Developing the

Analytic Framework©

Assessing Innovation and Quality Design
In
Science and Mathematics Teacher Preparation

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Background

Context for Launching the Science and Mathematics Teacher Imperative (SMTI)

The economic and social imperatives to improve student achievement in science and mathematics are well documented in a number of reports, studies, newspaper articles, assessment results, and even legislation. At this stage in the 21st century, the United States appears under threat by the rapid globalization of financial and human capitol coupled with dramatic educational advances in other nations and the general stagnation of educational progress in the United States, particularly in science and mathematics. Education, political, and business leaders have offered a variety of remedies for this perceived national malady. Many have advocated for greater rigor in the U.S. science and math curriculum, higher expectations for student achievement and increased accountability for teacher performance. Others have emphasized the need for school administrators and parents to focus on creating the conditions in schools and homes that better support student learning in science and mathematics. Still others focus on the importance of raising teacher's salaries in order to lend greater prestige to the profession and attract more talented individuals. Virtually all agree, however, that how teachers perform with students in the classroom matters a great deal. Consequently, *how teachers are prepared* to teach remains an issue of great concern nationally.

In response to these concerns, and to the recommendations of the National Academies' report *Rising Above the Gathering Storm,* the Association of Public and Land-grant Universities (APLU) launched the Science and Mathematics Teacher Imperative (SMTI) in 2008. The specific goal of SMTI is to measurably increase the *quantity, quality, and diversity* of STEM teachers prepared by APLU institutions. Presidents and chancellors of over 125 APLU institutions have committed themselves and their institutions to SMTI, making it the largest such effort in the nation. But APLU members knew they were entering a crowded field. Dozens if not hundreds of efforts were already under way to transform or renew science and mathematics teacher preparation and development. Nancy Zimpher, a former education dean who is now State University of New York Chancellor, challenged her fellow APLU board members by lamenting, "With all the reports and initiatives over the last 30 years, we have hardly moved the dial!" Tom Luce, CEO of the National Math and Science Initiative, characterized the same disaggregation of efforts across the country as hundreds of pilot lights, each with insufficient power to create significant, sustained energy.

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APLU leaders also realized that to build SMTI into a successful national initiative that would galvanize university presidents and provosts to enhance significantly their science and math teacher preparation, a common framework was needed to (a) help identify desirable, feasible, comparable and effective strategies across institutions; (b) make these strategies known to others; and (c) allow for and celebrate differences among programs by showing how different but equally valid strategies can contribute toward the same goals and objectives. But that framework was missing. A common framing tool did not exist to help guide the decisions by campus leaders on how to achieve the goals of improving the quantity, quality and diversity of science and mathematics teachers. Even more surprising was the discovery that there was no readily available resource to access leading practices in science and mathematics teacher preparation and development. Nor was there available a well-developed instrument with a common structure and language for identifying, analyzing or sharing coherent and successful practices in science and mathematics teacher preparation and development.

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The Analytic Framework has been developed to fill this void. The Framework is a comprehensive tool that allows institutional and program leaders, faculty and others to assess their policies and practices and to better determine program coherency. Moreover, the Framework offers institutions the opportunity to identify, in a systematic way, areas in which programs can be benchmarked to other programs.

Purpose

Creating the Analytic Framework to Identify Effective Practices and Design More Coherent Science and Mathematics Teacher Preparation Programs

The level of criticism directed at college- and university-based teacher preparation has probably never been as intense in the United States as it is currently. Disenchantment with the quality of teacher preparation programs has been growing over several decades, but recently it has become more intense primarily for three reasons. First, the well being of the nation's economy is seen as increasingly and vitally linked to developments in the sciences, mathematics and technology. Second, repeated research studies have shown that the quality of the teacher is, not surprisingly, the number one in-school causal factor related to student achievement (Sanders and Rivers, 1996). Third, the passage of the No Child Left Behind Act greatly increased the focus on accountability for student results regardless of race, ethnicity, and past performance. The poor academic performance of huge numbers of U.S. students, combined with the focus on teachers as primarily responsible for these outcomes, has led to strong criticism of the programs that prepare them.

Virtually all states have approved alternative licensure programs, and others have authorized districts and cities to create their own teacher preparation programs that bypass higher education institutions completely. Initially and largely created as attempts to address state teacher shortages, policymakers are now justifying alternative programs because of the uneven quality of teachers produced by traditional higher education programs. Policymakers are taking these actions even though university-based teacher education programs are subject to several levels of quality review: (1) approval by the university and, for public universities, by system offices; (2) review and, if warranted, sanctions by the state's program and licensure approval agencies; and (3) more often than not, national accreditation.

In spite of these quality-control processes, studies show there is not routine uniformity in the performance of program graduates (or program completers), as measured by impact on student achievement, within and across programs in the same institution, or across institutions within a state. (Noell and Gansle, 2008; Henry Thompson, et al., 2010; and Sanders, 2010*).* In three different states – Louisiana, North Carolina and Tennessee – researchers using different methodologies found similar results: there is as much variability among program graduates (in the same content areas) within a teacher education program as there is across other teacher education programs within the same state. The North Carolina study found that this variability held true for alternative licensure programs as well. While few states have the sophisticated data systems in place to link program graduates to student achievement, there is little reason to believe that the mixed results found by

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researchers in Louisiana, North Carolina and in Tennessee would be dramatically different in other states.

As significant as the variability of results found within and across teacher education programs is the inability, currently, of any of these value-added studies to be able to identity the "active ingredients" within programs that link to the effective performance of program completers. It is not known what factors – academic achievement of preservice candidates, particular courses or course sequences, specific professors, clinical placements, type of supervision and feedback, importance of school-university partnerships or what combination of these and other factors – account for the ability of program completers to positively impact the measured achievement of their students. As the 2010 National Research Council study *Preparing Teachers: Building Evidence for Sound Policy* notes:

Because of the paucity of systematic research as well as the enormous variation in virtually all aspects of teacher preparation programs and pathways, we cannot draw any specific conclusions about the characteristics of current teacher preparation programs.

> "[B]oth programs and pathways vary dramatically in their requirements, structure, and timing. *Because of the paucity of systematic research as well as the enormous variation in virtually all aspects of teacher preparation programs and pathways, we cannot draw any specific conclusions about the characteristics of current teacher preparation programs."* [emphasis added]

There is a similar lack of evidence about effective induction and mentoring and effective professional development. And there is an absence of both evidence and vigorous discussion about the appropriate role of teacher preparation programs – largely regarded as concerned with pre-service – in the inservice development of teachers.

In creating the Science and Mathematics Teacher Imperative, APLU leaders were faced immediately with questions of "what to do" by the presidents and chancellors of some of America's leading public research institutions who had agreed to participate in the effort. University leaders were willing to commit to produce more and better teachers of science and mathematics, but they and their deans and faculty wanted guidance and a common framework to guide their decision-making about program improvement to meet the SMTI long-term goals of driving up the quantity, quality and diversity of the science and mathematics teacher education programs. They wanted to know the specific strategies that would produce these results. And although there were prominent efforts which show evidence of promise or success – such as UTeach, the Woodrow Wilson Fellows Program and Math for America – not all university leaders saw these models as the most compatible for their campuses, for a variety of different reasons. These same leaders , however, wanted greater assurance, beyond achieving state and national accreditation, that programs developed by their faculties were coherent and employed 'standards' of effective practice.

In the face of these realities and in the absence of a common tool, the authors of what has come to be known as the Analytic Framework began the process of creating a classification of the critical components, goals, objectives and strategies that attempt to codify a shared language of concepts, strategies and assessments that are particular to science and mathematics teacher preparation. The creators of the Analytic Framework were well aware of the relative paucity of research on quality teacher preparation. They also knew that while significant progress has been made in recent years, notably in clinical practice in partnership schools, there remains a lack of consistent implementation and even some continuing lack of agreement within the profession and across content areas about the core elements of teacher preparation – the curriculum and content.

The Analytic Framework is intended to be a useful tool in creating and achieving greater program coherence – and providing greater assurance that program completers will possess sufficient knowledge and skills to teach effectively. The creators of the Analytic Framework do not claim that it is inclusive of the kind of "signature pedagogy" for science and mathematics teacher preparation for which Lee Shulman (2005) has so eloquently advocated. However, the authors have developed this tool with a strong belief that the response to the question asked by Linda Darling-Hammond – "Can universities prepare teachers well?" – is *yes*! But, universities can and must improve their programs to produce greater consistency in positive outcomes. The experience of developing this tool confirmed for the authors Darling-Hammond's research (2006) that, "…it is possible (if not easy) to create the context for high quality teacher education within even the most resistant institution: the research university."

…the response to the question asked by Linda Darling-Hammond – "Can universities prepare teachers well?" –* is *yes!

The Analytic Framework was developed with significant input and critique by research scholars, teacher educators, disciplinary faculty, educational policy analyst, classroom teachers and other P-20 educators from across the nation. The wise council of a very distinguished advisory committee improved the Analytic Framework. The authors, contributors and advisory committee members are listed on page 18.

The Analytic Framework is designed to a be a shared tool that enables P–20 educators, teacher educators, content specialists, researchers, campus leaders, and policymakers to carefully assess and improve the design of science and mathematics teacher preparation programs. The Analytic Framework enables users to compare programs and specific program features within and across institutions – and thereby learn from one another and share with one another to stimulate program improvements. The Analytic Framework will continue to evolve as the evidence of success for program strategies is collected and as promising practices in science and mathematics teacher preparation, using the Analytic Framework, are identified and shared.

Structure

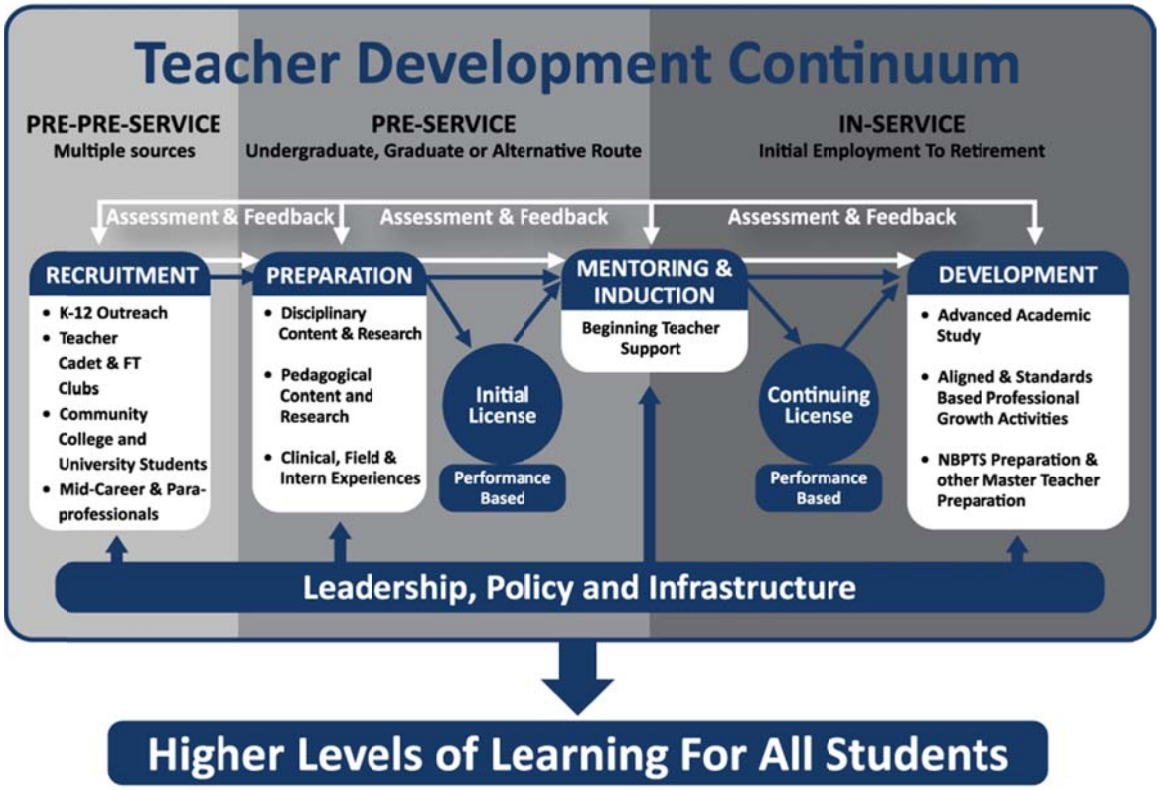
The Analytic Framework is intended to serve as a tool for better understanding leading practices and design features employed to prepare and develop science and mathematics teachers. These design features are critical and permeate the Framework: teacher preparation is an all-campus responsibility; it is clinically based, requiring close links with P-12 schools; and it must be focused on reliably preparing beginning teachers that can positively impact student achievement. The dual importance of teaching as a clinical practice and school partnerships are core recommendations of the 2010 Report of The NCATE Blue Ribbon Panel on Clinical Preparation and Partnerships for Improved Student Learning. SMTI and the authors of the Analytic Framework embrace that viewpoint and an "all-campus" perspective that faculty (disciplinary and pedagogical) and campus leaders are responsible for creating and sustaining the P-12 partnerships necessary for effective clinical-based teacher education, and for aligning content and pedagogical courses to the actual needs of teachers. All of these factors contribute to the ultimate goal of improving student achievement.

> ***These design features are critical and permeate the Framework: teacher preparation is an all-campus responsibility; it is clinically based, requiring close links with P-12 schools; and it must be focused on student achievement.***

The conceptual backbone of the Analytic Framework was, in part, inspired by the 2001 National Research Council publication, *Educating Teachers of Science, Mathematics and Technology: New Practices for a New Millennium*. The NRC report strongly suggested that there is more to teacher preparation than the formal preparation program itself. Not only do a program's recruitment practices have an important impact on the success of its candidates, but helping graduates succeed after their preparation, as beginning teachers, should be perceived as an on-going responsibility of the university. This responsibility should extend to the teachers and schools that partner with the university in providing clinical and field experiences for teacher candidates and to schools where program graduates are historically employed.

The NRC report and the Analytic Framework reflect the work of John Goodlad (1994) by embracing the perspective that university engagement with these schools and teachers can contribute to improved teaching and teacher preparation simultaneously. This extended model of teacher education also includes a focus on the role of leadership and policy as critical to the effective preparation of science and mathematics teachers and others. The continuum is illustrated in Figure 1 below.

Figure 1. Teacher Development Continuum



The authors of the Analytic Framework strongly believe, as Figure 1 shows, that rigorous and regular assessment and feedback are important at every stage along the continuum of teacher development. The Analytic Framework assessment prompts colleges and universities to document the evidence necessary to measure the impact of policies and programs that are employed to attract, prepare, support and retain teacher candidates and, most important, the impact on student achievement.

Table 1 presents the organization of the Analytic Framework around the **five Core Components**, including the goals and objectives under each Core Component. The five Core Components stretch the traditional, and limiting, conception of what constitutes teacher education.

- **Core Component 1. Leadership, Policy and Infrastructure**. The preparation of science and mathematics teachers exist within a 'sea' of local, state and federal policies that requires thoughtful leadership to help form and support if the education of teachers is to be coherent and produce a reliably effective and sustained teaching force for states and the nation.
- **Core Component 2. Recruitment, Selection and Admission.** The preparation of science and mathematics teachers begins well before candidates are formally accepted into preparation programs; much care should be given to identifying and actively recruiting those with the demonstrated interest and ability to prepare for the rigors of teaching.

- **Core Component 3. Content, Pedagogy and Clinical Practice.** Integrating pre-service candidate's science or mathematics academic content with learning how to develop well-structured lessons for P-12 students - and applying and honing this integrated capability in authentic school settings is core to the work of science-mathematics teacher preparation.
- **Core Component 4. Beginning Teacher Support.** The education of beginning science and mathematics teachers is not complete on graduation day; the content and pedagogical faculties have a continuing responsibility to provide a reasonable level of support to their program completers who assume teaching roles in a variety of settings and often without the mentoring and induction needed of all beginning teachers.
- **Core Component 5. Teacher and School Development.** Colleges, universities and other organizations that aspire to prepare teachers must also be engaged in developing both the teachers and the schools in which pre-service science-mathematics teachers are consistently placed for clinical and field experiences; it is these teachers and schools – ones committed to the success of all of its students and that can model effective practices and inspire prospective teachers of science-mathematics.

Four cross-cutting design features are critical and permeate the entire AF. They are:

- **First, *teacher education must be an "all-campus" responsibility*.** Science and mathematics faculty must insure that teacher students have a comprehensive understanding of science and mathematical concepts and theories. Science and mathematics faculty should also collaborate with pedagogical faculty who must assure that pre-service teachers learn how to teach science and mathematics effectively to students with different preconceptions and levels of understanding. Campus leaders must foster policies that support collaboration for effective science and mathematics teacher preparation

- **Second, *teacher education must be clinically based, requiring close links with P-12 schools*.** Deep and sustained partnerships between higher education and the P-12 schools are essential to effective science and mathematics teacher education.

- **Third, *teacher education must be focused on reliably preparing beginning teachers who can advance student achievement.*** The end-goal of positively impacting P-12 student success must be kept clearly in mind; all science and mathematics teacher education graduates must demonstrate the capability to advance student learning to be recommended for a teaching license

- ***Fourth, teacher education must fully embrace digital technology and communications strategies to be made more efficient and effective.*** Accessing digital content, using social media and applying other technologies appropriately to teaching and learning are now essential skills for teachers and teacher candidates to master*.* Accessing digital content, using social media and applying other technologies appropriately to teaching and learning are now essential skills for teachers and teacher candidates to master.

The Analytic Framework survey assessment provides the opportunity to rate each objective and strategy on two scales: first, how *valued* the objective and strategy under each Core Component is perceived to be; and second, how effectively *implemented* the objective or strategy is perceived to be in their program. The two ratings both provide five response options: Uncertain, Strongly Disagree, Disagree, Agree and Strongly Agree. Assessing program components on both perceived value and perceived level of implementation allows for a deeper discussion and analysis of the current program and the desired program.

The 5 goals, 14 objectives and 56 strategies under the Core Components were derived, as mentioned earlier, from an extensive process of engaging faculty, administrators, researchers, practitioners and others across the nation over a three-year period. The process also involved numerous site visits to witness and verify that the strategies selected for inclusion in the Analytic Framework were actually functioning practices and with evidence that the practice was producing the desired result.

The Analytic Framework will continue to evolve as the research base of teacher preparation and development evolves and as more institutions use the tool for self-analysis and as an aid for strategic planning and program improvement. Readers are invited to join the effort to improve and employ the Analytic Framework, and also encouraged to visit **www.aplu.org/SMTI** to learn more about APLU's Science and Mathematics Teacher Imperative (SMTI) and the Analytic Framework.

Table 1 The Analytic Framework Structure: Core Components, Goals and Objectives	
Core Component I: Leadership, Policy and Infrastructure Goal I: Promote and Sustain a Strong Institutional Commitment to the Preparation and Development of Highly Capable Teachers of Science and Mathematics	
Objective I.A	*The Institutional Infrastructure Promotes Shared Responsibility and Accountability for Science and Mathematics Teacher Preparation within the Institution and with P-12 Schools and the Community*
Objective I.B	*Institutional Policies and Practices Provide Encouragement, Support, and Rewards for Disciplinary and Pedagogical Faculty Leadership in Science-Mathematics Teacher Preparation*
Objective I.C	*The Institution and/or Program Pursues Partnerships and External Financial and Policy Support for Science- Mathematics Teacher Preparation and Development*
Core Component II: Recruitment, Selection and Admission Goal II: Recruit High Quality and Diverse Candidates into Science and Mathematics Teacher Preparation	
Objective II.A	*Institutional and/or Program Policies and Practice Ensure that Science and Mathematics Teacher Preparation Is Highly Selective, Admitting Teacher Candidates With Demonstrated Academic Skills and Genuine Interest in K-12 Science or Mathematics Teaching*
Objective II.B	*The Teacher Education Program has Developed and Sustained an Infrastructure to Recruit and Retain Teacher Candidates Matched to Assessed Needs for Science and Mathematics Teachers in the Region or State*
Objective II.C	*The Teacher Education Program Actively Recruits Diverse and Underserved Populations into Science and Mathematics Teacher Preparation*
Core Component III: Content, Pedagogy and Clinical Practice Goal III: Prepare Quality Teachers with Demonstrated Capability to Improve Student Success in Science and Mathematics	
Objective III.A	*The Teacher Preparation Program Ensures that Teacher Candidates Have the Knowledge and Understanding of Science and Mathematics to Promote Student Success*
Objective III.B	*The Teacher Preparation Program Ensures Students Have the Education and Preparation to Improve Student Success in Science and Mathematics*
Objective III.C	*The Teacher Preparation Program Embeds Sequential and Diverse Clinical Experiences to Ensure that Teacher Candidates Develop and Demonstrate Proficiency in Improving Student Interest and Success in Science and Mathematics*
Objective III.D	*The Science and Mathematics Teacher Preparation Program Ensures Coherence and Alignment with Local and State Education Policies and National and International Science and Mathematics Standards and for Producing Teacher Candidates who Demonstrate the Capacity to Teach to High Standards*
Core Component IV: Beginning Teacher Support Goal IV: Support and Learn from Program Completers as Beginning Science and Mathematics Teachers	
Objective IV.A	*The Science and Mathematics Teacher Preparation Program Track and Assess the Effectiveness of Program Completers and Beginning Teachers*
Objective IV.B	*The Teacher Preparation Program Provides Mentoring and Support Mechanisms for Recent Science and Mathematics Program Completers*
Core Component V: Teacher and School Development **Goal V:** Provide Continuing Learning Opportunities and Advanced Studies for In Service Science and Mathematics Teachers	
Objective V.A	*The Science- Mathematics Teacher Education Program Partners with Schools and Community to Assess, Plan and Implement Professional Advancement Options for Science and Mathematics Teachers*
Objective V.B	*The Science-Mathematics Teacher Education Program Promotes and Sustains Professional Development Programs for Graduates and Other Science and Mathematics Teachers*

Underlying Assertions of the Analytic Framework

Several studies, including the five-year study resulting in the 2010 National Research Council report *Preparing Teachers: Building Evidence for Sound Policy*, cited above, have documented that the research base for teacher preparation is weak overall, almost non-existent in some areas, and is particularly deficient in the lack of outcomes expressed as impact on student achievement. However, there is sufficient evidence or professional consensus to support 10 assertions about quality teacher preparation and development that underlie the Analytic Framework. All of the assertions are presented in Table 2. (A literature review supporting these assertions is available upon request.)

Table 2. Ten Underlying Assertions of the Analytic Framework

1. Teacher education is a campus-wide responsibility. The policies and practices of the entire university affect the number, quality, diversity—and ultimately the competence—of students who enter and complete teacher preparation programs.

2. Teacher preparation is a clinical-based and extended enterprise that, of necessity, must engage P-12 educators and schools as equal partners in the process or preparing and developing teachers

3. Institutional, state, and local policies affect the quality of teacher preparation. Thus, attention to policies and their impact on preparation programs and practices, including recruitment into programs and into the teaching profession, should be a high priority.

4. Multidimensional and targeted teacher preparation recruitment strategies, when effectively managed, can increase the quality, quantity, and diversity of teacher preparation candidates in response to identified needs.

5. Prospective teachers need to be well grounded in the content knowledge of what they teach.

6. Prospective teachers need sufficient pedagogical knowledge and skill to enable them to succeed in teaching the course content to students with different cultural and linguistic backgrounds and different levels of prior knowledge.

7. Prospective teachers need knowledge of the intellectual, social and emotional development of young people, an understanding of how young people learn, and the skills to manage classrooms so that they motivate and support students' intellectual and emotional growth.

8. Prospective teachers need frequent well-structured and well-supervised clinical and field experiences in different school environments to support their ability to reflect on and improve their classroom effectiveness.

9. Intensive, high-quality mentoring and induction during the early years of new teachers' careers can increase their effectiveness and the likelihood that they will remain in the profession.

10. Teachers in partnership schools must be supported to learn, grow, and reflect with others on what and how they are teaching and how to mentor, guide and assist teacher candidates and beginning teachers.

Analytic Framework Development

The early development of the Analytic Framework began in 2007 with the financial support of APLU and the Carnegie Corporation of New York, and continued with support from the National Science Foundation. The creators took the lead in developing the initial content of the Framework, and embedded advice and recommendations received from meetings with individuals, focus group discussions, invited critiques, and campus visits. Particularly helpful in this process were those universities that had documented how their programmatic reforms led to an increase in the number, quality, or diversity of science and mathematics teacher graduates. The Framework has been significantly improved over time because of site visits to selected institutions and the extensive input and critique of many disciplinary and pedagogical university faculty, K-12 teachers and administrators, and respected organizational leaders – many of whom were champions as well as critics of teacher education. A listing of contributors and reviewers of the Framework is presented on page 15. The summary of meetings, focus groups and other activities involved in the deliberately iterative process of the Framework's development can be found in the Appendix.

> ***Extensive engagement with respected educators, including disciplinary faculty, and with leaders of organizations engaged in teacher education – and science and mathematics teacher preparation specifically – has greatly enhanced the face validity of the structure and content of the Framework.***

The refinement and validation process for the Framework continues with the participation of 25 institutions that are part of an NSF MSP/RETA grant awarded to the Association of Public and Land-grant Universities. Administrators and faculty are using the AF to identify and recommend for external review selected strategies that they believe are promising practices. They will make formal nominations, with supporting evidence, to APLU staff and external reviewers. This extensive engagement with respected educators, including disciplinary faculty, and with leaders of organizations engaged in teacher education – and science and mathematics teacher preparation specifically – has greatly enhanced the face validity of the structure and content of the Framework. There is general agreement among the many reviewers of the Framework that it can be used as a tool for assessing both the strengths and weaknesses of existing programs, benchmarking with other programs, building more coherent programs and sharing successful practices.

Usefulness of the Framework

The iterative evolution of the Analytic Framework was intentional. It was based on a model of teacher development that is guided by a set of logical and (where the evidence exists) research-based assumptions. The various focus groups, invited critiques and campus visits that contributed to the Framework's development process were intended to test the Framework's logic and content by asking four related questions of interest, shown in Table 3, to both the developers and potential users of the tool. In each case the creators attempted to develop the Framework in ways that would yield an affirmative response by users.

Table 3. Four Questions About the Analytic Framework

- **Utility:** Is the Analytic Framework a tool that people want to use and find useful?
- **Accuracy:** Does the Analytic Framework produce accurate, comparable information?
- **Feasibility:** Is the Analytic Framework able to be used easily in a variety of contexts?
- **Propriety:** Can the Analytic Framework be employed with appropriate privacy safeguards?

The Analytic Framework is structured as a comprehensive and ordered classification of goals, objectives and strategies of science and mathematics teacher preparation and development that can be used to:

- **Undertake an ordered analysis of entire programs or selected practices within programs to identify key factors contributing to program/practice success**
- **Assess programs and identify possible program improvements**
- **Build new and more coherent and effective models of teacher preparation and development.**

Reflecting the extensive consultation with leading national experts, the Analytic Framework is a rich source of ideas for program and policy improvements to enable institutions and other program providers to:

- **Benchmark their program to other programs within their own university**
- **Benchmark/compare programs to peer institutions within or across a states**
- **Benchmark their programs to recognized promising practices,**

The Analytic Framework was guided in its creation by a combination of available research, national expertise and observed practice. As such it is a useful structure to:

- **Identify current and needed research across the continuum of teacher preparation and development**
- **Support collaborative research across institutions and organizations using a common framing tool.**

Next Steps for the Framework

With support from NSF and other sources, the immediate next steps in the development of the Analytic Framework are described in the following four tasks and activities:

Task 1: Refine usability of the Analytic Framework and define features critical to high quality programs

- Refine accessibility, accuracy and feasibility of Framework as a tool for program assessment and benchmarking across both institutions and university system;
- Define a smaller subset of key program features or quality indicators that are fundamental to overall program effectiveness

Task 2: Identify Promising Practices and benchmark programs against them

- Explore how to use the Framework to identify leading and promising practices with the help of expert P-12 practitioners and higher education faculty
- Engage institutions and their partners in benchmarking their programs to those practices.

Task 3: Enhance Use of the Analytic Framework with associated technical assistance

- Investigate the effectiveness of different forms of technical assistance that can be used in conjunction with the Framework's online survey to advance program improvements, including self-study, expert site visits, peer-to-peer coaching, and access to online and in-person assistance
- Evaluate impact of intensive expert site visits and develop a protocol for site reviews.

Task 4: Explore using the Analytic Framework for better alignment w/key policies and guidelines

- Pilot the potential of using the Framework's assessment to help institutions better align their programs with policies and guidelines such as those of the National Science Teachers Association, the National Council of Teachers of Mathematics, the Common Core State Standards in Math, the NRC Science Framework, NCATE's Blue Ribbon Report on Clinical Practice, CCSSO InTASC standards, and also perhaps as a complement to national program accreditation by the Council for the Accreditation of Educator Preparation, Inc. (CAEP).

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Appendix A

Date	Progression of Input and Development Notable Events
Summer-fall, 2007	The need for a tool to describe the complexity of effective teacher preparation and to "capture" and share promising practices across the broad spectrum of secondary science and mathematics teacher preparation and development was conceived and initial drafts crafted around a model called the Teacher Development Continuum. The first drafts were structured around four goals and a set of objectives and strategies linked to teacher recruitment, preparation, induction and development.
February 2008	Sharon Robinson, CEO of AACTE, hosts a discussion and review of the initial draft of the AF with Coble and five selected leaders and AACTE board members in New Orleans, LA.
March 28, 2008	Gerry Wheeler, then-president of the National Science Teachers Association, hosts a discussion and review of the AF with principal author Charles Coble, SMTI co-director Howard Gobstein and six selected leaders in science education in Boston, MA.
June 1, 2008	NSF proposal written by C. Coble and L. DeStefano: Content Validation Study for an Analytic Framework to Identify Strategies Employed in Promising K-12 Science and Mathematics Teacher Preparation Programs. Funded for $197,000.
June 5, 2008	George Hynd, then Dean of the Arizona State University College of Education, convenes a discussion and review of the AF with C. Coble and five disciplinary and pedagogical faculty.
July 1, 2008	Mary Ann Rankin, Tracy Parker, and several colleagues associated with the UTeach Program host a half-day discussion with C. Coble and H. Gobstein and review of the draft AF.
September 21–22, 2008	Tony Bryk and Linda Darling-Hammond co-host with C. Coble and H. Gobstein a meeting of 20 teacher educators, disciplinary leaders, and researchers at the Carnegie Foundation for the Advancement of Teaching in Palo Alto, CA to critique the content of the AF
September - December 2008	Nancy Shapiro, Associate Vice Chancellor, University System of Maryland, and Jennifer Frank, P-20 Partnership Project Evaluator, University System of Maryland, conceptualize and draft what becomes the basis of Goal I of the AF with a focus on policy development and institutional sustainability.
February 26-27, 2009	University of Arkansas site visit and case study led by C. Coble who meets with Gay Stewart, Department of Physics, David Gearhart, Chancellor, and 12 faculty, administrators, physics students and teachers.
April 15, 2009	AERA presentation on AF, San Diego, CA by Coble, DeStefano, Shapiro and Frank
April 29-30, 2009	Richard N. Steinberg, Professor of Science Education, School of Education and Department of Physic hosts a two-day site visit to City College of New York (with American Physical Sciences National Task Force on Teacher Education in Physics) to study site visit protocol and share AF development
May 5, 2009	Donna Wiseman, Dean, College of Education, University of Maryland hosts a critique of the AF with Coble, Shapiro and Frank.
May 19–20, 2009	Comments and critiques solicited from representatives from 27 institutions of higher education selected to be a part of an APLU NSF-funded MSP/RETA grant in Boulder, CO.
June 2–3, 2009	Ron Henry, then Provost at Georgia State University, Cherilynn Morrow, Physics faculty at GSU, disciplinary administrators and director of teacher education conduct (with C. Coble) a day-long retreat and review of science-math teacher preparation using the AF at Amicolola Falls State Park and Lodge, GA
June 26, 2009	C. Coble, L. DeStefano and H. Gobstein conduct a daylong analysis and critique in Chicago by selected science program leaders from the University of Arkansas, University of Colorado-Boulder, and the University of Illinois at Urbana-Champaign.

Date	Progression of Input and Development Notable Events
June 30, 2009	Follow-up visit with Tony Bryk at the Carnegie Foundation in Palo Alto to share progress in the development of the AF and seek his further advice and collaboration.
July 1, 2009	Mary Ann Rankin, Tracy LaQuey Parker, Kim Hughes and other UTeach staff meet with C. Coble, L. De Stefano and H. Gobstein for a half-day debrief on their analysis of UTeach and the AF.
July 24, 2009	Felice Nudelman, Director of Education for the *New York Times*, hosts a meeting that includes Andrew Thomson of Cisco International to discuss ways to create an online version of the AF that might be made available nationally and internationally.
August 29, 2009	Jim Hamos, Joan Ferrini-Munday, Janice Earle and Joan Prival at NSF, and Michele Cahill, Carnegie Corporation of New York, meet with Coble, DeStefano and Gobstein in DC to review progress and potential extended support for AF development.
August–September 2009	David Imig, University of Maryland-College Park and past-president and CEO of AACTE, Ed Crowe, consultant to NCTAF and Teachers for a New Era, Gene Hall, University of Nevada, Las Vegas, and Suzanne Wilson, Michigan State University submit invited critiques of the AF.
September 3-4, 2009	AF significantly revised based on invited critiques during two-day work meeting in Chapel Hill, C. Coble and L. DeStefano
October 22, 2009	Submission of NSF RETA Supplement proposal written by Coble, DeStefano and edited by Gobstein to continue development of AF, develop rubrics, initiate an advisory committee and identify promising practices; funded for $297,069.
November 2, 2009	Kay Howe, director and Susan Van Gundy, Assistant Director of NDSL, host meeting in Boulder, CO with Felice Nudleman, *NY Times*/Epsilon, followed by meeting with Lynne Rhodes, then dean of the College of Education, University of Colorado-Denver with Coble and Katy Anthes to discuss technology support and applications of AF.
December 14, 2009	Lee Todd, President, University of Kentucky, hosts meeting with H. Gobstein and C. Coble with Kumble Subbaswany, Provost; Mary John O'Hair, Dean of the College of Education; and John Yopp, Director of the Appalachian Math and Science Partnership and Associate Provost to discuss potential applications and the sustainability of the AF after NSF funding.
December 15, 2009	Angela Baber, STEM Program Director, National Governors Association, Washington, DC meets with Coble and Gobstein for SMTI/AF and NGA updates.
February 2010–present	Hatteras Designs, Inc. contracted to assist the authors in developing an online version of the AF featuring three main dimensions: (a) Explore the AF Tool; (b) Take the AF Assessments; and (c) Access the Promising Practices.
March 2-3, 2010	In Washington, DC, APLU hosts directors of state and national programs offering pre-service and in-service research experiences for teachers to share knowledge and recommend changes in the AF to reflect this emerging trend in STEM preparation and development.
February–April 2010	Michael Allen conducts literature review and makes recommendations for substantive additions and changes, particularly to Goals IV and V.
May–June 2010	James Raths, Jr., University of Delaware, and Jim Lewis, University of Nebraska-Lincoln, submit detailed critique of AF.
May 27–28, 2010	Dean Mary Lynn Calhoun and University of North Carolina-Charlotte host the first field test of the online version of the AF.
June 8–11, 2010	2nd Annual SMTI Conference and RETA Leadership meeting in Cincinnati, Ohio yields additional suggestions and invitations to serve as field test sites.

Date	Progression of Input and Development Notable Events
October 10, 2010	Battelle/Ohio STEM Learning Network host meeting in Columbus, Ohio for H. Gobstein and C. Coble with Steve Krak, Program Manager; Rich Rosen, Battelle/OSLN Education & Philanthropy; Brad Mitchell, Batelle/OSLN Education & Economic Engagement; Marcy Raymond, Principal, Metro Early College High School and Nelson Vincent, Associate Dean, College of Education, University of Cincinnati for the purpose off exploring applications of the AF to the Battelle/Ohio work.
September 15, 2010	C. Coble and L. DeStefano meet with Teach for America Chicago staff, Josh Anderson, Jeremy Mann, Sarah Gallagher, and Heather McMillan to examine the recruitment, preparation, and induction of successful TFA candidates.
October 21, 2010	H. Gobstein, C. Coble and L. DeStefano conduct APLU Forum on the AF in Washington, DC with panelists Michael C. Lach, Special Assistant, STEM Education, U.S. Dept of Education; Ed Crowe, Senior Consultant, Woodrow Wilson Foundation; and Donna Wiseman, Dean, College of Education, University of Maryland.
December 3, 2010	Steve Warwick, CEO of Innovations Commercialization, LLC leads Coble and DeStefano (via Skype) in a guided discussion of a sustainability plan for the AF.
December 15, 2010	Lee Todd, President, University of Kentucky, hosts meeting with H. Gobstein and C. Coble Mary John O'Hair, Dean of the College of Education; John Yopp, Director of the Appalachian Math and Science Partnership, Jana Bouwma-Gearhardt, Margaret Mohr-Schroeder, and Jennifer Wilhelm who completed the first written draft of AF Level I "Quick" Assessment developed by C. Coble. .
January 12, 2011	Jayne Fleener, Dean, College of Education at NC State University and Gerald Ponder, Associate Dean, meet with Coble and agree to field test initial draft of AF Level I Assessment (as agreed to in a meeting on December 20, 2010 at NCSU).
January 17, 2011	Valerie Brown-Schild, Director of the Kenan Fellows Program at NC State University and Susan Parry, Assistant Director of Partnerships and Resource Development, engage with Coble in a daylong analysis of their responses to and critique of the AF Level II Assessment.
January 24, 2011	Donna Gollnick and Emerson Elliot with NCATE meet with Coble in DC to discuss possible applications of the AF for program recognition by NCATE.
February 13-14, 2011	Jennifer Presley and Coble attend CSU STEM TQ Summit in Irvine, CA and meet with Sharon Robinson, President of AACTE and Jim Cibulka, CEO of NCATE to provide an update of the AF and potential applications.
February 15, 2011	Deborah Lowe-Vandell, Chair, Department of Education UC-Irvine, Acting Dean of Biological Sciences Albert Bennett and Sue Marshall, Cal Teach Co-Director, meet with Presley and Coble for an update of SMTI, the Teaching and Learning Collaborative and the AF.
February 15, 2011	Victoria "Vikki" Costa, Director of Science Education, CSU-Fullerton organizes and hosts a site visit and consensus-building process involving 12 faculty and administrators who had previously completed the AF Level I Assessment.
February 25, 2011	Presentation on AF by C. Coble at AACTE Annual Conference, San Diego, CA.
March 1, 2011	Jim Hamos, Program Director, DUE/EHR, NSF; Steve Robinson, White House Domestic Policy Advisor; and Krish Mathur, FIPSE Program Director, meet with C. Coble and H. Gobstein in DC for AF update and potential applications with federal initiatives.
March 9 and 24	Krish Mathur, FIPSE Program Director, completes AF critique resulting in important adjustments in Goal I meaning and syntax.
March 11, 2011	Presentation on AF at NSTA Annual Convention, San Francisco, CA, by C. Coble and H. Gobstein.

Date	Progression of Input and Development Notable Events
March 23, 2011	Michelle Goddard Terrell, NC Policy Consultant, completes a crosswalk of the AF Level I Assessment (v3.14.11) and NCTQ Rating Standards, INTASC Standards and NCATE Unit and SPA Standards in Science and Mathematics.
March 27, 2011	Michael Allen completes two-day review and critique of the AF, resulting in significant adjustments throughout the AF, particularly in Goals III and V.
April 27, 2011	Deborah Ball, Dean, College of Education, University of Michigan and Francesca Forzani, Associate Director of the UM Teacher Education Initiative, critique the AF.
May 1-9, 2011	Susan Ganter, chair of the 25-member Mathematics, Science and Instructional Technology Department at East Carolina University, pilots the AF Level I Assessment as a departmental strategic planning tool, with C. Coble.
May 23, 2011	Sidney Moon, Associate Dean, College of Education and Woodrow Wilson Fellowship Program coordinator at Purdue University, engages faculty in pilot study of the AF and assessment of the STEM Goes Rural, Biology Education, Physics Education, Chemistry Education, Math Education, and Technology Education programs.
May 31, 2011	Marsha Levine, Project Director, NCATE Blue Ribbon Panel on Clinical Preparation and Partnerships for Improved Student Learning, submits her comparative analysis of the recommendation of the Blue Ribbon Report and the AF Level I Assessment.
June 7, 2011	Twenty-six institutions that are part of an NSF MSP/RETA grant to APLU invited to submit nominations and supporting evidence of Promising Practices, which will be critiqued by panels of national experts. Accepted practices will be posted on the SMTI/AF website.
June 8, 2011	First meeting of the AF Advisory Committee, Portland, OR: Deborah Ball, Cynthia Bauerle, Carlos Contraras, Daniel Goroff, Jim Lewis, Lynne Weisenbach, Stamatis Vokos and Suzanne Wilson. (David Imig and Deborah Lowe Vandell unable to participate, but provide follow-up comments and suggestions for improving the AF and AF White paper.)