if this is not done, science really becomes a random list of facts rather than a discipline" (K- 2/20/08).

Meaning making: Using natural connections between the subjects. The third point of dissatisfaction was prompted by lessons labeled as integrated wherein the literacy and science did not naturally fit together. It seemed to us that in these cases connecting the two subject areas in the same lesson was forced, as if the teacher thought that *any* connection between two or more disciplines was educationally sound practice. We came to describe this point as the need for a "natural connection." In other words, the curricular links should be mutually reinforcing (Alvermann, Swafford, & Montero, 2004; Wellington & Osborne, 2001), thereby supporting children's ability to make meaning during instruction.

Early on in our conversations, we determined that we both valued natural connections in an integrated lesson. We readily agreed that the skills, strategies, and content should "match" in order to make this type of teaching effective and mutually supportive of both curricular objectives.

> We're looking for real connections, natural connections…so you have to consider the things that match and those that don't match…[for example] if you want to teach sequencing as a literacy skill, there is some science content that matches that literacy objective and some that does not. You might teach about life cycles with sequencing; there is a sequence to a life cycle. But, it is not as helpful to teach animal classification with sequencing because there is no relevant sequence to that content. (K-9/1/06)

Another example of a natural connection might be "to teach the children how to structure a cause and effect paragraph while teaching them about hurricanes or tornadoes" (L-9/1/06).

Coming to Know: Outcomes of Our Collaborative Self Study

As a result of our shared inquiry, we have gained a number of important insights relative to our view of integration and our roles as teacher educators. The experience has served as a catalyst for change in our individual practice and we acknowledge the need to continue our work together. The outcomes of this self-study include (a) a shared, working definition of curriculum integration, (b) a heightened recognition of the challenges of teaching integration to preservice teachers, and (c) a renewed commitment to collaboration.

A Shared, Working Definition of Integration

After two years of negotiating points of dissatisfaction and challenges faced when working with our preservice teachers, we have constructed a shared, working definition of integration. We wish to emphasize the tentative nature of this definition, which highlights the complex nature of the construct. We also acknowledge that our definition is rooted in our view of the purpose of integration, which is to make learning more authentic and meaningful. As such, we recognize that those who see different purposes for integration may also wish for a broader definition of the construct. However, throughout our negotiations we found that one or both of us were dissatisfied if our definition was broadened to include other purposes. Thus, for us, curriculum integration is instruction during one lesson that is based on two or more objectives from two or more subject areas, which are (a) explicitly taught and assessed, (b) authentic to the discipline and its discourse, and (c) represent a natural connection between the subject areas, thus supporting and honoring the key ideas and nature of each discipline.

A Heightened Recognition of the Challenges of Teaching Integration

As we shared our perspectives with our preservice teachers, we met a variety of challenges. These included things such as, students' ability to a) explicitly teach and assess two objectives in the same lesson, b) tendency to trivialize the science content by emphasizing activity over the objective, and c) inclination to favor one discipline over the other in lesson planning. While we have not fully resolved these challenges, we feel that they represent an important part of our experience. Of the three challenges, students struggled most with explicitly teaching and assessing two objectives in the same lesson. This challenge is represented in the example below.

Interestingly, for our preservice teachers, our definition seemed to be relatively straightforward. It was clear from their lesson plans that they understood that an integrated lesson requires more than one objective from more than one curricular area; they were successful in writing these objectives. We discovered, however, that planning how they might implement both objectives proved to be a difficult task for them. They struggled to construct lesson plans that included explicit instruction for both objectives. Most often, their lesson plans described instruction for just one of the two objectives (generally, the science objective), while simply using the literacy skill during the lesson to communicate about the science content. After one class, Kendra commented, "They were still a little confused about how you would teach both objectives…they were still struggling with the difference between just having [the children] perform the literacy skill or use the literacy skill, versus explicitly teaching it and then asking them to perform it" (10/10/07). Leigh continued, "Right! For example, when teaching the water cycle, one group wanted to teach [the children] sequencing. So, they were having them sequence, but they really hadn't taught them what sequencing was all about" (10/10/07).

Although some students demonstrated a full understanding of how to teach two objectives in one lesson, we were unable to bring all of them to a full level of understanding in the limited time we could devote to curriculum integration, particularly given the multiple other objectives of our individual course content. "We've devoted four class periods of instruction to integration to this point and some of them are just starting to get it!" (L-10/12/07). As we discussed the challenge, we determined that one of the obstacles faced by novice teachers is that they "need a great deal of knowledge about pedagogy and a more substantial understanding of the content in both disciplines in order to be able to really understand how to effectively teach two objectives from two different disciplines in the same lesson" (K-10/12/07). Although we recognize this may come with time, we continue to wonder if it is even reasonable to suggest that all beginning teachers might be developmentally prepared to do this.

We admit that leaving the discussion here was not completely satisfying to either of us, but we also both acknowledged that we had laid a foundation from which these intending teachers could build, and that their level of understanding was greater than each of us had been able to accomplish in previous semesters when we had worked independently.

A Renewed Commitment to Collaboration

Ultimately, our collaborative inquiry reinforced for each of us the need for continued collaboration across disciplinary boundaries, thus pulling us from our traditional teacher education silos in order to support our students in the most effective way possible. We acknowledged that when working individually our professional practice would never arrive at perfection (LaBoskey, 2004).

> [Prior to our work together], I had not really thought through or even recognized the problems tied to literacy that were connected to what I was describing as ideal practice. I just assumed, as many of our cooperating teachers seem to assume, that asking students to demonstrate what they know about a [science] concept through some form of written work would be appropriate. I honestly hadn't considered supporting their ability to do so with specific [literacy] instruction during the science lesson. (L-10/15/07)

Thus, the conceptual and practical complexities of curriculum integration for novice teachers reinforced our commitment to our collaborative professional relationship. Throughout our conversations, we discussed problems we viewed as inherent in trying to teach integration with a dual emphasis without working together. For instance, we recognized that without continued collaboration, we would likely gravitate back toward our initial individual perspectives and practices, an insight that foreshadowed the following experience, which occurred a couple of semesters following official data collection for this study.

Because of scheduling problems, we decided to teach integration in our indi-

vidual courses rather than co-teaching the four class periods, as we had previously done. Later, as we debriefed the experience with one another (9/08), we each acknowledged our tendency to revert back to our own perspective and to foreground our particular discipline at the expense of the other. For example, Kendra taught integration with more emphasis on teaching major concepts in science but still devoted less time to discussing how science content could be enhanced or to emphasize staying true to the nature of science. Rather, the focus was on bringing content into the literacy block and providing children meaningful things to read and write about. Similarly, Leigh found herself emphasizing how literacy skills can enhance conceptual understanding of science content during science lessons. Although she acknowledged that there should be an objective developed for both science and literacy, and that these objectives should both be taught and assessed during the lesson, little time was devoted to describing what the literacy instruction might actually look like. Thus, while, we both used many of the activities we had previously planned together, it was clear that our focus was on our own discipline. We also seemed to be less careful about attending to the issues in the "other" content area and were less able to help our students view integration in the same interdisciplinary way. While our two-year collaboration may have changed some of our instructional practices, we recognized that without continued collaboration, or at least collaboration of a longer duration, we had not been able to provide our students the same perspective on integration.

Through this experience, we also acknowledged that our reliance on collaboration had served as a model for our students, one that was missing when we reverted back to teaching integration in our separate methods courses. Teaching integration together during prior semesters had allowed the prospective teachers in our classes to observe our interactions with one another as we shared with them our jointly developed conception of curriculum integration. Even though we shared the same working definition of integration, teaching the construct in our individual courses had removed the visual example of our collaboration.

Understanding Perspectives, Operationalizing Practice, and Supporting Novice Teachers

The aim of this self-study was to critically consider our individual thinking and practices as we worked toward a shared understanding of connecting science and literacy during instruction. As teacher educators from different disciplines, this work required us to carefully and recurrently examine our individual understandings of the purposes and processes underlying curriculum integration. It also asked us to consider and reconsider integrated instruction through the lens of a colleague whose disciplinary focus is different from our own. Through this process, we refined our individual understandings of curriculum integration and negotiated enough of a shared perspective to develop an operationalized definition of what it means to

make meaningful connections across disciplines during instruction. Additionally, we have found this definition to be useful in describing and modeling meaningful curriculum integration for prospective teachers in our methods courses. At the same time, we recognize the tensions between what we have come to better understand as natural and authentic integration and what might be doable for novice teachers, who struggle to plan and implement single-subject lesson plans with young children.

Participation in this collaborative self-study has also led us to several important conclusions. First, like Davison, Miller, and Metheny (1995), we advocate for better consensus among teacher educators concerning the conceptualization of curriculum integration that crosses disciplinary boundaries. As a starting point, we offer the working definition we have generated through this collaborative self-study. While it remains tentative, this definition has enabled us to more clearly and explicitly describe and model integrated instruction in our preservice methods courses. Our hope, as we look to the future, is that the intending teachers with whom we worked now have a better conceptual understanding of the particulars of linking science and literacy in ways that honor the principles of both disciplines.

Second, we now have a clearer picture of the challenges inherent in implementing instruction that seeks to integrate science and literacy without losing focus on quality instruction in one area at the expense of meeting goals in the other. In particular, through our experience we acknowledge the inherent tensions between theory and practice, particularly for beginning teachers. We understand that recognizing natural connections between academic subjects requires a fairly well developed understanding of the content and nature of each discipline even while elementary and early childhood teachers have limited preparation in specific academic disciplines, such as science. We also recognize that conceptualizing, planning, and implementing integrated lessons is more time and labor intensive than more traditional single-subject methods of instruction. As a result, we realize that we must be cautious in our expectations of novice teachers' understandings and abilities to implement curriculum integration. At the same time, we worry that if they do not develop the knowledge and skills to enact integrated curricula during teacher preparation, they may never do so. Thus, we argue that we must continue to work with these preservice teachers, while laboring together to determine instructional strategies that we might implement in teacher preparation programs to better scaffold their understanding and abilities. At the same time, we must also examine the possibility of continuing our work with inservice teachers, who have additional experiences and knowledge bases that may assist them in understanding and negotiating the complexities of meaningful and authentic integrated instruction.

Third, we acknowledge the power of the process of collaborative self-study in our own professional development as teacher educators. We now understand, from a practical perspective, the impact of critical and "public" reflection about personal practice. This process has required each of us to think deeply about our own individual understandings of and beliefs about the concepts and constructs we are trying to teach

prospective teachers. Moreover, it has forced us to articulate those beliefs and to view them from different perspectives. As a result, our individual understandings and beliefs have evolved; we believe we have become better teacher educators.

Finally, we argue that teacher educators from differing disciplines must work together. Crossing borders is not only critical to our own individual professional development but is also essential to our efforts to prepare intending and practicing teachers to provide meaningful, authentic learning experiences for children. Teacher educators cannot afford the luxury of operating in the traditional silos of their individual disciplines, particularly when attempting to help preserivce teachers understand and implement complex constructs such as integration. This is particularly true in light of the new expectations represented in the Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), which call for a more integrated approach to curriculum. This self-study emphasizes the value of critical conversations about topics and practices that cross-disciplinary boundaries and that this type of collaboration potentially results in improved practice for each participant. As such, we call for more collaboration among teacher educators from different disciplines. These collaborations certainly would extend beyond curriculum integration, but would require that we reach across traditional content boundaries to extend our understandings and offer greater support for our preserivce teachers.

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