Integrating Language and Content: The Knowledge Framework

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Abstract

Teaching English Language Learners (ELLs) academic literacy skills—academically appropriate ways of thinking, talking, writing, and problem solving—is an important goal of our school systems, and subject-based literacy is critical for students to succeed both academically and professionally. Given that language is the primary means through which teaching and learning is carried out, teachers need strategies to ensure that they can develop these skills in all their students. This article describes a non-commercial heuristic called the knowledge framework (KF), which provides a springboard for developing classroom tasks that aim to bridge language and thinking skills so that students can learn content and academic language simultaneously. We present selected work that has been carried out on the KF for more than twenty years and offer ideas for thematic units as an illustration of how to implement the KF.

T he teaching of academically appropriate ways of thinking, talking, and problem solving is a key element in our classrooms at all educational levels. Following the *No Child Left Behind* act of 2001, school districts have been charged with improving the academic achievement of all students such that no child becomes left behind educationally. Yet with the shift of demographics associated with world migration, English language learners (ELLs)—as well as many other learners—are not faring well in areas that require language skills (Fillmore & Snow, 2000). While many content area teachers feel that English language development is the sole responsibility of English teachers (Gibbons, 2009), it is critical that everyone, both teachers and administrators alike, understand that language is the primary medium through which teaching and learning is carried out and assessed (Schleppegrell, 2004). Thus, developing academic language should be understood as helping students learn to participate fully in all of the various disciplines and contexts of the academic community in which they study. Indeed, when thought of in this way, we can consider every teacher to be a teacher of language (Gibbons, 2009; Mohan, 1979). In fact, the essential nature of language in content teaching is the most frequently referenced claim in the literature (Janzen, 2008). But how can teachers from different content areas tailor their unit plans to ensure that they are addressing the academic language and thinking skills that students need to succeed across the curriculum?

This article describes and discusses a gestalt called the knowledge framework (KF) that brings together the connections between language and thinking skills in content areas. At a simple level, the KF is a heuristic that teachers can exploit to ensure the integration of language and content, thereby helping ELLs or other at-risk school populations tackle and understand the linguistic demands of the various content areas. At a more complex level, the KF can be used as a theoretical framework for analyzing classroom discourse, to help illustrate how expert content-area teachers use language to teach and promote critical thinking in their disciplines. The following pages will describe the KF, review the work that has been done on it, and introduce steps that teachers can follow to begin using it in their classrooms.

What is the KF?

The KF, described fully in the seminal work by Bernard Mohan on the integration of language and content in teaching (Mohan, 1986), is a heuristic that provides a springboard for organizing pedagogic tasks that can help teachers bring language development into content teaching. It revolves around the concept of activity. Mohan distinguishes activity from the simpler notion of topic, suggesting that whereas a topic is anything that can be talked about, an activity is "a combination of action and theoretical understanding" (Mohan, 1986, p. 42), which thus brings both doing (action) and knowing (theoretical understanding which guides the action) into the forefront. In other words, the tasks created for use within the KF aim to develop students' understanding of the content being taught as well as focus on the language used to construct the content. Students learn the content while doing the tasks and also learn how to talk about the content critically, with scaffolding by the teacher. Such subject-based literacy development is essential for students to succeed academically and professionally (Gibbons, 2009).

As a heuristic, the KF consists of six boxes representing three related pairs of knowledge structures (KSs), or semantic patterns of texts, as shown in Table 1.

Table 1*:*

Mohan's knowledge framework

CLASSIFICATION	PRINCIPLES	EVALUATION
DESCRIPTION	SEQUENCE	CHOICE

These three pairs of KSs form theory/practice relationships that can be illustrated in the following way.

(1) Classification/Description: The practice of describing something infers an understanding (theory) of a set of classifications such as color, size, or other typologies. For example, a knowledgeable description of a triangle in mathematics would involve understanding the types of triangles that exist and how to define them. Describing an atom in science infers an understanding of the items that make up an atom, such as electrons, neutrons, and protons. Describing games in PE classes

may involve understanding the types of games, strategies, or equipment. Describing art involves classifications of color, shape, texture, and media. And so on across the curriculum.

(2) Principles/Sequence: We create sequential order (practice) informed by our understandings (theory) of the principles behind the order. We may order certain things because we are aware of what we are attempting to achieve (means/ends), as in instructions for lab reports, mathematical solutions, baking, or any set of directions. We may also order actions in a particular sequence to discover cause and effect, as in many plot lines in literature, time lines in history, and the use of certain types of media in art.

(3) Evaluation/Choice: Decision making and problem solving (practice) involves being able to evaluate logically the available options. This cannot be done well without understanding how a specific discipline justifies best options (theory); these options are often explained and justified through the previous KSs. For example, choosing which matter to remove first in a science problem (practice) relies on an understanding of what kind of matter it is (classification theory) and what that matter can cause (principles theory) as well as how scientists typically carry out experiments (sequence practice). In other words, scientists do not look for salt in a salt-and-sand mixture and pick it out with tweezers; they use their understanding of solubility to wash the salt out. In fact, choice and evaluation is probably the most common task in education, from students choosing to respond to a question in class, to assessment, in which students choose their answers and teachers evaluate their correctness.

Each of the boxes in Figure 1 has thinking skills and language associated with it, and each has specific key visuals that relate to the thinking skills. For example, the KS of classification involves thinking skills of grouping, talking about part/whole relationships, and defining. The language associated with these thinking skills includes verbs such as "be," both as a relating process (e.g., X is a kind of Y) and as existence (e.g., there are three kinds of Z), and "have." Classification suggests nouns that are general rather than specific ("dogs" and "triangles" rather than "Lassie" or "this shape here") and KS-related words such as "types," "kinds," "include," and "made up of." A classification tree is an example

of a key visual that shows grouping and part/whole relationships, and a definition can be captured visually

using something as simple as an equals (=) sign. Table 2 offers a starting point for examining the KSs

from the point of thinking skills, language, and key visuals (see below).

Table 2

Connecting key visuals

Connecting Key Visuals, Language, and Thinking Skills
(based on Early, 1990, and Mohan, 1986)

Knowledge structure	Thinking skills	Key visuals and examples		Language
Classification	Classify, group, sort, categorize Define Parts/wholes	Tree Web Table	web classification tree	General reference "Being" verbs (e.g. *be, have*) Additive conjunctions (e.g., *and*) Taxonomic, part/whole lexis (e.g., nouns: *types, classes, kinds, categories, ways;* verbs: *classify, sort, group, organize, categorize, divide, comprise*) Passives (e.g., *are classified, are grouped*)
Principles	Explain, predict, draw conclusions Apply causes, effects, means, ends, rules Formulate, test, and establish hypotheses Interpret data	Cycles Line graphs Cause/effect chains Problem/solution branches	graph cycle cause/effect chain Problem/solution	General reference Action verbs Consequential conjunction and adverbials (e.g., *since, due to, in order to, consequently, because, thus, if*-clauses) Cause-effect lexis (e.g. nouns: *cause, effect, result,* verbs: *cause, produce, bring about*) Passives + agency (e.g., *is caused by, are produced by*)
Evaluation	Evaluate Rank Judge Criticize	Grid Rating chart Evaluation chart	Rating chart/ Grid Evaluation charts	"Thinking" verbs (e.g., *believe, think, value, consider, rank, judge*) Comparative conjunction (e.g., *likewise, however, while*) Evaluative lexis (e.g. nouns: *best, worst;* adjectives: *good, bad, right, wrong, boring, acceptable;* verbs: *rank, approve, value, like*)
Description	Identify Label Describe Compare, contrast Locate	Picture, map, diagram, drawing Venn diagram Pie chart Same/different chart	Picture/ drawing/ map venn diagram Bar graph pie chart Alike Different	General or specific reference "Being" verbs (e.g. *be, have*) Additive conjunction (e.g., *and*) Attributive lexis (e.g., adjectives of color and size) Language of comparison and contrast (e.g., *the same as, similar to, like, different from*)
Sequence	Arrange events in order Note changes over time, processes Follow directions	Timeline Action strip Flowchart	Flow charts Timeline Sequence strip	Specific reference Action verbs Temporal conjunction and adverbials (e.g., *after, since, as, initially, firstly, finally, when*-clauses, *as*-clauses) Sequential lexis (e.g. nouns: *beginning, end;* verbs: *start, conclude, continue, summarize*)
Choice	Select, make decisions Propose alternatives Solve problems Form opinions	Decision/ consequence tree Generating alternatives/ decisions chart	Decision Tree Generating Alternatives/ Decisions chart	Specific reference "Sensing" verbs (e.g. *like, want*) Alternative conjunction (e.g., *or*) Appositional choice lexis (e.g., nouns: *choice, option, which* + noun; verbs: *choose, opt, select, prefer*)

As can be seen by the above description, the six knowledge structures appear in every content area across

the curriculum, from art to zoology, both in the content itself and in the classroom management language

that revolves around teaching and learning the content. The KF, therefore, becomes a very powerful tool

for teachers to help students transfer their language and thinking skills across different contexts (Early,

1990). In other words, if a teacher teaches the language of classification, students can use language and

key visuals to classify any information across the curriculum, such as triangles in mathematics, countries

in social studies, forms of energy in physics, vertebrates and invertebrates in biology, games in PE, media in art, muffins in food sciences, and so on. Outside of school, students will be able to classify meat at the supermarket and gas at the gas station. Moreover, teachers can help students understand that there are simple ways to construct these taxonomies linguistically as well as more sophisticated ways. The linguistic choices the teacher makes and models can help the students expand their resources for constructing the various KSs.

How has the KF been used?

The KF has been used most extensively for pedagogical purposes, and several studies will be described below. Developed in Western Canada in the late 1980s, most of the research and development has been done in Canadian K-12 classrooms with the goal of helping mainstream ELLs.

With the six KSs in mind, Early, Thew, and Wakefield (1986) examined several curriculum resource guides and textbooks, finding that the six structures recurred throughout these, both as texts and as thinking skills to be developed. In a large-scale action research project, more than one hundred educators engaged in a series of activities, including needs assessment, materials and strategies development, strategies and context evaluation, and testing out of the applicability and utility of the KF within the local K-12 schools (Early, Mohan, & Hooper, 1988).

Early et al. (1988) argued that thematic units set up using the KF

illustrated that students, when adequately supported in tasks specifically designed to elicit certain knowledge and discourse structures, were able to produce recognizable examples of particular types of discourse and to improve on their performance in this type of language use in a short period of time. (p. 121)

Early (2001) elaborated on the earlier project, describing various case studies that were carried out using the KF and concluding that the approach was highly successful in bringing to light the role of language in content-based teaching.

Using a unit on fish developed by an ESL teacher using the KF and taught to a class of fourth- and fifth-grade ELLs with diverse educational backgrounds, Early (1990) illustrated how teachers can

develop students' cognitive and academic abilities alongside their language ability using the KF. She noted that even low proficiency students learned the knowledge structures of classification and description and were able to produce well-written expository texts at their grade level using key visuals.

Early (1991) addressed the application of the KF to wordless picture books by showing how one teacher worked with a group of primary (eight-year-old) ELLs to develop their oral language, academic literacy, and thinking skills, particularly sequence, choice, prediction, and cause/effect. Using the book *The Angel and the Soldier Boy* by Peter Collington, the teacher worked through a variety of questions and tasks using the KF, such as having students describe the characters, relate the plot, and write narratives based on the visuals in the picture book. Early concluded that wordless picture books used with the KF have great potential for academic language development while motivating learners with their illustrations and clever tales.

Tang (1997a) described the application of the KF to a seventh-grade social studies class in which the teacher organized the content of the textbook into KS-based key visuals. The teacher alternated between key visuals and the authentic text from which they were developed. At times, she presented the visuals she had made and had students read the text and organize the information using the visuals. At other times she worked with the students to develop visuals from the texts they were reading based on the characteristic language features of the KSs being examined, which she taught explicitly. Once the students were familiar with the key visuals and the language of the KSs, the teacher had them write texts from familiar key visuals. Tang concluded that using the KF in this way helped increase students' ability to read and write academic discourse. Moreover, having students create a key visual from a text and then use that key visual as a springboard for writing helped them write in their own words, rather than copying or plagiarizing the original text.

Several studies on the KF have heralded the importance of key visuals in academic literacy development. Key visuals lower the linguistic demands and display ideas while making explicit the underlying semantic relationships between them. In other words, whereas text structures are patterns of discourse that ELLs may find difficult to understand because of language, key visuals display the

semantic relations of the KS they represent. Moreover, key visuals based on the KF have been shown to be cross-cultural (Tang, 1994; 1997b) and thus able to trigger background knowledge that ELLs may have developed in the first language. Key visuals can serve multiple functions in the classroom, including *generative* to promote language generation, *representative*, to increase learner understanding, and *evaluative*, to assess content and understanding of language (Early et al., 1988).

Early (1989), following up on the primary study of Early et al. (1988), focused on teachers' use of key visuals as tools to prepare students for reading tasks. The article not only lists steps that can assist teachers in the construction of good key visuals but also reports on the teachers' informal evaluations of using these graphic representations of KSs with their ELLs, in which they report students demonstrating better recall and understanding of information from the text and showing much more engagement with the materials. The students themselves stated that the use of key visuals made them feel they had more control over their learning as they had a strategy to help them organize their notes; moreover, they felt more confident as learners using key visuals.

Early and Tang (1991) proposed using key visuals in tandem with the KF to help ELLs work with content-based texts. To support their proposal, they reported early results of a study that aimed to see if using key visuals helped students read and write in science and social studies. This pretest–posttest nonequivalent-control-group study was carried out in Grade 8 Social Studies, Grade 11 Social Studies, and Transitional ESL Science in two Western Canadian high schools. Preliminary results showed that the experimental group (using key visuals) improved consistently whereas the control group's findings were inconsistent, with several results showing no change or regression. From the positive results of the study, the authors noted that there is tangible evidence of the power of using key visuals within the KF format.

Tang (1991a), in her ethnographic study on the role and value of graphic representations of knowledge structures, found that teachers needed to provide strong guidance on how to use key visuals before their students could make full use of them themselves. She followed 56 seventh-grade students (46 were ELLs) in their classrooms, the library, and the spaces just outside of the classrooms for about five months. Tang found that the students who were not given guidance on the use of key visuals rarely

attended to them, but those given explicit lessons on their use experienced no difficulties. The author concluded that there was great potential in using key visuals within the KF, but that teachers need to draw explicit attention to them and give "systematic guidance on how to read, interpret, and use them" (p. 38) before students can see the value for themselves.

In Tang (1991b; 1992), the author focused on the use of student-generated diagrams, examining both their role in helping students understand and recall the materials as well as students' own ideas on their usefulness in understanding texts. Her study involved 45 ELLs in two classrooms. To respond to the effectiveness of student-generated key visuals, the author used a pretest–posttest nonequivalent-control-group quasi-experimental design, while interviews were used to establish students' own ideas. Treatment in the quasi-experimental design involved systematically teaching the students how to create a key visual from a text and having them do this as a class, whereas the control group went over the same text in an oral question-and-answer format. The posttest involved either drawing a key visual of the text (for the experimental group) or making notes (the control group), then using either the visual or the notes to recall the text. The results showed that the experimental group outperformed the control group in the total amount of information that was recalled about a new text that they were asked to draw a key visual about. Moreover, the essays they were asked to write about the text were more organized than those of the control group. With regards to students' attitudes towards using key visuals, results were also positive, although many reported that they wanted more guided practice in using them. Tang recommended further research on the regular incorporation and use of key visuals.

The KF has also been used in assessment. Huang and Morgan (2003) used KS analysis to evaluate student learning of both language and content by examining the discourse features that ELLs used in their writing as they learned about particular scientific classifications. Their aim was to look at the simultaneous development of students' content understanding of matter and writing ability about the topic. The authors reiterated the benefits of using the KF for its role in the (a) construction of content knowledge, (b) organization of knowledge, (c) development of language, and (d) creation of visual knowledge representations.

A full chapter on using the KF to assess projects in project-based language learning (Slater, Beckett, & Aufderhaar, 2006) describes a model that allows teachers to implement the KF to assess any academic project. This chapter offers snippets of texts from relevant literature and key visuals to provide assessment ideas and new ways of thinking about the assessment of project-based language-and-content learning and teaching.

Finally, Mohan and Slater (2005, 2006) used the KF to track patterns in discourse that emerged as a primary teacher worked to teach science to groups of first and second grade students (2005) as well as a secondary science teacher working with classes of ninth-grade students (2006). These articles identified logical progressions of KSs in science teaching, where concepts are described and classified, talked about sequentially and causally, and then students solved problems logically. These types of KSs can be presented with non-science materials to help ELLs develop understanding in science, as argued in Slater and Mohan (2010), who showed how an ESL teacher worked collaboratively with her school's science department to help her ELLs understand how language is used to construct science knowledge.

To summarize, the key points that can be taken from the review of literature on the KF based on the frequent reiteration by the authors are as follows:

1. The six KSs recur across all areas of the curriculum in texts, tasks, and thinking skills to be developed.

2. Explicitly teaching the language and key visuals associated with the six KSs is needed to help ELLs develop academic language and thinking skills.

3. Using key visuals that represent the KSs triggers content-based background knowledge, helps ELLs develop language, improves academic reading comprehension and retention, assists students in the organization of academic writing, and raises students' confidence as learners.

How can a KF unit be developed?

From the literature reviewed above, it can be seen that the KF offers a systematic way to integrate language and content to help students develop the academic discourse skills they require to succeed while

simultaneously learning the content that is appropriate for their grade levels. But how easily can such a unit be developed? As noted in Figure 2 earlier, the KF has specific thinking skills, language, and key visuals that work together. Each KS also has guiding questions that can help teachers develop the material. These questions appear in Table 3 (from Early, 1990).

Figure 3

Questions the KF asks

CLASSIFICATION	PRINCIPLES	EVALUATION
What concepts apply? How are they related?	What principles are there? (cause/effect, laws, rules, explanations, interpretation of data)	How are things judged or tested? By what criteria?
Who? What? Where?	What happens? What happens next?	What are the choices? Alternatives?
DESCRIPTION	SEQUENCE	CHOICE

To put these questions to use, the teacher needs to decide on a theme for the unit. Take, for example, apples as a theme. For classification, the teacher might consider the types of apples that one finds in a local supermarket. How can they be grouped? By color? By softness for baking? By size? (A web visual can be used here.) What is an apple? Where does it appear in the classification of food types? (A classification tree diagram can be used here.) These are all questions that can be addressed when focusing on classification. Tasks can be developed to have students focus on these questions and to encourage them to use the language of classification in their responses to the questions. Description could involve describing different apples, a task that relates closely to grouping. A cut-section diagram might be used to teach the names of the parts inside an apple. Identifying the types of apples by looking at and labeling them would also bring out description language (e.g., "This is a Red Delicious."), while teaching students how to identify particular kinds of apples. (Pictures of different apples can be used here.) The language and content go hand in hand.

For principles, the lesson might focus on what causes bruising in apples (using a cause and effect chain diagram) and what can be done to prevent bruising. Creating an experiment in which apples are

bruised and placed in different contexts might engage students in making predictions or explaining their ideas, all principles discourse. Talking about the annual growing cycle of apples (a cycle diagram) promotes sequence discourse. Engaging students in a discussion about what they like to do with apples involves choice language (a chart or match-the pictures diagram), and creating a form for judging apples (a rating grid) brings in evaluation. In covering all these aspects of apples, the teacher not only ensures that the students learn a great deal about apples, she also provides opportunities to have them focus their language on the different knowledge structures associated with the tasks, which in turn are related to specific thinking skills that appear in all content areas across the curriculum. Thus, the teacher who uses the KF is able to systematically organize the unit in such a way that she is developing language and content in an integrated way. And each of these tasks can involve key visuals as noted above, either teacher selected/produced, or student generated as they work with authentic materials.

Other themes can be broken down into the six boxes of the framework, as many of the examples from the literature suggested. For example, magnets can be broken down into the following KSs: classify types of magnets (classification), label the ends (description), explain the rule of magnetism (principles), make a magnet from a magnet (sequence—instructions), choose the strongest magnet (choice), and evaluate the magnet's strength (evaluation). Thematic units can be created from any concept that the teacher needs to teach across the curriculum, and from the discourse in existing textbooks so that ELLs will be better able to learn and talk about the content. Tang (1991b; 1992) advised having the teacher create the key visuals to use from the text initially, to use as a model if needed, even in cases where the teacher wants the students to generate their own key visuals.

Conclusion

It has been claimed that to be literate in a content area implies understanding how the concepts in that discipline are organized and evaluated (Gibbons, 2009). Mohan's knowledge framework allows teachers to organize their lessons so as to draw attention to the organization of both language and content in a systematic way that can be applied across the curriculum. Research on the KF has shown that knowledge is structured in similar ways across a wide variety of situations, and so as Early (1990, p. 569)

states, "This raises possibilities for the transfer of certain language and thinking skills across different content areas and situations, and thus across the curriculum." The KF offers a very useful heuristic for helping our ELLs develop language and content across all subject areas. Given that a major objective of ESL programs in North America is to prepare ELLs to be functionally successful in all subject areas, it may be well worth our time and effort to give it a try.

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