Enhancing Content and Pedagogical Knowledge

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The accomplished teacher places students as the primary focus for planning and instruction. Additionally, students' learning interests are best served by the teacher who displays mastery of subject-based content. There are teachers who instruct ineffectively due to lack of confidence with academic content. Conversely, there are teachers who are truly content experts, but struggle to offer students effective explanations and engaging experiences. The highly effective teacher both understands content and explains it on a level that enables students to become engaged and extend their learning. Teachers have a professional responsibility to actively and regularly update their subject knowledge. Danielson (2009) urges teachers to incorporate 21st Century issues in their content, such as as "global awareness and cultural diversity." The effective teacher is able to approach learning from a cross-curricular, student's point of view, appreciate academic skills that are common to other subjects, and distinguish approaches that are unique to one subject area.

Koehler (2011) cites the research findings of Lee Shulman in order to illustrate the need for teachers to make instruction as comprehensible as possible for students by integrating subject content and pedagogy. The effective teacher is aware of the most easily understandable representations of ideas, the most attractive analogies and metaphors, and the best "illustrations, examples, explanations, and demonstrations." Students benefit in terms of enhanced learning experience when the teacher is able to confidently integrate subject content with best pedagogical practices.

Information Alignment

Materials presented in this eBook align with the following:

Module Questions

- How can content area resources and methods increase your knowledge and student understanding?
- How can honing your teaching skills (pedagogy) in your content area lead to improved teaching, cross-curricular strategies, and learning?
- How can professional development increase your content knowledge and pedagogy?

Learning Outcomes

- Explore resources for improving knowledge of your content area/discipline and connecting that knowledge to related concepts.
- Investigate methods for improving and enhancing pedagogy in your content area.
- Examine professional development opportunities beyond the classroom that make a difference in the field of teaching and learning in your content area.

Topic Focus

- Exploring Content-specific Resources
  - National and State Content Area Organizations
- Improving and Enhancing Pedagogy in Specific Content Areas
  - Content Specific Strategies
  - Cross-curricular Strategies
- Examining Professional Development Opportunities
  - National Content Specific Conferences, Workshops, Seminars
  - State Content Specific Conferences, Workshops, Seminars
  - Local Content Specific Conferences, Workshops, Seminars
  - Face-to-face Content Specific Opportunities
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At time of publishing, all of the website information was accurate. Due to the nature of the internet, some of the website information may have changed or become unavailable. Please see the references section of the corresponding online module for the most up-to-date information.

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Exploring Content-specific Resources

A wealth of tried and tested resources are available for adoption by subject specialists. Colleagues, school districts, state organizations, and many Web-based sources provide lesson plans, original source materials, videos, workshops, courses, professional forums, wikis, and blogs. At times the choices seem unlimited, and choosing useful and effective resources becomes the challenge. The Pennsylvania Department of Education is a prime example with the SAS portal. The Curriculum Framework specifies what is to be taught for each subject in the curriculum. In Pennsylvania, Curriculum Frameworks include Big Ideas, Concepts, Competencies, and Essential Questions aligned to Standards and Assessment Anchors and, where appropriate, Eligible Content.

National and State Content Area Organizations

National and state organizations offer support to educators in the form of subject-specific Web sites, journals, virtual and face-to-face conferences, forums, and the opportunities to build professional Web-based communities. A range of organizations span cross-curricular themes, such as middle school, and highly specialized content areas, such as high school physics or history teaching.

National content specific conferences, workshops, seminars. Leading professional organizations offer annual, face-to-face conferences featuring acclaimed keynote speakers, topical workshops, and opportunities to meet fellow subject specialists. For example, the National Science Teachers Association organizes an annual conference in a different city each year and also several regional conferences. The National Council of Teachers of Mathematics offers three annual conferences in different cities. Other subject-based professional organizations offer grand scale residential conferences, details of which are accessible online. Some of these events attract thousands of participants over several days and provide the most current educational research, pedagogy, and materials.

State content specific conferences, workshops, seminars. Most states are represented by a range of professional teacher organizations catering to subject-based, skills-based, or age range appropriate interests. Many national organizations include local chapters that provide professional development opportunities with a local bias. For example, the National Science Teachers Association (n.d.) supports local chapters in more than fifty states (http://www.nsta.org/about/collaboration/chapters/.aspx). The state of Pennsylvania is home to an array of professional teacher organizations (Table 1) catering to a range of specializations.

Art	http://www.paeablog.org/
Earth Science	http://www.paesta.psu.edu
English and Language Arts	http://www.pctela.org/
Geography	http://alliances.nationalgeographic.com/detail/pennsylvania-alliance-for-geographic-education/edn9A758DB7BC74DEE1C
Health, Physical Education, Recreation and Dance	http://www.psahperd.org/
History	http://www.pahistorycouncil.org/
Humanities	http://www.pahumanities.org/
Mathematics	http://www.pamte.org/
Modern Languages	http://www.psmla.net/
Music	http://www.pamusicteachers.org/
Reading	http://ksrapa.org/
Science	http://www.pascience.org/

Table 1. A sample of professional teacher organizations in the state of Pennsylvania.

Local content area (district, department, school, colleague). Colleagues offer an immediately accessible resource for sharing professional ideas. Harrison and Killion (2007) expand upon the possibilities for teachers to assume leadership roles in professional learning communities within their own schools. Opportunities for content-oriented leadership are varied and include sharing of quality resources, modeling instructional strategies, leading workshops, mentoring inexperienced teachers, and providing guidance on curriculum requirements. Teachers are able to access the services of acknowledged specialists in order to improve their instructional effectiveness. For example, the Pennsylvania Department of Education (PDE) provides a selection of online resources (http://www.pdesas.org/Instruction/Frameworks) to support "instructionally certified personnel with unique roles and functions." These include materials for early childhood, emotional support, English as a second language, gifted students and others.

Improving and Enhancing Pedagogy in Specific Content Areas

Subject disciplines are associated with characteristic and established knowledge structures. Danielson (2009) describes subject disciplines as having "a dominant structure, with smaller components or strands as well as central concepts and skills." Effective teachers are able to incorporate specific subject needs into lesson plans and formulate appropriate instructional outcomes. Awareness of the relationships between commonly acknowledged demands of different subjects enables the knowledgeable teacher to support students by encouraging them to draw upon prior-learned skills and content. Distinct disciplines have evolved unique pedagogies that unlock the most effective approaches to teaching. Students

McTighe and Wiggins (2012) urge educators to find consensus and clarity in recognizing that independent transfer of knowledge and skills is a primary reason for content teaching and learning. Students can only be judged to have really understood content when they are able to apply learning independently, in authentic situations, and without a teacher or supervisor giving directions. Teachers should be providing experiences for students that enable them to handle new situations independently by means of drawing upon a bank of learning experiences in order to develop appropriate strategies and solutions. McTighe and Wiggins propose that students are prepared for this independent transference of learning by designing learning experiences that expose them to more "problem- and project-based learning, small-group inquiries, Socratic seminars, and independent studies" (p.9).

Content-specific Strategies

The skilled teacher is able to sort and transform pedagogical content knowledge in order to present students with an optimally accessible learning experience. The experienced teacher is able to anticipate which topics present the greatest challenges within their subject discipline and plan accordingly. Knowledge of students enables the teacher to harness and build upon prior-learning in order to teach concepts more effectively. The teacher with a deep knowledge of subject matter is able to recognize links between concepts and offer flexibility in understanding how students develop thoughts and map ideas. Depth of understanding is key to making meaningful links with other subject disciplines and provides teachers with the confidence to embed learning with authentic life experiences. Solis (2009) maintains that subjects such as language, science, mathematics, and social studies contain unique strands of subject-specific pedagogical content knowledge. Additionally, there are areas of pedagogical content knowledge that transcend and link subjects.

The Measures of Effective Teaching Project (2010) cites the research of Lee Shulman to describe pedagogical content knowledge "as comprising an understanding of the content being taught; a mastery of the illustrations, examples and explanations that best support students' learning." The effective teacher is able to appreciate the challenges of learning content within their discipline and adapt instruction for students at various developmental stages and from a variety of backgrounds.

Mathematics. Mathematics is a subject that requires skilled teaching at an early stage in order to build a sound framework of understanding in preparation for later years. Wilson (2010) outlines some of the essential and detailed elements of mathematics learning that should be emphasised in the elementary classroom. Mathematics is founded in **numbers**. Students need to learn counting and the instant recall of single digit numbers before they are able to tackle addition and multiplication. **Place value** provides the "organizing and unifying principle" for mathematics learning and, according to Wilson, many students would benefit from more attention to this essential component of math learning. Arithmetic and algebra, in later years, are dependent upon an understanding of place value. Much of mathematics is a generalization of **addition, subtraction, multiplication, and division** of whole numbers. Mastery of these operations gives "students power over numbers and, by learning them, gives students and teachers a common language." The four basic arithmetic operations with whole numbers can be extended to working with fractions and decimals. The understanding of fractions is a critical ingredient prerequisite for algebra and handling the concept of ratio. **Problem solving** is an important skill that is introduced early in a student's mathematical education, "especially word or story problems." The complexity of problems progresses from one step to complex multi-step problems. Such problems provide the experience of translating words into mathematics. Mathematics is dependent upon precise **communication** and students, even at elementary level, need to be aware of the commonly understood meanings of symbols and terms.

Mathematics requires a balance between computational skills and subject knowledge, and the ability to develop a strategy and argument. French (2005) explains how teachers are able to best support learning when they display the abilities to use both mathematical and pedagogical knowledge. French maintains that effective teaching requires "an awareness of common misconceptions and ways of looking at them, the importance of forging links and connections between different mathematical ideas and the flexibility that comes from seeing alternative ways of looking at the same idea." Research categorizes elementary school mathematics teachers as displaying varying degrees of a mixture of three styles labelled

"transmission, discovery and connectionist." **Transmission** style involves a traditional teacher explanation followed by practice examples. In **discovery** style students are tasked to discover mathematical ideas. **Connectionist** style emphasizes connections between pre-learned and new mathematical ideas, and develops understanding through discussions. According to French, evidence suggests that teachers displaying dominance in the connectionist style were found to be most effective. A reflective notebook or log with subject based ideas and reflections is proposed as one effective means of improving instructional effectiveness. French suggests that the ability of teachers to connect between strands of a mathematics curriculum, based upon a depth of mathematical understanding, is a more important indicator of effective teaching than a formal mathematical qualification.

Turner (2010) describes, based on recent research, domains of mathematical literacy that teachers should be aware of, and considers challenges that citizens may encounter in their everyday lives when faced with the need to apply mathematical knowledge.

- **Communication** - Students need to understand and clarify mathematical problems and formulate a mental model of the situation described. Supporting skills include the the abilities to read carefully and then interpret statements, questions, tasks, and diagrams. Once solved, the student needs to present a solution and explanation.
- **Mathematising** - Students need to bridge the mathematical literacy gap between real world problems and their mathematical translations. Tasks could involve the selection of variables, taking measurements, and drawing illustrative diagrams.
- **Representation** - Representations, such as "equations, formulas, graphs, tables, diagrams, pictures, textual descriptions and concrete materials" are used to capture situations, tackle problems, and present solutions. Simple examples of this mathematical ability include tasks such as translating text into numbers and reading values from graphs or tables of data
- **Reasoning and argument** - Students use logic to piece together elements of a problem in order to infer and argue a possible solution. Reasoning can be as simple as following instructions. Higher level reasoning can involve analysis of a problem and creation of a multi-step argument.
- **Devising strategies** - Students use strategies to "recognize, formulate and solve problems." The strategy may be as simple as taking a direct action based upon the task description. More complex examples may require interpretation of information or modification of information in order to draw conclusions.
- **Using symbolic, formal, and technical language and operations** - Students need to use mathematical representative symbols and the rules and conventions needed for arithmetic expressions.

    Science. Science instructional outcomes vary widely from the acquisition of core knowledge and understanding to the ability to plan investigations, analyze data, and create hypotheses. Students can be bombarded with scientific misconceptions, such as evolutionary mismatches in *Flintstones* television programs and misrepresentations of force and acceleration in *Star Trek* movies. Teachers require a depth of scientific knowledge in order to avoid the reinforcement of misconceptions and to anticipate learning situations in which students may fail to assimilate counterintuitive explanations.

Allen (2006) argues that elementary science teachers with a "solid grounding in the topic" are able to help students further their understanding of science by building upon prior knowledge. Science teaches students to make observations and apply reasoning in order to make sense of the world. Elementary and middle school students are commonly faced with instructional outcomes that require them to understand and make predictions based on knowledge of natural systems of the Earth's seasons, day, month, and year, phases of the Moon, and weather. The area of curriculum is relevant, as an appropriate example, to one of the research findings cited by Allen. A study by the Harvard-Smithsonian Center for Astrophysics showed that "a majority of randomly chosen Harvard University graduates, faculty, and alumni could not give correct explanations for either the change in seasons or the phases of the moon." (For the record, the correct explanation concerns the tilt of the earth as the major factor.) The common misconception is that the earth follows an exaggerated elliptical orbit that places the planet much further away from the sun in the winter.

The Association for Science Education (n.d.) explains how a deep knowledge of science subject knowledge enables teachers to anticipate common misconceptions and challenges that science students at various ages encounter. For example, middle and high school students engaged with chemistry content are challenged by "having to switch attention rapidly between the macro-scale (what is seen and experienced directly), the sub-micro-scale (atoms, molecules, ions, electrons, etc. that are essentially invisible) and the representations (symbols, formulae and diagrams) chemists use in their writing." Student explanation of natural phenomena may be influenced by fiction and confuse facts. For example, students frequently associate dinosaurs with cavemen, "who are given as the cause of the dinosaurs' extinction." Students, both young and old, will say that "light travels further at night (or in the dark) than it does in the day." Many more misconceptions and challenges, based upon counterintuitive experiences or abstract ideas, are recognized in the teaching of science. The effective teacher is aware of the challenges and develops appropriate strategies to correct misconceptions and support student learning.

    English. English teaching ranges from the skills of basic communication such as persuasive language to the study and analysis of complex works of literature. According to the National Council of Teachers of English (NCTE) "literacy education and literacy practices are in the midst of a profound change" (Gillespie and Graham, 2012). An NCTE survey of teachers highlighted the need for students to be able to "communicate clearly and understand complex messages" both in classroom situations and out of school. Three specifically identified academic English language arts abilities identified were to: "seek information and make critical judgments about the veracity of sources, read and interpret many different kinds of texts, both in print and online, and innovate and apply knowledge creatively."

The Common Core State Standards Initiative (2012) describes English language arts expected outcomes for students in the K-12 age range. Students' progress with advancing levels of **reading** comprehension as they move through grades. Knowledge and insight are gained from reading a broad range of literature and informational texts. Students in early grades are able to **write** opinions and develop arguments based upon "sound reasoning, and relevant evidence." **Research** abilities to analyze and present research findings are emphasised in the writing

component. The skills of **listening** and **speaking** are developed in order to evaluate and communicate information and ideas. Development of a repertoire of **vocabulary** enables students to understand word meanings and nuances. Critical analysis and **media** production skills are are integrated throughout the Common Core State Standards.

Social Studies. Berson, Bennett, and Dobson (2009), in a position statement paper for the National Council for the Social Studies, outline some of the requirements for a successful social studies program in elementary school classrooms as being connected, coherent, and comprehensive. Elements "from the four core social studies disciplines: civics, economics, geography, and history" form part of a structured program. A well-crafted social studies curriculum is built around logical sequences with the possibility of studying in depth and with focus. The placement of social studies as "an essential part of the elementary curriculum" is necessary to prepare young students for their place in a democratic society. The effective teacher of social studies at the elementary level commands a knowledge of subject matter and the "the ability to engage students in the learning process through a variety of instructional methodologies."

National Council for the Social Studies (NCSS) posits that the development of attitudinal outcomes in students, such as civic competence and good citizenship, are primary motivations for the inclusion of a social studies curriculum. School programs may integrate content from varied disciplines such as "anthropology, archaeology, economics, geography, history, law, philosophy, political science, psychology, religion, and sociology" (2010). NCSS recommends ten organizing strands that may be used to create a school curriculum for any content within the social studies domain:

- Culture
- Time, continuity, and change
- People, places, and environments
- Individual development and identity
- Individuals, groups, and institutions
- Power, authority, and governance
- Production, distribution, and consumption
- Science, technology, and society
- Global connections
- Civic ideals and practices.

The intent is that any section of content—such as the American Civil War, ancient Greek civilizations, or biomes around the planet—may be presented using a focus from one or several of the stated themes.

World Language. The discipline of world language requires the teacher to create an environment in which students feel safe to make mistakes as they use their developing language skills to communicate. Ingold and Wang (2010) propose a set of required competencies, based around the target language, for effective world language teachers. They include language proficiency, understanding of language structure, appreciation of associated culture, and a pedagogy for second language acquisition.

Partnership for 21st Century Education describes the expectations for world language learning in a contemporary U.S. school classroom, with an "emphasis on developing students' communicative competence" and a goal of communicating with native speakers of the language (Theison et al., 2011). Three modes of communication are prescribed.

Interpersonal mode between participants uses "active oral or written communication in which the participants negotiate meaning to make sure that their message is understood." **Interpretive mode** finds meaning by listening or reading a text. **Presentational mode** is one-way written or oral communication in which the presenter must take into account the impact on the audience. In addition to technical aspects of language, there is an "emphasis on the relationship among the perspectives, practices, and products of the culture." The contemporary teacher seeks opportunities for students to authentically use the learned language outside of the classroom.

Related Arts (Family Consumer Science, HWF (Health, Wellness, Fitness), TE (Tech. Ed). Music, Art. Larrick (2008), writing for the California County Superintendents Educational Services Association, suggests that a proportion of elementary teachers are challenged in delivering visual and performing arts instruction due a lack of background training. A number of attributes for the planning of effective arts lessons are suggested. An effective sequence to a lesson maintains the focus on a few objectives, flows logically, and is practically achievable. The student is at the heart of planning, activities involve active participation and, plans anticipate how students may respond to the lesson. A tight lesson script can anticipate questions that students may ask. The overall plan should include activities that challenge students and create interest. An effective introduction provides guidance for the path the lesson should take and may involve activities such as warm up routines in movement lessons, such as dance and theater. The inventive teacher is able to adapt a lesson plan in order to make use of spaces and resources that are realistically available. This may involve substituting art materials, sources of music, scripts for plays, or stories.

According to the Pennsylvania Department of Education SAS Web site, **family and consumer science** enables students to develop skills, attitudes, and behaviors for living, such as finance and resource management, family, work and community responsibilities, food science, and nutrition and child development (n.d.-b). It also describes a range of specialist vocational subjects, in the field of careers and **technical education**, that may be offered at high school level. Subjects such as accounting, car repair, computer technology, child care, and electronics are aimed directly at potential career pathways (n.d.-a).

The IDEA Health and Fitness Association recommends that **health, wellness, and fitness** is taught as a whole school effort. Measures such as

regulating the nutritional qualities of food available on campus, encouraging physical activities during recess, and integrating health topics within other subject areas are designed to promote attitudes and behaviors for healthy living (McCary, 2007).

The Healthy, Hunger-Free Kids Act of 2010 addresses the types of foods that should be available to students on campus during the school day. Science-based nutrition guidelines were used to develop practical, operational healthy food options for schools to follow. Foods such as "whole grains, low fat dairy, fruits, vegetables and leaner protein" are promoted. Foods with high fat, sugar, sodium and caffeine are to be avoided. This initiative involves all members of the school community in a quest for healthier eating (United States Department of Agriculture, 2013).

The American Alliance for Health, Physical Education, Recreation and Dance (2013) recommends standards for **physical education** classes. Important objectives are the development in students of motor skills and movement patterns, personal fitness, attitudes of respect for others, and enjoyment of challenge, social interactions, and self-expression.

Cross-curricular Strategies

The effective teacher sees instruction through the eyes of students and seeks opportunities to indicate connections and overlaps between subject disciplines. Collaboration between colleagues enables instruction to be planned in such ways that the teaching of common skills is coordinated. According to McTighe and Wiggins (2012) there are a small number of overarching, long-term transfer goals in each subject. For example, a long-term goal in mathematics would be for students to solve real-world problems on their own. A long-term transfer goal in history might be for students to apply what they are learning to issues that are occurring today: "In every case, the ability to transfer learning manifests itself in not just one setting but varied real-world situations. Furthermore, transfer is about independent performance in context" (p. 1). Students who develop depth of learning are able to apply concepts and skills without any further help from the teacher. Transference of learning enables students to develop a repertoire of knowledge, skills, and strategies that may be selected in order to address the context of many real life situations.

Writing across the curriculum. Students experience the need for writing in almost all of their subject disciplines. Effective teachers in any of the content areas embrace the need for writing and promote the development of style and skills appropriate to that discipline. Writing across the curriculum is a pedagogical approach that encourages students to write skillfully in order to enhance comprehension and improve retention of knowledge. Wells (2013), on the Purdue Owl Web site, offers examples of "writing and reading journals, summaries, response papers, learning logs and problem analyses." This practice accepts that subject disciplines demand their own styles of writing as found in such common examples as "literature reviews, project proposals, and lab reports." Wells asserts that "the style, organization, and format that is acceptable in one discipline may not be at all acceptable in another." Students benefit from learning and practicing the writing conventions of each discipline.

The Pennsylvania Department of Education (n.d.) Web site states that "Developing literacy skills in reading, writing, speaking and listening is a collaborative responsibility of all educators." There is an expectation that skills, such as communication and critical thinking should be enhanced by improved literacy.

Dr. Douglas Reeves calls nonfiction writing one of the most powerful practices that impacts student achievement (California Department of Education, n.d.). Michael Schmoker, author of Results Now, expresses concern that students are too often occupied for an excessive proportion of instructional time on undemanding tasks such as "completing worksheets, watching movies, cutting and pasting PowerPoint presentations, and passively listening to group presentations" (Murray, 2007). Schmoker advocates for more time spent on "analytical reading and discussion or completing writing and mathematics assignments" and argues that students need to read non-fiction articles and simultaneously make notes and ask critical questions. Depth of learning comes from discussion with other students and persuasive writing tasks about the topics studied.

Graham and Perin (2007) used a meta-analysis of research approaches in order to determine the most effective instructional strategies that serve to enhance writing skills for students in the grades 4 to 12 range. Eleven specific elements were identified as effective in helping adolescents to improve writing skills:

- Writing strategies
- Summarization
- Collaborative writing
- Goals for a specific product
- Word processing
- Sentence combining
- Prewriting
- Inquiry activities
- Process writing
- Study of models
- Writing for content learning

The eleven elements are applicable for adoption by all teachers, in an effort to enable students to write well and to use writing as a tool for learning across the whole curriculum.

Collaborative concept planning. Collaborative planning is key to developing a culture in which teachers share responsibility for the advancement of all students in the school. Newell (2012) explains the advantages of collaborative lesson planning by teams of teachers in

scheduled meetings. A process of reflection and discussion is the basis of a sustainable model of improvement for the instruction and learning process. According to Newell, collaborative planning can enable success with cross-curricular learning initiatives and further curriculum development with new ideas. The engagement and dialogue between teachers is likely to create an environment of cooperation and trust between colleagues. Furthermore, teachers are able to share evidence about student learning and evaluate teaching challenges and strategies.

Examining Professional Development Opportunities

Effective teachers assume a professional responsibility for their ongoing development and update of pedagogical and content-based skills. Wiliam (2013) maintains that research from the past decade has identified teacher quality as "the most important variable in most education systems." A student taught by a highly proficient teacher is able to learn in only six months what an averagely proficient teacher enables in one year. The least effective teacher will need two years to effect the same advancement in student learning. Wiliam argues that teachers need to follow the research and develop practices that are likely to improve classroom instruction and learning.

National Content-specific Conferences, Workshops, Seminars

Contributors to the Triangle Coalition for STEM Education (2011) present a number of reasons that large national conferences benefit educators. The positive tone of such conferences highlights the important professional challenges for educators and situates some of the perceived bureaucratic obstacles in the background. National conferences are typically able to host an extensive array of speakers and workshops. Acclaimed researchers and practitioners, of national and international repute, provide a special stimulus for classroom teachers. The forum for sharing and exchanging ideas at a national conference provides encouragement and opportunity for teachers to reflect on their own current practice. Networking generates new and valuable contacts with other educators who may offer collaboration, support, or opportunities to make career moves.

State Content-specific Conferences, Workshops, Seminars

Many state-sponsored opportunities are available for all forms of professional development for teachers. Conferences, workshops, and seminars include events with a focus on new state initiatives and those that provide a boost for teachers on the implementation of establishedcurriculum areas.

Local Content-specific Conferences, Workshops, Seminars

 Local workshops provide an inexpensive opportunity to meet like-minded professionals and participate in professional development on a specific topic. Workshops are typically one day in duration and many of them are inexpensive or offered for free. Harry Wong (2002) stresses the importance of professional development for new teachers. A proposed model includes an initial workshop over several days, followed by "systematic training over two or three years."

Face-to-Face Content Specific Opportunities

 Face-to-face meetings provide rich opportunities to develop professional relationships with like-minded educators. The personal bonding that results from such meetings can be a powerful catalyst for continued online collaboration. Disadvantages include the demands on a teacher's agenda of being at a specified venue at a designated time. Time away from family and the classroom may be difficult to manage. Financial outlay may also be incurred for travel and accommodation.

Courses, seminars, workshops. A variety of face-to-face courses, seminars, and workshops is accessible to teachers at local, state, and national level. Opportunities are offered by universities as well as academic institutions such as museums, state education departments, and others.

Online Content Specific Opportunities

Content specific opportunities are available from a range of professional organizations, universities, public institutions, and individual teachers who have a passion for sharing ideas and materials on the Web.

Courses, blogs, wikis. Blogs and wikis enable educators to share ideas within professional learning communities. Furthermore, physical location and distance offer no restrictions to communities that can extend beyond schools, states, or even countries. The sole teacher of a specialist subject is no longer isolated from colleagues when the digital world enables online collaboration. Ferriter (2009) explains how "thousands of accomplished educators are now writing blogs about teaching and learning." Tools are available to improve the efficiency of identifying and viewing examples of relevant online content from blogs and wikis. Ferriter recommends the use of a RSS (really simple syndication) feed reader. Feed readers are tools that automatically check for content updates on Web sites of favorite or selected contributors. Much effort is saved by avoiding the need to manually search a range of blogs and wikis. Examples of RSS tools are Pageflakes (www.pageflakes.com), and Bloglines (www.bloglines.com). Teachers with word processing skills and ideas to share are

able to create their own blogs and wikis. Educators can use blogs and wikis to develop and share instructional materials, compare successful strategies for grading, clarify the implications of new district policies, and discuss any aspect of professional activities.

Online courses provide structured and interactive opportunities for professional development. Some online learning opportunities are free of cost and accessible on demand. One example is the first year teacher program from Reading Rockets http://www.readingrockets.org/firstyear. In this case, the course is self-paced and all feedback is provided automatically in the form of multiple response questions. Other online courses require registration, payment of fees, and a commitment to a published timeline. Graduate credits may be available. The American Museum of Natural History provides courses on topics directly applicable to school science curriculum. http://www.amnh.org/learn/About.

Teachers in the State of Pennsylvania can access information about recommended online courses from a variety of providers at http://pennsylvaniateacherscontinuingeducation.com.

Conclusion

The effective teacher reflects periodically about the body of knowledge and pedagogical skills needed to deliver an optimum experience for students. A quest for updated content and enhancement of classroom skills stems from a recognition that the educational environment is dynamic and responsive to change. Empathy is a quality that enables teachers to recognize the many demands, from a range of subject disciplines, that students synthesize on a day-to-day basis. Recognition of links and overlaps between subjects can help students to map ideas and apply skills across subject boundaries, leading to the application of learning in the real-world. Professional development is key to maintaining and adding to a set of professional teaching attributes. The improving teacher seeks professional development opportunities at national, state, and school levels and is prepared to create opportunities by displaying leadership in pursuit of collaboration and professional learning communities.

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