

Incorporating Knowledge of Students Systematically into TPACK-based Instruction: An Illustration

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Abstract: How might teachers' knowledge of students' specific learning needs and preferences be incorporated into their TPACK, and subsequently into their practice? How can this knowledge help teachers to select and employ particular technologies in specific ways that can accommodate students' differing learning requirements? Building upon previous work that supports teachers' TPACK-based instructional planning with taxonomies of learning activity types in nine different curriculum areas, we developed a taxonomy of *teaching strategies*, each supported by recommended digital technologies, that are specific to particular learners' needs. In this first TPACK-based teaching strategies taxonomy, the needs of English Language Learners (ELLs) are addressed. The new taxonomy is designed to be used in concert with one or more curriculum-based learning activity types taxonomies, scaffolding the development and use of teachers' TPACK while they are planning curriculum-based, well-differentiated instruction.

In the eight years since a description of the technological pedagogical content knowledge (TPACK) construct was first published (Koehler & Mishra, 2005), questions have surfaced concerning where teachers' knowledge of their students—that is, their specific interests, learning preferences, prior knowledge, skills, needs, and more—is represented within the construct's seven subdomains. Although it can be argued that this is an aspect of the larger pedagogical knowledge (PK) embodied in the construct, references in TPACK literature to teachers' knowledge of students tend to describe general knowledge that seems to be incorporated within all of the subdomains. Koehler & Mishra (2008), for example, say that TPACK

requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. (pp. 17-18)

How, then, is teachers' knowledge of different students' *specific* learning needs and preferences incorporated within their enacted TPACK? How can this knowledge help teachers to select and employ particular technologies in specific ways to help to differentiate instruction successfully, accommodating students' differing learning requirements? How can we assist teachers in developing and using these student-centered aspects of their TPACK?

TPACK-based Strategies

In their careful conceptual analysis of the TPACK construct, Cox and Graham (2009) call upon Magnusson, Krajcik and Borko's (1999) analysis of Shulman's (1986) notions of pedagogical content knowledge (PCK). Magnusson, et al. suggest that teachers' PCK includes knowledge of both *subject-specific* and *topic-specific strategies*. The strategies that they describe are instructional approaches that teachers can use that are specific to either a particular content area or a particular content area-related concept, respectively. Examples include structured academic discourse in social studies (subject-specific) and proof construction (topic-specific) in geometry. Cox and Graham add *general strategies* to Magnusson et al.'s content-related strategies to comprise the pedagogical knowledge (PK) subdomain of the TPACK construct. These strategies can be used in multiple content areas.

Examples include strategies such as project-based learning, collaborative learning, and communication, motivation, and classroom management techniques.

Magnusson, et al. (1999) further subdivide topic-specific strategies into *topic-specific activities* and *topic-specific representations*. Topic-specific activities are the sequenced learning acts in which students engage to help them to comprehend content-related concepts, processes, and relationships. Examples in science education include simulations, demonstrations, and experiments. Topic-specific representations are ways of communicating content-related ideas, such as examples, models, and illustrations.

Our TPACK-based, curriculum-focused learning activity types (Harris, Hofer, Blanchard, Grandgenett, Schmidt, Van Olphen, & Young, 2010) can be classified as both subject-specific strategies and topic-specific activities in Magnusson et al.'s (1999) terms, delineated according to distinct types of thinking, knowing, and inquiring that distinguish among and between nine different curriculum areas. In one of our newest taxonomies, we have delineated general teaching strategies (as Cox and Graham have defined them) that can be used in combination with content-specific learning activity types to plan curriculum-based instruction that accommodates the specific needs of English language learners (ELL). We will overview the ELL teaching strategies here to illustrate how a taxonomy of research-based pedagogical methods designed to assist learners with specific (in this case, linguistic) needs can be used to help teachers to plan curriculum-based, technologically facilitated instruction that addresses those specific needs intentionally and directly.

ESOL Instruction

Current theories of school-based second language acquisition (Cummings, 1979, 1986, 2000; Echevarria & Graves, 2007; Echevarria & Graves, 2007; Ellis, 1999, 2003; Krashen, 1983) suggest that instruction for ESOL (English for Speakers of Other Languages) learners should be designed so that it supports language development and curriculum content simultaneously. Specially Designed Academic Instruction in English (SDAIE, also known as Sheltered Instruction) (Echevarria & Short, 2009; Echevarria, Short, & Vogt, 2008) is a widely recommended instructional approach for such curriculum-based second language acquisition. This approach combines high-quality general teaching strategies with second language acquisition principles, helping to ensure grade-appropriate, curriculum-based learning that is comprehensible to ELLs. The approach focuses upon content learning, while simultaneously helping students to master English language forms, conventions, and vocabulary.

Stages of Language Development

Given that language acquisition is a progressive process, planning for ELL-adapted instruction should be designed with students' developmental needs in mind. Language development is often conceptualized according to Krashen and Terrell's (1983) four widely accepted stages of language development:

Stage 1	Preproduction
Stage 2	Early Production
Stage 3	Speech Emergence
Stage 4	Intermediate Fluency

Students functioning at the *preproduction* stage (or "silent period") tend to be overwhelmed and anxious, particularly when required to produce speech in the target language (For ELLs, the target language is English). The intensity of absorbing an unknown language makes students tire easily and shortens their attention spans. At this stage, students rely heavily upon nonverbal communication and any contextual clues that they are able to perceive and understand (Krashen & Terrell, 1983).

During the *early production* stage, students are beginning to feel more comfortable communicating in the target language, and can respond to questions with single words (e.g., "yes," "no," "you," and "me"). They are also able to recite short and simple texts (e.g. poems, short phrases, and sentences). A low-anxiety learning environment fosters higher risk-taking dispositions in ELLs. Therefore, it is critical that teachers create nurturing learning environments by employing strategies such as circumlocution (offering multiple ways to define a word or phrase), paraphrasing, and repetition to assist with language acquisition at this stage (Krashen & Terrell, 1983).

As students continue to develop their target language skills, they enter into the *speech emergence* stage. They begin providing longer answers to questions and more complex utterances, using language more freely. With the use of longer and more complex utterances, however, they tend to produce more syntax errors. During this stage, teachers should scaffold instruction by providing many opportunities for students to work in small groups and to use organizers (advance and graphical) to help ELLs to generate language. It is also helpful at this stage to permit students to use their primary language to support target language development—for example, by member checking utterances with a bilingual peer or teacher (Krashen & Terrell, 1983).

Once students have reached the *intermediate fluency* stage of language development, they are able to initiate and maintain conversations in the target language. Syntax errors continue to be evident, but at this stage, students are more aware of their language skills, and can often identify their own errors and correct themselves. Although ELLs may seem to know a good deal of English and may appear to be near-native in their *conversational* English at this stage, they probably have not achieved the same near-native proficiency in *academic* English. To the less experienced educator, this can be a misleading stage, generating unrealistic expectations for academic writing, reading comprehension, and/or oral presentation.

How can this knowledge of language development be incorporated into instructional planning that integrates use of educational technologies in ways appropriate for students who are English language learners? We suggest building upon previous TPACK-based research and development about curriculum-based learning activity types to do so, combining these with teaching strategies specific to the developmental needs of ELLs.

Combining ESOL Strategies with Learning Activity Types

Our previous work with TPACK-based learning activity types (cf. Harris et al., 2010) suggests that teachers begin instructional planning for students' curriculum-based, technologically-facilitated learning by selecting the specific curriculum learning goals and objectives to be addressed in the lesson, project, or unit being planned. Once these have been identified, teachers can then consult the TPACK-based learning activity types taxonomies that have been developed in nine curriculum areas to date—K-6 literacy, mathematics, music, physical education, science, secondary English language arts, social studies, visual arts, and world languages (<http://activitytypes.wmwikis.net/>)—to identify the learning activities best suited to support students' learning needs and preferences to comprise the lesson, project, or unit that addresses the specific curriculum goals and/or objectives selected. Then, we suggest that teachers identify their ELL students' language development levels so that specific ESOL teaching strategies can be chosen that will best facilitate the learning that will be structured using the selected activity types.

Taxonomy of ESOL Teaching Strategies

To that end, we offer a taxonomy of research-based ESOL instructional strategies (Echevarria & Graves, 2007; Echevarria, Short, & Vogt, 2008; Shrum & Glisan, 2009) that are organized into eight general recommendations which remind teachers to:

- a) Communicate clearly.
- b) Make content understandable.
- c) Check students' understanding.
- d) Elicit students' responses.
- e) Demonstrate and model.
- f) Encourage interpersonal communication.
- g) Group students to assist their learning.
- h) Promote cross-cultural awareness.

Samples of specific, technologically facilitated instructional strategies that can be used to operationalize each of these recommendations appear in the sections and tables below.

Once teachers select and sequence the learning activity types, then choose the ESOL strategies to use within a specific lesson, project, or unit that they are planning, they can consider the suggested technologies associated with each, making selections based upon appropriateness, availability, and students' and teachers' prior

experience. In the charts of sample ESOL recommendations and strategies that appear below, the columns that read “Stage 1,” “Stage 2,” “Stage 3,” and “Stage 4” correspond to the four stages of ELL students’ language development explained earlier: preproduction, early production, speech emergence, and intermediate fluency, respectively.

Communicate Clearly

Communicating clearly when working with language learners is very important. It is common for native speakers to think that they must speak slowly to be understood, and that everyone understands idioms and other colloquial expressions, given their wide usage. As native speakers, we are not fully aware of the wealth of linguistic knowledge and resources we possess; we take this for granted. It is not until we are confronted with learning another language that we become more conscious of how challenging it can be to understand these idioms and colloquialisms. Communicating clearly requires the use of concrete language that is content-related and not idiomatic or colloquial (Krashen, 1981, 1983; Shrum & Glisan, 2009). The table below includes three of the eight strategies for teachers to use that will help them to communicate clearly when teaching language learners.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Repeat and/or paraphrase with sufficient wait time.	Audio recording software, audio discussion tools (e.g. <i>VoiceThread</i>)	X	X	X	
Use body language to assist comprehension.	Video recorder (to analyze your use of body language)	X	X		
Explain instructions step-by-step.	Presentation software, document camera, interactive whiteboard, word processor to create handouts	X	X	X	X

Table 1: Sample Strategies for Communicating Clearly

Make Content Understandable

Making content understandable or providing *comprehensible input* (Krashen, 1981) helps teachers to communicate in an ESOL-friendly format that fosters students’ understanding of the content focus of the lesson. While presenting information, teachers must make some adaptations that help students to understand key concepts. The table below shares four of the 15 strategies that teachers can use to improve ELLs’ comprehension of curriculum-based content.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Activate students’ background knowledge, experiences, perceptions, and interests.	Presentation software, video clips, digital images	X	X	X	X
Display visuals (e.g., images, diagrams, pictograms) that illustrate content presented.	Presentation software, document camera, word processor to create printed images to reference/display in class	X	X	X	X
Visually emphasize (e.g., circle, highlight, display, label, animate) English words that represent key concepts.	Presentation software, document camera, interactive whiteboard	X	X	X	X

Table 2: Sample Strategies for Making Content Understandable

Check Students' Understanding

Checking for students' understanding is part of most teaching procedures. With ELLs, frequent comprehension checks are key to both ongoing assessment and maintaining students' engagement in the learning process. The table below provides three of the seven strategies that can be used to check students' understanding.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Students complete sentences, charts, tables, etc.	Word processor, Web-based interactive tools, interactive whiteboard, concept mapping software	X	X	X	X
Students restate an idea in their own words.	Word processor, audio recorder	X	X	X	X
Students indicate a response nonverbally (e.g., pointing, acting out, clicking)	Student response system, printed student response cards	X	X		

Table 3: Sample Strategies for Checking Students' Understanding

Elicit Students' Responses

Eliciting students' responses helps teachers to perform periodic informal language assessments. In response to teachers' spoken and written prompts, ELLs produce language (output) that will vary in complexity, especially over time. Teachers can use the Student Oral Language Observation (SOLOM) Matrix (<http://www.cal.org/twi/evaltoolkit/appendix/solom.pdf>) to estimate students' spoken language development and monitor their progress toward facility with academic English. The table below offers three of the eight strategies that help to elicit students' responses.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Ask questions that evoke simple responses (e.g., words or phrases).	Presentation software, document camera, interactive whiteboard to display questions	X	X		
Solicit students' perspectives, experiences, etc.	Web-based survey, email, blogs, discussion forum, student response system	X	X	X	X
Request written responses in different formats (e.g. answers to questions, poetry, news stories, picturebooks, letters, skits)	Word processor, drawing software, animation software, video/audio creation software	X	X	X	X

Table 4: Sample Strategies for Eliciting Students' Responses

Demonstrate/Model

Modeling and demonstration are generally effective instructional approaches. When teaching ESOL students, it is helpful for teachers to demonstrate—in advance and step-by-step—what is expected from students, and to model ways of thinking, behaving and communicating that will help students to reach curriculum-based learning goals. The strategies presented below can assist all learners—native English speakers and ELLs. The table below offers three of the seven strategies that can support teachers' modeling and demonstrations.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Use mnemonics to build memory of content.	Audio recorder	X	X	X	
Model comprehension strategies.	Presentation software, document camera, interactive whiteboard	X	X	X	X
Model presentation skills.	Presentation software, video recorder	X	X	X	X

Table 5: Sample Strategies for Demonstrating/Modeling

Encourage Interpersonal Communication

All learners need to interact with peers, teachers, and others involved in the learning process, regardless of their language backgrounds. For ELLs, it is even more important to have extensive opportunities to practice oral and written communicative language. By interacting with peers, teachers, and others, ELLs can expand their content knowledge as well as strengthen their second-language reading and writing skills. The table below illustrates three of the eight strategies that encourage interpersonal communication within and beyond the classroom.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Exchange opinions, emotions, and/or perspectives.	Web-based discussion, email, chat, videoconferencing			X	X
Exchange written documents (e.g., letters, stories, dialogue journals, peer feedback, etc.).	Word processor, wiki, email, blog	X	X	X	X
Extend opportunities for interpersonal communication beyond the classroom.	Web-based discussion, email, chat, blog, videoconferencing	X	X	X	X

Table 6: Sample Strategies to Encourage Interpersonal Communication

Group Students to Assist Their Learning

Grouping students strategically can assist their learning in multiple ways. Teachers often try to keep ELLs away from other students with similar linguistic backgrounds to prevent them from talking with each other in their native language. At times, though, it can be helpful for students to work with a group member who speaks their native language to prevent the ELL from getting lost. It is not a good idea, however, to segregate ELLs by native language. Groupings—in same-language or different-language clusters—should be determined by considering the nature of the learning task at hand and the language facility of the students participating. The following table offers three of the five strategies that teachers can use when grouping their ELL students.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Work with a partner who can speak in the student's native language.	Videoconferencing, wiki, blogs	X	X	X	
Work collaboratively to create a product.	Wiki, collaborative word processor	X	X	X	X
Work cooperatively to accomplish a task.	Wiki, collaborative word processor	X	X	X	X

Table 7: Sample Strategies for Grouping Students to Assist Their Learning

Promote Cross-Cultural Awareness

ELLs arrive with diverse cultural backgrounds. Helping them to develop an understanding and appreciation of their adopted country’s culture should not be pursued at the expense of fostering respect for and maintenance of students’ cultural identities. The table below provides three of the seven strategies that can support such intercultural endeavors with ELLs.

Strategy	Possible Technologies	Stage 1	Stage 2	Stage 3	Stage 4
Present to the class different holidays from ELLs’ home countries and from the U.S.	Video streaming sites, DVDs	X	X	X	X
Invite guest speakers (face-to-face or virtual visits).	Audio/ Videoconferencing	X	X	X	X
Take classroom virtual tours to ELL’s home country’s iconic places and compare those of similar meaning for U.S. people.	Web-based virtual tours, DVDs, video streaming sites, videoconferencing	X	X	X	X

Table 8: Sample Strategies for Promoting Cross-Cultural Awareness

Most of these strategies are familiar to teachers. However, their relevance and impact on ELLs’ language development are not often fully understood or addressed. SLA principles, when properly applied to the content area classroom, contribute to better learning for both ELL and non-ELL students. The taxonomy excerpted here can assist teachers in considering these principles to inform their instruction as they integrate technology use into class activities. The complete taxonomy is available online at: <http://activitytypes.wmwikis.net/>.

Future Work with TPACK-based Teaching Strategies

The second language acquisition principles described in this chapter suggest research-based teaching strategies (with accompanying recommended technologies) that can help to meet the specific needs of English language learners while simultaneously addressing required curriculum standards. There are other sets of research-based teaching strategies that address the needs of other types of learners.

For example, the Center for Applied Special Technology (CAST: <http://www.cast.org/>) offers the Universal Design for Learning (UDL) framework to help educators consider learners’ cognitive differences as they plan for instruction. Similar to the use of the ELL strategies described above, by using three UDL principles—offer multiple representations of content, provide multiple means of student expression, and plan for multiple means of engagement—teachers can enhance the learning experience of all students, while accommodating the specific cognitive demands of a wide range of student learning styles and preferences.

Other educational sub-disciplines, such as early childhood, gifted, and multicultural education offer similarly tested approaches and strategies that address specific learners’ particular needs. We invite other educational researchers to explore how these differentiated strategies can be supported and enhanced with the use of particular types of digital tools, as illustrated with the ESOL teaching strategies taxonomy described above. With this complementary approach to instructional planning, teaching strategies and content-based learning activities can be combined intentionally to help teachers to better connect the use of technological tools and resources to both curriculum-based learning goals and students’ particular learning needs and preferences.

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