



## Grant Proposal for STEM ACT Conference

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# Science, Technology, Engineering and Math - Alternative Certification for Teachers (STEM-ACT)

## Introduction

The STEM Education Institute and the School of Education at the University of Massachusetts Amherst propose to hold a conference entitled Science, Technology, Engineering and Math - Alternative Certification for Teachers (STEM-ACT) in November 2005 in the Washington D.C. area. The conference will focus on alternative certification programs for the preparation of science teachers. The overall purpose of the conference is to identify key features and issues relating to the alternative certification of science teachers as a basis for developing a more systematic approach to the study of these efforts. In particular, the conference asks, "What do we know and what more do we need to know to incorporate the results of more than 30 years of research on science teaching and learning into alternative certification programs?"

The *intellectual merit* of the conference is that it will provide a forum for the exploration of what is known about the alternative preparation of science teachers and identify the agenda for future research. The team organizing this conference has extensive experience in research in science education and education policy studies, and has run two successful NSF-sponsored conferences in recent years.

There are *two broader impacts* of the proposed conference. One is that by bringing together experts in science education, teacher education, and educational policy with educational administrators and policy makers it will help to shape the national conversation on the pros and cons of alternative and traditional certification programs. By asking salient questions about the alternative certification of science teachers, we change the unit of analysis from all teachers to teachers of science. As a result, the conference will open up for inquiry the importance of the large body of research on the teaching and learning of science on the preparation of science teachers, and insert it into policy discussions about how best to incorporate this knowledge into the training and certification of science teachers.

The second broad impact is that the conference will have effects on the development, implementation and evaluation of alternative certification programs for science teachers. That is, we expect that by asking how we incorporate research on science teaching and learning into alternative programs, attempts will be made to do so, which should result in the improvement of alternative programs. The result would be to not only meet the national demand for more science teachers, but would also help to provide a cadre of new teachers who know and can use the knowledge generated through science education research.

## **Rationale and Purpose**

The purpose of this conference is to explore issues that have arisen in science education as a result of the proliferation of alternative certification programs in the United States. We seek to identify the research that needs to be done to reconcile the rapid growth of these programs with the demands that national standards (AAAS, 1993; National Research Council, 1996) and state curriculum frameworks (e.g., CADOE, 2000; MADOE, 2001) put on science teacher quality. Science education reforms articulate images of teaching that place great demand on teachers' content knowledge and pedagogical expertise. Teachers are expected to effectively plan and implement instruction that fosters equity and excellence for all students; actively engage students in extended inquiries to help them build conceptual understandings of key concepts and theories in science and mathematics; help students understand the nature of science, mathematics, and technology, and their interactions with the social, economic, and cultural spheres; and provide opportunities for students to develop attitudes, values, skills, and habits of mind (e.g., decision-making and higher order and critical thinking skills), that would enable them to engage in lifelong learning (National Research Council, 1996). "Traditional" teacher preparation programs usually entail having or earning a major in the target content area, completing substantial coursework in education, and going through some form of supervised student-teaching experience, while in alternative certification programs college graduates can secure an emergency teaching certificate, put off formal education training, and begin teaching immediately (USDOE, 2002). As a result, there is little or no opportunity for participants in most alternative programs to explore the research literature in science education.

Against this background, alternative certification for science teachers has become a tapestry woven of various strands - political and professional, ideological and academic. Given the complexity of issues, the continued growth, and the on-going investment of public resources associated with alternative certification, a comprehensive, in depth and systematic descriptive analysis is needed to help evaluate the ways in which alternative teacher certification does or does not address teacher supply and demand, and science teacher quality. Therefore, one purpose of this conference is to identify key features and issues relating to alternative teacher certification as the basis for suggesting a more systematic approach to the study of alternative teacher certification efforts.

A second purpose, and one that is specific to science teacher education, is related to the extensive research programs on science teaching and learning that have been going on for the past 30 years. During that time the National Science Foundation (NSF) and other agencies have invested vast sums in studies in the learning sciences, curriculum development, teacher professional development, and teaching the nature of science. As a result, we now know a great deal about the teaching and learning of science in schools. Therefore, given that alternative certification programs will continue to exist and most likely will become more common, we ask in this conference, "What do we know and what more do we need to learn about how to incorporate the results of more than 30 years of research on science teaching and learning into alternative certification programs?"

### ***Research on alternative certification***

Alternative teacher certification has become a proliferating phenomenon in the United States in response to current and projected widespread teacher shortages. A quick review of alternative certification efforts nationwide reveals that as of 2003 there were 46 states and the District of Columbia that collectively reported the existence of 144 routes other than the traditional approved college teacher education program route for certifying elementary and secondary teachers. Moreover, there are an estimated 200,000 individuals that have been certified to teach through alternative routes since 1985, with approximately 25,000 people per year within the last five years having been certified to teach through these routes (<http://www.ncei.com/>). While most teacher certification programs are state-level efforts, a few of these routes are under the auspices of the Federal government for assisting mid-career professionals to be certified as public school teachers (<http://www.ncei.com/>). Some federal money has come from the NSF through programs such as CETP, TPC, and the Noyce Scholarship program. In addition, there are organizations such as Teach For America and The New Teacher Project that work with school districts to facilitate alternative routes to certification (EOTP, 2002; USDOE, 2004).

The growth of alternative certification, while rapid, has not been systematic and there is little agreement on how to define, structure and ensure quality control across a diverse array of programs. Since 1985, which saw the first implementation of alternative teacher certification, the policy landscape has been dominated by a myriad of definitions and programs, intense debate about the professional legitimacy of the solution, and mixed, inconclusive and even contradictory research in terms of the effectiveness of such programs. Regarding the semantic meaning and connotation of the policy initiative, some researchers (e.g., Roth, 1986) interpret it as a policy encouraging teacher recruitment choice between certified and unprepared individuals, and others (e.g., Dixon and Ishler, 1992) understand it as a policy that de-professionalizes teaching as a mere craft. With reference to alternative teacher certification programs, some grant licenses to teachers based on passage of a qualifying test, some are traditional teacher education programs in a different package delivered at night for working adults, others are for teachers hired with emergency certificates to complete certain amount of coursework, and still others are “fast-track” programs providing accelerated entry for prospective teachers to move through the basic curriculum quickly into classroom teaching (Huling-Austin, 1986; Feistritzer & Chester, 2002); some programs are intended to attract career switchers, others are designed for paraprofessionals to become teachers, and still others are for new college graduates to enter teaching after graduation.

In addition to this state of flux, alternative teacher certification has become a topic of intense debate. Proponents (e.g., Ballou and Podgursky, 2000) frame the problem of teacher preparation in terms of an open market approach to educational policymaking, while opponents (e.g., Darling-Hammond, 2000) state that this open-market approach to teacher selection only continues and exacerbates inequities in terms of access to learning resources and, in turn, disparities of learning outcomes between advantaged and disadvantaged students. This heated debate is then fueled by mixed, conflicting and inclusive research results regarding the impact and effectiveness of alternative teacher

certification. Although alternative teacher certification has been implemented for nearly 20 years, and there are an increasing number of studies that have been conducted, valid and reliable research on this area appears thin. For instance, Wilson, Floden & Ferrini-Mundy (2002) conducted a review of high-quality research concerning teacher preparation. They found 14 studies, out of the total of 57 that met all their criteria, related to the impact of alternative licensure, and only half of those studies involved comparisons between alternatively certified teachers in a specific alternative route and graduates of traditional teacher preparation programs. Even the limited literature rarely includes content descriptions, which makes it difficult to ascertain real differences between alternative and traditional approaches. Thus they commented that a teaching credential is a “crude indicator” of professional preparation with little known about the critical and specific aspects of pedagogical preparation; that when certification status and degrees are used as indicators of teacher preparation in large scale research, there is no information about the significant aspects of the coursework taken for regular certification. Moreover, “this problem is exacerbated by the wide variation in certification practices across states” (p. 193). Some states treat all post-baccalaureate programs as alternative, whether they include pre-service coursework and students teaching or offer little structured training; some alternative routes have high entrance standards, and some require substantial coursework and mentoring (Post, Pugach, & Thurman, 2002).

In the field of alternative teacher certification with its different interpretations of the term “alternative certification”, with the large variety of programs in existence, and the intense debate, the mixed and conflicting research results add one more ingredient to the complexity of the phenomenon. A more systematic documentation is needed regarding how alternative teacher certification works in the particular contexts identified above. However, the range of individual and contextual factors that appear to affect the effectiveness and impact of alternative teacher certification comprise a complex set of issues. The complexities involved require the development of a systematic research agenda that generates a more comprehensive set of context-specific studies while also building a more broadly accessible and coherent base of knowledge about this important topic.

### ***Teacher demand***

Although the projected severe nationwide teacher shortages have not materialized in general, such shortages do exist in specific localities and specialties, indicating that teacher distribution rather than teacher production is the issue. There is a balanced teacher supply in general in the Northwest, Northeast, Great Lakes and Middle Atlantic states alongside teacher shortages in Rocky Mountain, Alaska, Midwest, West and the South (AAEE, 2002), while student enrollments are projected to increase in the Midwest, West and the South but decrease in the Northeast (NCES, 2004). The teacher turnover rate varies greatly among teachers of different subject areas. The turnover rates for science teachers (15.6%) teachers are among the highest in any fields (Ingersoll, 2003). Moreover, in the public teaching force, 57% of science teachers lack a major or certification in their field ([www.recruitingteachers.org](http://www.recruitingteachers.org)).

The demand for teachers is complicated by the diverse demographic features and uneven distribution of student population. A high proportion of students from diverse racial/ethnic backgrounds and from high poverty families concentrate in schools in large inner cities, and another high proportion of students are enrolled in small schools in rural areas with fiscal constraints where “the likelihood of hiring a physics major to teach one physics class a day is remote” (Feistritz & Chester, 2002, p. 9). These hard-to-staff schools are those that fall victim of teacher shortages. In 1993-1994, only 8% of public school teachers in wealthier schools, in comparison with 33% in high-poverty schools, taught without a major or minor in their main academic assignment (Darling-Hammond & Sykes, 2003). These schools even experience shortages in specialties for which a surplus of licensed teachers (e.g., qualified English teachers) exists (McDiarmid, Larson, & Hill, 2002). Hence, despite the endeavor to solve the generic teacher production problem at the macro level, alternative teacher certification has been criticized for having fallen short of addressing teacher distribution and retention at the micro level (e.g., Haberman, 1992; Zumwalt, 1996), that is, in most hard-to-staff schools in urban and rural areas and in high-need subject areas, such as mathematics and science, English as a second language, bilingual education, and special education, and for teachers of color and male teachers.

The mixed and inconclusive research results may be partly due to flaws in research design and methodology. Nevertheless, research is value-laden. How “the problem” is framed in teacher education determines definitions of terms used, procedures for data collection and selection, interpretations of results, and formulation of conclusions. Framing of the issue also reflects individual biases based on values, beliefs and attitudes embedded in the whole research process, and provides policy makers, who have their own preferences and political agendas, with opportunities to shape and use research for their own purposes in the policy process (Earley, 2000). In addition, most studies of alternative certification programs tend to focus solely on the observable characteristics of the participants - such as age, race, gender – and little attention is given to the motives of the participants to become teachers and minimal information is gathered about the process and curricula of the programs themselves. Moreover, a link that is consistently missing in the research is the description of and attention given to demographic and socio-economic features of teaching contexts. A more detailed understanding is needed regarding how well different types of alternative certification programs work for various types of individuals being trained for specific high need contexts (e.g. urban, rural) in the highest need fields, such as science. A more systematic approach to studying the interaction of these factors is likely to provide a more informative picture and more relevant data about what works where for whom. This in turn should help policy-makers and educational leaders make better data-driven decisions about how best to use alternative certification as a vehicle for improving and retaining the supply of qualified science teachers in the areas that need them the most.

### *Science education*

As can be seen in the previous section, much of the literature on alternative certification programs is in the policy domain. Because the debate on alternative programs has been at the policy level, most of the studies have looked broadly at teachers and teacher

education, without a subject matter focus. This was confirmed by a thorough search of the literature in which we found few references to studies of alternative certification programs for science teachers. This is problematic because one of the main issues currently being debated is the importance of subject matter knowledge and literacy skills compared to pedagogical and pedagogical content knowledge (Allen, 2003; Darling-Hammond & Youngs, 2002; EOTP, 2002; USDOE, 2002). For example, the Secretary's annual report of teacher quality (2002) concluded that

*To meet the highly qualified teachers challenge, then, states will need to streamline their certification system to focus on the few things that really matter verbal ability, content knowledge, and as a safety precaution, a background check of new teachers. (USDOE, 2002, 40)*

In their rebuttal to the Secretary's report, Linda Darling-Hammond and Peter Youngs (2002) conclude the opposite

*Although there is evidence that verbal ability and content knowledge contribute to teacher effectiveness, there is also evidence that teacher preparation – including student teaching and methods coursework ... -- contributes at least as much to outcomes ranging from teacher effectiveness to teacher retention. (USDOE, 2002, 23)*

What neither side addresses is the importance of science teachers' knowledge of research findings on science teaching and learning, and how to use those findings in their classrooms.

A thorough review of the past 30 years of research on science teaching and learning is beyond the scope of this proposal. However, we believe that it is necessary to highlight some of that literature. A significant portion of that research has been on how people learn science. Much of that research was summarized in the National Research Council publication, How People Learn (Bransford, Brown, & Cocking, 1999). More specifically there is the research done on misconceptions (e.g., Clement, 1982; Helm & Novak, 1983); conceptual change (e.g., Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1992); constructivism (Driver, Asoko, Leach, Mortimer, & Scott, 1994; Fosnot, 1996; Tobin, 1993); and the language of science (e.g., Crawford & Kelly, 1997; Layman, 1996; Lemke, 1990) Each of these research programs has significant implications for the education of new science teachers. There have also been large research programs on the teaching of science. These have primarily been in the areas of inquiry (e.g., Solomon, Duveen, & Scot, 1992); the science, technology and society (STS) approach (e.g., Solomon & Aikenhead, 1994; Yager & Tamir, 1993); and the assessment of learning (e.g., Atkin, Black, & Coffey, 2001; Bell & Cowie, 2000; Black & Wiliam, 1998). Other research programs that have informed science teacher preparation include the nature of science (e.g., Brickhouse, 1990; Lederman, 1992; National Science Teachers Association, 2000); and women and underrepresented groups in science (Atwater, 1996; Brickhouse, Lowery, & Schultz, 2000; Davis, 2001; Fennema, 2000; Rodriguez, 1998).

Alternative certification programs, especially those that are "fast-track," provide little time for new teachers to explore research on teaching and learning. And, because so many of them are generic programs that pay little attention to that subject that the teachers are being prepared to teach, the accumulated knowledge on teaching and learning science is not made available to the teacher candidates. Given the apparent permanency and growth in alternative programs, we believe that it is important to address our question, "What do we know and what more do we need to know to incorporate the results of more than 30 years of research on science teaching and learning into alternative certification programs?"

## **Goals and Outcomes**

The purpose of this conference is to identify key features and issues relating to alternative teacher certification as the basis for suggesting a more context sensitive approach to the study of alternative teacher certification efforts. The conference will provide an opportunity to bring together experts from around the country to engage in a constructive dialogue about the current state of knowledge regarding the impact and effectiveness of alternative teacher certification in science. This conference will have four primary foci

1. The conference will provide an overview of the existing policy on alternative certification of secondary (middle and high school) science teachers in the US, including key assumptions and questions.
2. It will begin a synthesis of existing research about the needs, methods, and outcomes of alternative certification for science teachers. The research areas that will be examined by presenters and participants will include science learning, the nature of science, context of schools, diversity and gender issues, teacher supply and demand, and initial teacher education and development.
3. Conference participants will take an in-depth look at existing programs and models through the examination of particular cases. The cases will include examples of alternative certification programs currently funded by NSF, but will also include district-based programs (e.g., Teach New York) and national programs (e.g., Teach For America).
4. The conference will seek to identify an agenda for future research questions on alternative certification to guide development and implementation of new programs.

These four foci will not only serve as the organizing framework for the conference, but will also serve as the structure for a book that will be edited by the Principal Investigators and be composed of chapters on the main topics presented at the conference in the form of invited and submitted papers. In addition, the proceedings of the conference will be disseminated electronically. This multi-faceted dissemination plan is intended to foster greater focus regarding a more systematic approach to understanding and studying alternative teacher certification. This approach is also intended to serve as the basis for providing a stronger base of knowledge to inform on-going efforts to improve the rapidly

growing alternative teacher certification movement, particularly in terms of efforts to improve the production and quality of science teachers in high need areas.

## **Description of Event**

### ***Format***

The conference will begin in the evening of the first day and conclude in the early afternoon of the third day. The goal is to have as many of the participants as possible to also be presenters. This will be achieved in two ways. First, all papers to be presented at the conference will be made available to all participants at least two months prior to the conference in draft form. Two to three participants will have the role of reading and responding to each paper at least one month before the conference. All draft papers and responses will be made available to all the participants by the beginning of the conference. We believe that this will allow the conference to be highly interactive rather than just a series of "talking heads."

There will be four plenary sessions, one for each of the foci described above. The first evening plenary will consist of a panel representing policy makers and policy researchers. The second plenary, which will occur on the morning of the second day, will consist of a panel of researchers who have expertise in alternative certification. The third plenary will be in the afternoon of the second day with a presentation of key case studies of alternative certification. The final plenary will be in the morning of the third day. Its purpose will be to report on the outcomes of the conference and early identification of an agenda for continued research. The presenter(s) in the final plenary will have had the role of participant-observer in the conference, and will in a sense, present an "instant analysis" of the overall conference. There will also be an opportunity for presentations of thematic groups that would have met the third morning to identify possible research, development, and implementation agendas.

There will be three sets of parallel sessions morning and afternoon of day 2, and morning of day 3. On day 2 the parallel sessions will follow the plenaries, and will focus on the same content and issues discussed in that plenary. There will be a poster fair that will remain set up through day 2 for participants to display information, including research or evaluation studies, of cases of alternative certification programs for secondary science teachers. On day 3 the parallel sessions will precede the plenary. They will be working sessions grouped by the research areas discussed above. The purpose of these sessions will be to determine research, development, and implementation agendas related to each of the research areas. As with the plenaries, all papers for the parallel sessions will have respondents who will read and comment on the papers before the start of the conference.

### ***Intended audience***

The participants of this conference will be science teacher educators; science education researchers; policy makers at the local, state and national levels; and school administrators. Given that the intention is for this to be a working conference, the attendance will be limited to 60 people.

### ***Presenters***

As noted above, the intention is for all participants to have roles as presenters in this conference; either as authors of papers or as their respondents. Approximately half the presenters will be invited. A preliminary list of invitees includes individuals from the National Science Teachers Association, Teacher for American, and the NSF. In addition, we will invite at least one administrator from a large urban school district, and teacher educators and evaluators with expertise in teacher certification. Other invited presenters will include PIs of NSF-funded projects that have a significant alternative certification program, researchers who have published in the field of alternative certification, and researchers who represent each of the research areas listed above. Other presenters will need to prepare a proposal that will be reviewed by the national steering committee and local planning team.

### ***Method of announcement or invitation***

The conference will be announced at the annual meeting of the National Association for Research in Science Teaching (NARST), to be held in Dallas, TX in April 2005, and at the annual meeting of the American Educational Research Association (AERA), to be held in Montreal, Canada in April 2005. The organizers of this conference have arranged for symposia on alternative certification in science education at both of these meetings. In addition the conference will be announced through the listserves and newsletters of NARST, the Association of Educators of Teachers of Science (AETS), and the AERA Special Interest Group on Science Teaching and Learning.

### ***Location and dates***

The conference will be held in the Washington D.C. area in November, 2005. The exact dates will be set after a hotel has been selected and space has been reserved. Preliminary conversations have taken place with the staff at a suitable hotel.

### ***Participation of diverse groups would be enlisted as presenters and participants***

The conference organizers will ensure that the members of the national advisory committee and the local planning team represent diverse groups, especially those underrepresented in STEM education. This will be done by inviting the participation of researchers, policy makers and school administrators who are working in the areas of equity, urban education, and rural education. The researchers will be identified by their work in organizations such as the Equity Strand of NARST and their publication records. We will seek out policy makers and school administrators who also have expertise in these areas.

## **Work Plan and Personnel**

Overall management of the STEM-ACT Conference will be the responsibility of the STEM Education Institute and its director, PI Morton M. Sternheim. Co-PI's Allan Feldman and Joseph B. Berger will be responsible for planning the program in cooperation with a national advisory committee.

Sternheim is a Professor of Physics Emeritus and has nearly twenty years of experience in efforts to improve K16 STEM Education. He has been a PI or co-PI on a large number of varied science education projects. Most notable of these is the almost completed NSF/CETP STEMTEC project, which involved 21 colleges and almost 300 school and college faculty. Feldman is a Professor of Education and is nationally known for his science education research. Berger is an Associate Professor of Education and Department Chair in the Department of Educational Policy, Research and Administration. UMass has had several alternative certification programs, including a "Summer/Fall" option that was begun by STEMTEC (Capobianco & Feldman, 2004), the 180 Days in Springfield program (Maloy, Pine, & Seidman, 2002), and the Massachusetts Institute for New Teachers (MINT) in Chicopee, MA. Berger has conducted evaluations of some of these, and is involved in research in this area.

The STEM Ed Institute has recently run two very successful national conferences for NSF. The first, *PATHWAYS TO CHANGE 2002 An International Conference on Transforming Math and Science Education in the K16 Continuum*, was held April 18-21, 2002. This served as a PI meeting for the NSF Collaboratives for Excellence in Teacher Preparation (CETP) program as well as a program for the general STEM Education public. STEM Ed also ran the *Teacher Preparation PI Conference for NSF CETP, STEMTP, and ATE Programs* on March 14-15, 2004. Both conferences were held at the Crystal City Doubletree Hotel, Arlington, VA. We have also had extensive experience in running local and regional conferences and workshops.

The two national events were well managed, and received very positive evaluations from the participants and from NSF program officers. The team that managed the logistics and overall planning is still in place, and will be available for the proposed conference.

### ***Advisory Committee***

As noted, co-PI's Feldman and Berger will plan the agenda and develop a list of invitees with the assistance of a national advisory committee. We have already begun conversations with prominent researchers active in this field, and expect to have a committee in place by January. The Committee will include several of the researchers who will be participating in symposia on alternative certification in science organized by co-PI Feldman to be held at the NARST annual meeting in March 2005 and the AERA annual meeting in April 2005. This group will consult via email and telephone.

## ***Timeline***

The timeline for the conference assumes that it will be held in November 2005, and that funding will be received by March 2005. If these dates change, the calendar will be modified accordingly.

January-February, 2005.	Form advisory committee to help plan program, select and contact major speakers. Develop tentative agenda. Develop list of potential participants keynotes, panelists, others. Develop conference web site Check with hotels for suitable spaces, dates; place tentative hold if possible.
March.	Send out invitations to participants Sign contract with hotel.
May	Deadline for acceptance of invitations. Possibly send out more invitations depending on returns and space availability.
July	Deadline for acceptances of second round invitations
September	Abstracts due for program.
October	Finalize agenda Mailing with detailed conference agenda and information
November	Conference
January 2006	Papers due from conference presenters
February-May	Edit papers, request revisions, make selections if necessary
July	Proceedings available on the web
Winter 2007	Book available at major conferences

## **Dissemination**

As noted above, the knowledge generated by the conference will be disseminated via a published book and the worldwide web.

## **Evaluation**

Success of the conference would be evaluated in terms of numbers of participants, participant satisfaction, and the successful publication of the book. All participants at the conference will be asked to fill out an evaluation form at the end of each session and at the end of the conference as a whole. Additionally, nationally recognized experts will be asked to review the book prior to publication as a means of providing formative evaluation of the final product.