The state of Maine K-12 science and mathematics preservice education 2010-2015

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Abstract

Five years of data reported by the US Department of Education Title 2 Higher Education Act on teacher preparation program completers in Maine were analyzed and reviewed along with Maine Department of teacher certification and endorsements. This analysis focused on teachers of science and mathematics such as general elementary teachers, secondary life science teachers, secondary physical science teachers, and secondary mathematics teachers. These are the teachers who teach STEM (science, technology, engineering and math) although there is currently no certification for integrated STEM teaching.

Findings included:

- Smaller and often private institutions are producing disproportional numbers of teachers of math and science graduating from undergraduate programs. For example, in AY 2014-15, Bowdoin College and the University of New England prepared as many secondary physical science teachers as did the two largest teacher preparation programs in the state, the University of Maine and the University of Maine at Farmington. This was only one teacher each.
- In terms of production, between 255 and 409 (aver = 339) elementary teachers are prepared each year; between 8 and 27 (aver = 19) secondary life science teachers are prepared each year; between 5 and 16 (aver = 10) secondary physical science teachers are prepared each year; and, between 15 and 38 (aver = 33) secondary mathematics teachers are prepared each year when the efforts of all undergraduate programs in Maine are considered.
- The Maine Department of Education is unable to disaggregate data on teacher recruitment making any statements on supply and demand moot.
- The Maine Department of Education does report that in 2015-16 there were 17,341 teachers, of which 6.9% (1,196) were in their first year of teaching.
- Graduation requirements range widely according to the reported data. For example, the average number of clock hours required for student teaching ranges from 250 (Colby College) to 936 (University of Southern Maine).

Additional findings as a result of development of this paper include:

- 3 of the 15 institutions in Maine that prepare teachers will undergo accreditation by the national Council for the Accreditation of Educator Preparation, although the program review will not involve national recognition.
- Maine statute Chapter 115 Certification, Authorization and Approval of Education Personnel is under review and revision.

The Maine Math and Science Alliance places a strong emphasis on listening to the needs of in-service teachers and administrators and designing programs and interventions to address those needs. It has become extremely clear in our conversations with Maine's schools that there is a concern amongst educators that there are simply not enough teachers applying for open science and math positions throughout the State, especially in our most rural regions. This review of teacher preparation data is a direct response to that concern and is meant to provide a systemic analysis of the problem. It is our intention that this initial review of the data can provide administrators and educational leaders with the information they need to meet the challenges of the upcoming retirements of many current STEM teachers.

I. Introduction

There are two major academic impacts on preservice educators also known as teacher candidates. One is the content and pedagogy of the *education* courses they accumulate, and the other is the content and pedagogy of the *content* courses they accumulate. And those two impacts are further split into strong content knowledge (a body of conceptual and factual knowledge) and pedagogical content knowledge (understanding of how learners acquire knowledge in a given subject). Teacher candidates must not only learn content and how to teach it to youth but they must be taught by those have strong content knowledge and strong pedagogical content knowledge.

It is common, especially at larger institutions of higher education, for these two units to be housed separately which could impede collaboration. With the frequent wisdom of practice proclamation "one teaches as they are taught", it is vital that units work hand in glove. Content faculty cannot just teach content as a body of knowledge unless it is their expectation that their students will do the same.

Probably the most comprehensive study of this area was conducted in 2010 by the National Research Council in a report titled *Preparing teachers: Building evidence for sound policy.* This report does a commendable job of addressing their charge but was generally hampered by the lack of comprehensive and empirical data on teacher preparation programs. Still, its chapters on preparing mathematics teachers and preparing science teachers remain relevant.

Maine contributes a wealth of information annually to the US Department of Education as required by the Title 2 Higher Education Act. These data answered many questions and raise a few others. Policymakers in the legislative and executive branches, at the higher education and at the local should take advantage of this as they work to improve K-12 education across the state.

A quick scan of relevant data reveals:

- 15 institutions of higher education in Maine have teacher preparation programs that prepare teachers in elementary, secondary life science, secondary physical science and/or mathematics in the years 2010-2015 (full reports are at https://title2.ed.gov/Public/Report/StateHome.aspx).
- By far the provider of the largest number of teachers in these fields in Maine is the Maine Department of Education through its transcript review process. These are people who transitioning from other fields into education or coming into Maine from other states. This is sometimes referred to as a non-traditional pathway.
- Between 255 and 409 (aver = 339) elementary teachers are prepared each year.
- Between 8 and 27 (aver = 19) secondary life science teachers are prepared each year.
- Between 5 and 16 (aver = 10) secondary physical science teachers are prepared each year.
- Between 15 and 38 (aver = 33) secondary mathematics teachers are prepared each year.
- For the 2016-17 school year, there were 539 new teacher hires; and 107 of the 539 (19%) were of STEM related fields of Mathematics, Life and Physical Sciences, Computer and Information Sciences, Engineering and Technology, Arts, A/V Technology & Communication, Information Technology, Science, Technology, Engineering & Mathematics (L. Gilman, personal communication, August 14, 2017).

- Program characteristics were quite variable (for example, the average number of clock hours required prior to student teaching ranged from 250 to 936 with an average of 569).

Caution should be exercised regarding the absolute value of these data. It is likely that the person reporting these for an institution changes frequently and is provided little training or explanation on the purpose or intended use of the data. While the US Department of Education makes available resources such as a Public Use Data Codebook and briefs such as 'Title II Tips for Reporting", there may be insufficient use or knowledge of these.

This does lead to the lack of comparability of data. For example, the "number of adjunct faculty supervising clinical experiences during this academic year (IHE and Pre-K-12 staff)" is a very useful statistic since it reveals the involvement of non-faculty in the critical period of reflection and growth during a student teaching experience. The US ED suggests three criteria for determining inclusion in the count of IHE and Pre-K-12 staff. Varying uses or interpretation of these criteria probably led to the variation in this measure of most institutions reporting 0 to 7 and others reporting 82 to 143.

II. Maine Department of Education teacher certifications and endorsements

Typically, a person is issued a professional certificate, either a two-year provisional certificate or a five-year professional certificate. Then a person is granted endorsements based upon the coursework she or he has taken.

At the current time, there are seven endorsements that of most interest - General Elementary Endorsement K-8 (020), Mathematics 7-12 (300S), Mathematics 5-8 (300M), Life Science 7-12 (395S), Physical Science 7-12 (350S), Science 5-8 (340M), and Computer Technology K-12 (680). With the exception of the middle level endorsements and the computer technology endorsement, the Title 2 HEA data are reported by institution and academic year for each.

Each of these teaching certifications requires student teaching as specified in Chapter 115, Part 2 "Completed one academic semester or a minimum of 15 weeks of full-time student teaching, or a combination of part-time and full-time student teaching in an amount equivalent to 15 weeks in this endorsement area at the specified grade level."

In this section, the content requirements for the major endorsements are described.

Since grades K-8 are the largest category of teachers, it is not surprising that Maine, on average, produces 339 elementary teachers per year. To gain this endorsement, candidates must have completed:

- a Bachelor's degree,
- at least 6 semester hours in mathematics,
- at least 6 semester hours in science,
- an elementary math methods course,
- an elementary science methods course,
- passed the Praxis #5732 mathematics test with a score of at least 150,
- passed the Praxis II #5003 mathematics subtest with a score of at least 157, and,
- passed the Praxis II #5005 science subtest with a score of at least 159.

No data were found on how many elementary teachers take more than the minimum 6 semester hours in mathematics and 6 semester hours in science. There is no separate state requirement that preservice elementary teachers have any instruction in technology or computer science.

To obtain a secondary mathematics endorsement, a candidate must have:

- a Bachelor's degree
- 24 semester hours in mathematics
- a secondary math methods course
- passed the Praxis #5732 mathematics test with a score of at least 150, and
- passed the Praxis II # 5161 Mathematics: Content Knowledge with a score of at least 160

Twenty-four semester hours at three hours per course equates to eight math courses. No level is specified for these courses but one presumes this rises to the level of advanced calculus/differential equations.

To obtain a secondary science endorsement, a candidate must have:

- a Bachelor's degree
- 24 semester hours in life science or 24 hours in physical science
- a secondary science methods course
- passed the Praxis II #5235 Biology: Content Knowledge with a score of at least 150 or, for the physical science endorsement, passed the Praxis II #5245 Chemistry: Content Knowledge with a score of at least 151 OR the Praxis II #5265 Physics: Content Knowledge with a score of at least 141 OR the Praxis II #5435 General Science: Content Knowledge with a score of at least 153.

Life sciences are defined as study in one or more of the following areas: biology, ecology, botany, zoology, anatomy, physiology, environmental science, entomology, ornithology. Physical sciences are defined as study in one or more of the following areas: chemistry, physics, geology, earth science, soil science, astronomy, meteorology, or oceanography.

III. APPROVAL OF PREPARATION PROGRAMS FOR EDUCATION PERSONNEL

Programs that prepare teachers and other education personnel undergo a regular review and approval process. There are two pathways for this – one a national process that until 2015 was under NCATE (National Council for the Accreditation of Teacher Education) and a state-level program review process.

A. Council for the Accreditation of Education Preparation

In 2015, the Maine State Board of Education signed an agreement for three of its teacher preparation programs (University of Maine at Orono, University of Maine at Farmington, and the University of Southern Maine) to undergo a new set of accreditation standards issued by the Council for the Accreditation of Educator Preparation (CAEP). CAEP has five standards:

- Standard 1: Content and Pedagogical Knowledge
- Standard 2: Clinical Partnerships and Practice
- Standard 3: Candidate Quality, Recruitment, and Selectivity
- Standard 4: Program Impact
- Standard 5: Provider Quality, Continuous Improvement, and Capacity

Interestingly, the process that Maine has agreed to is the least rigorous of the three levels of program review options.

Table 1: Council for the Accreditation of Educator Preparation

	CAEP Program Review with National Recognition	CAEP Program Review with Feedback	State Program Review
Format	Program report forms completed for each content area and level describing evidence of candidates' performance on a set of key assessments that demonstrates meeting standards	Submitted as an addendum to the self-study report (Inquiry Brief or Institutional Report)	State-defined process
Standards	Specialized Professional Association (SPA) standards	State-selected standards	State-selected standards
Timing of submission	Mid-cycle of the overall accreditation cycle (3 years in advance of the accreditation visit for most states)	At the same time as the Inquiry Brief or Institutional Report documents (roughly 8-12 months in advance of the visit)	State-defined timing
Review team	SPA review teams trained by both the SPAs & CAEP	Reviewed by state visitors	State review team
Results	Recognition Report with a decision of "Nationally Recognized", "Recognized with Conditions", or "Further Development Required/Recognized with Probation/Not Nationally Recognized"	Feedback is provided to the Educational Program Providers and the state on specialty licensure area aligned to CAEP and state standards based on disaggregated data presented in the self-study	State decision regarding program approval
Additional information	This is the only program review option that can lead to national recognition by CAEP/SPAs.		

From http://caepnet.org/accreditation/caep-accreditation/program-review-options

The following table describes involvement level of the 28 states currently participating in CAEP. Note that the state may choose from among the three options or a combination of them.

Table 2: States Participating in CAEP

State	CAEP Program Review with Nat'l Recognition	CAEP Program Review with Feedback	State Program Review
Alabama	✓		✓
Arizona	✓	✓	✓
Arkansas	✓	✓	✓
California			✓
Delaware	✓		
Idaho			✓
Indiana	✓		✓
Kansas			✓
Kentucky			✓
Louisiana	✓	✓	
Maine			✓
Massachusetts	✓		✓
Michigan	✓	✓	✓
Montana	✓	✓	✓
Nebraska	✓	✓	✓
New Hampshire	✓	✓	✓
New Jersey	✓	✓	
North Carolina	✓		✓
North Dakota	✓	✓	✓
Ohio	✓	✓	✓
Oklahoma	✓		
Oregon	✓	✓	✓
South Carolina	✓		✓
South Dakota	✓	✓	✓
Virginia		✓	
Washington			✓
West Virginia	✓	✓	
Wyoming	✓	✓	✓

From http://caepnet.org/accreditation/caep-accreditation/program-review-options

B. Maine Review and Approval of Preparation Programs for Education Personnel

Every 5 or 7 years after initial approval, approval to offer educator preparation programs must be reaffirmed. Although not clearly explicated, it appears that teacher preparation programs are guided by a set of 11 standards and school leader preparation has 6 additional standards.

Standard #1: Learner Development
The teacher understands how students learn and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.

Standard #2: Learning Differences

The teacher uses understanding of individual differences and diverse cultures and communities to ensure inclusive learning environments that allow each learner to reach his/her full potential.

Standard #3: Learning Environments
The teacher works with learners to create environments that support individual and collaborative learning, encouraging positive social interaction, active engagement in learning, and self motivation.

Standard #4: Content Knowledge
The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make these aspects of the discipline accessible and meaningful for learners.

Standard #5: Innovative Applications of Content
The teacher understands how to connect concepts and use differing perspectives to engage learners in critical/creative thinking and collaborative problem solving related to authentic local and global issues.

Standard #6: Assessment
The teacher understands and uses multiple methods of assessment to engage learners in their own growth, to document learner progress, and to guide the teacher's on-going planning and instruction.

Standard #7: Planning for Instruction
The teacher draws upon knowledge of content areas, cross-disciplinary skills, learners, the community, and pedagogy to plan instruction that supports every student in meeting rigorous learning goals.

Standard #8: Instructional Strategies
The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to access and appropriately apply information.

Standard #9: Reflection and Continuous Growth
The teacher is a reflective practitioner who uses evidence to continually evaluate his/her practice, particularly the effects of his/her choices and actions on others (students, families,

and other professionals in the learning community), and adapts practice to meet the needs of each learner.

Standard #10: Collaboration
The teacher seeks appropriate leadership roles and opportunities to take responsibility for student learning, to collaborate with learners, families, colleagues, other school professionals, and community members to ensure learner growth, and to advance the profession.

Standards #11: Technology Standards for Teachers
Effective teachers model and apply the National Educational Technology Standards for Students (NETS•S) as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community. All teachers will meet the following standards and performance indicators.

Additional standards for school leader preparation programs:

Standard #12: Vision, Mission and Goals
Education leaders promote the achievement of all students by guiding the development and implementation of a shared vision of learning, strong organizational mission, and high expectations for every student.

Standard #13: Teaching and Learning
Education leaders promote achievement and success of all students by monitoring and continuously improving teaching and learning.

Standard #14: Managing Organizational Systems and Safety
Education leaders promote the success of all students by managing organizational systems and resources for a safe, high performing learning environment.

Standard #15: Collaboration with Families and Stakeholders
Education leaders promote the success of all students by collaborating with families and stakeholders who represent diverse community interests and needs and mobilizing community resources that improve teaching and learning.

Standard #16: Ethics and Integrity
Education leaders promote the success of all students by being ethical and acting with integrity.

Standard #17: The Education System
Education leaders promote the success of all students by influencing interrelated systems of political, social, economic, legal, and cultural contexts affecting education to advocate for their teachers' and students' needs.

It seems that the state program review process is very focused on the individual product of the program whereas the CAEP process looks much more systemically at the product, the process, and the impact. The CAEP review process may provide more of a quality understanding than does the state process.

But this paper was not prepared as a thorough crosswalk between these two program review methodologies. Only major differences were identified and upon closer scrutiny it may be that these differences are minor.

This does, however, raise the powerful opportunity for leading Maine educators including teachers and administrators, education faculty, and staff from educational non-profits to serve on program review committees. This would result in at least two useful outcomes: one is to build teacher leadership and a second is to broaden understanding of how certification works. Doubtless, teachers, administrators, and non-school non-governmental organization staff have valuable insights and different viewpoints to strengthen educator preparation.

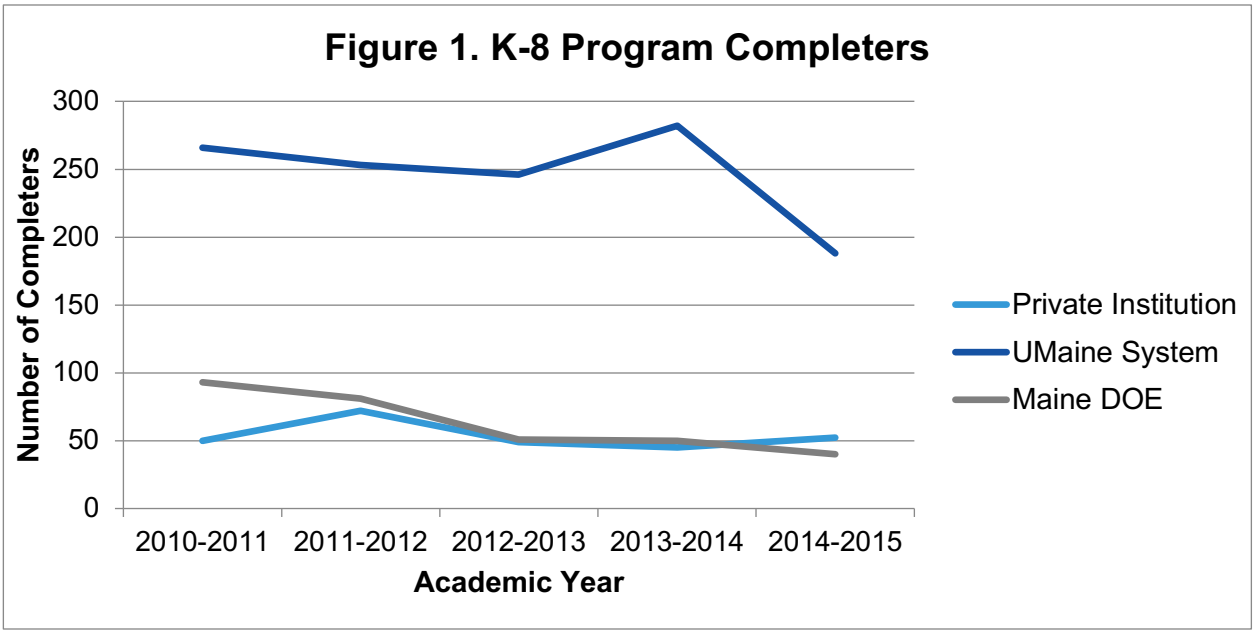
IV. General Data 2010-2015

Fifteen institutions of higher education that prepare teachers of science, technology and mathematics report data to the US Department of Education (see https://title2.ed.gov/Public/Home.aspx). Clearly the Maine Department of Education certifies the most teachers through its transcript analysis, non-traditional vehicle. But exploring the data across these five years of data reveals some interesting facts.

A. K-8 Elementary

One fact is that the University of Maine campuses produce vast numbers of K-8 elementary teachers. For the academic years 2010-2011 through 2014-2015, 6 public universities had 1,235 program completers compared to the 6 private colleges that had 268 program completers. The 6 private institutions are College of the Atlantic, Colby, Husson University, St. Joseph's, Thomas College, University of New England. (NOTE: there is an aberration in the data for University of Maine at Presque Isle. The data show 122 K-8 elementary teacher candidates for AY 2013-14 and the other four years of data average 34 program completers. The 1,235-number used above included the reported 122 at UMPI.)

The Maine Department of Education's (MDOE) non-traditional certification process added 265 K-8 elementary teachers during this period. That is an average of 53 teachers per year.

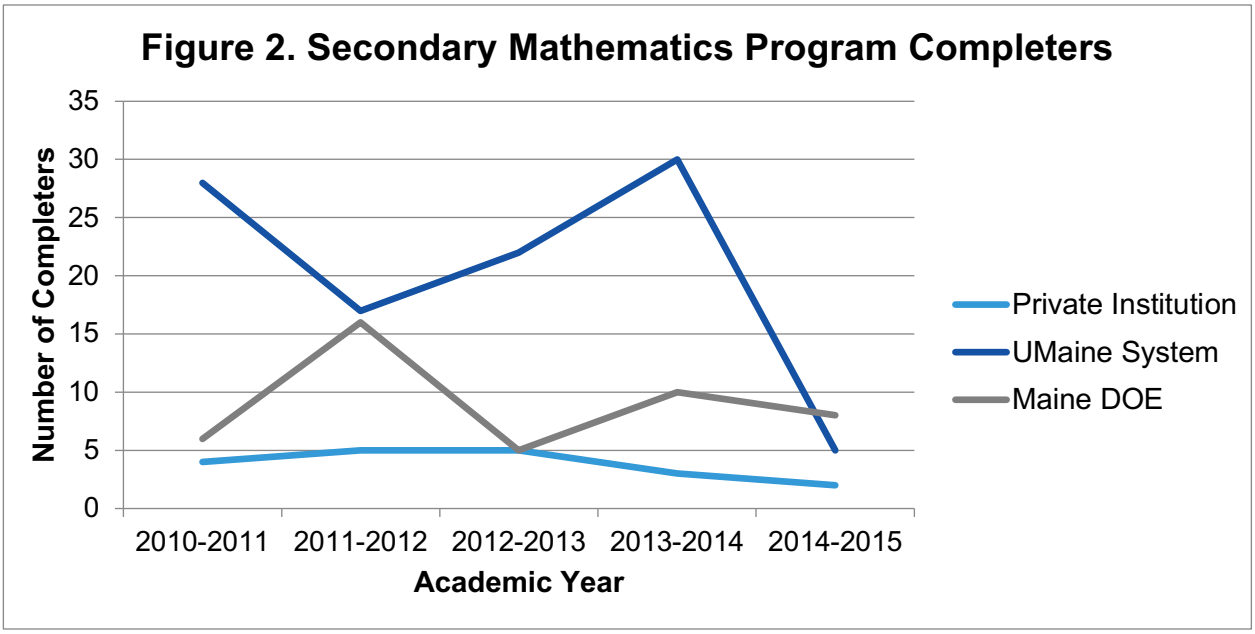


Looking across the five years of data, there is a gradual lowering of the number of K-8 elementary teachers being prepared in Maine.

B. Secondary mathematics

Only 5 private colleges (Bates, Bowdoin, Colby, St. Joseph's, and the University of New England) had program completers in secondary mathematics and 6 public universities did so.

Over the five-year period under review, 19 secondary math teachers came from private colleges, while 102 came from the publics. During this same period, the MDOE's non-traditional pathway certified an additional 45 teachers. St. Joseph's, Bowdoin, and UNE lead the private college production with 7, 4 and 4 teachers prepared, respectively. University of Maine at Farmington (34) and USM (24) lead the public universities.

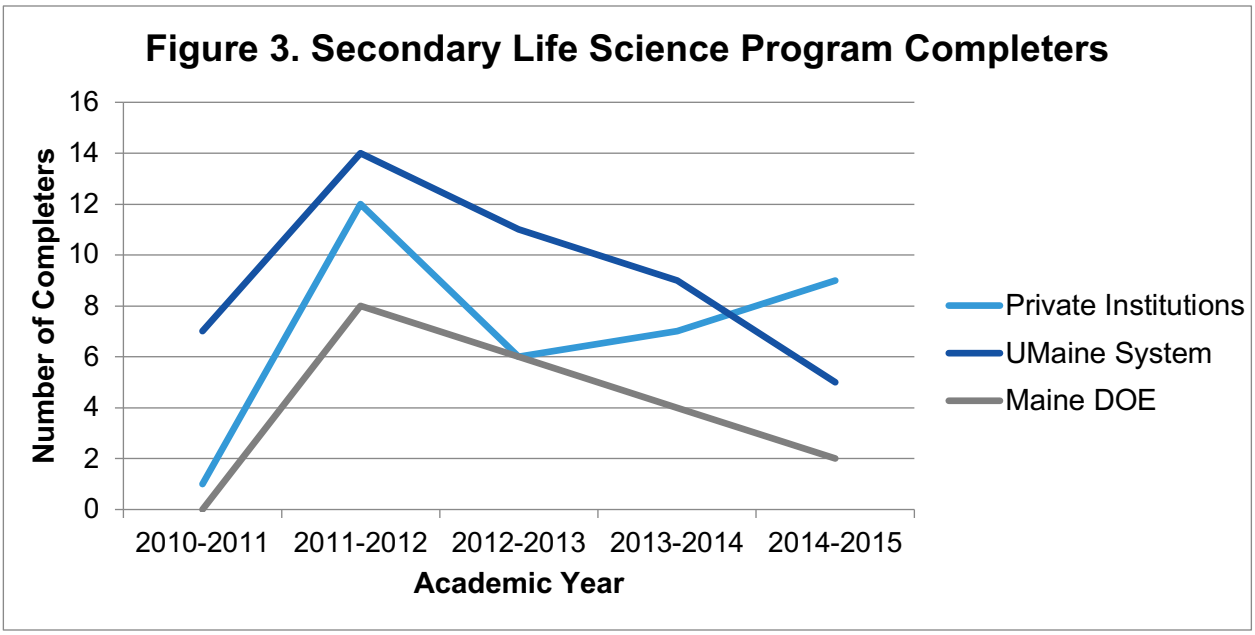


There was a major drop-off in academic year 2014-15 for both the private colleges and public universities, while the MDOE numbers remained steady.

C. Secondary Life Science

Six private institutions produced secondary life science teachers over the five-year period while five publics did. Surprisingly the University of Maine at Orono produce no secondary life science teachers in those five years. Bates (1), Bowdoin (3) and Colby (4) created more secondary life science teachers than did the University of Maine at Orono.

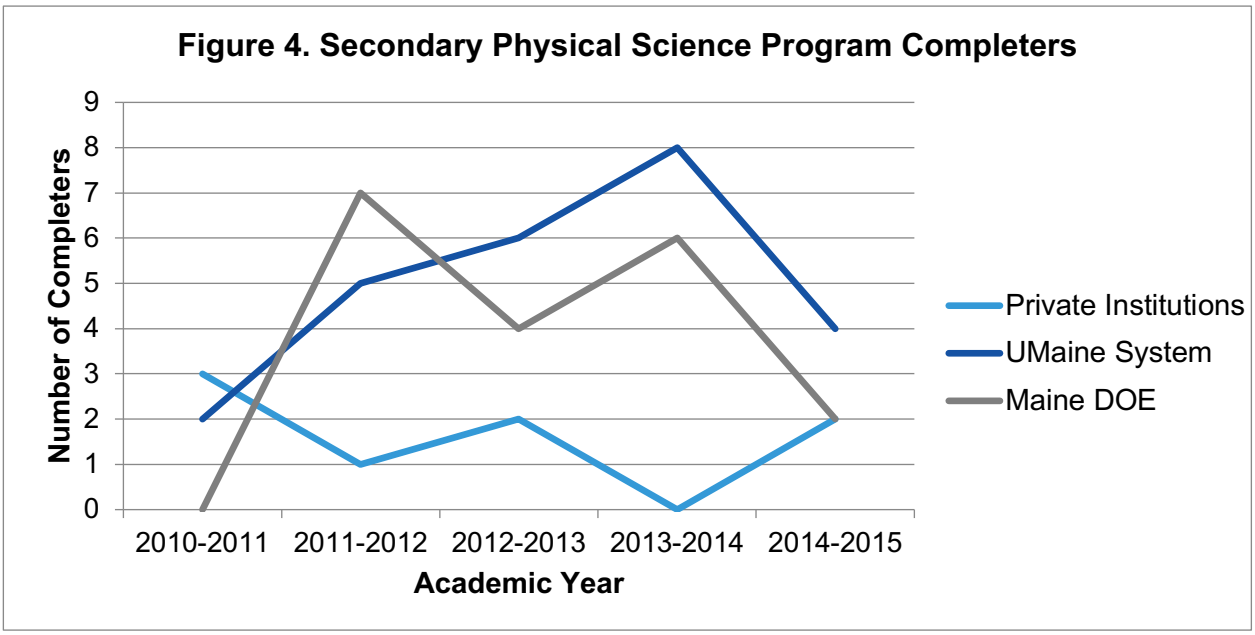
The private institutions produced 35 teachers, the public universities produced 46, and the MDOE contributed an additional 20. USM was the biggest producer with 34 program completers and UMF was second with 5. At the private institutions, St. Joseph's and UNE tied with 12 each.



Probably related to the small numbers of program completers, there is great variability across the year classes.

D. Secondary Physical Science

During the study period, four private institutions produced 8 secondary physical science teachers compared to three public universities that produced 25 and the MDOE qualified 19 others. Again, it is interesting to note that the University of Maine at Orono produced zero secondary physical science teachers. Bowdoin and UNE tied for highest production by private institutions with 3 each and USM far outstripped the rest of the programs by producing 21.



The small numbers make trend analysis problematic but the private institutions have been relatively steady in production as has USM.

V. Specific data in AY 2014-15

The US Department of Education Title II Higher Education Act reports very specific data and several sets of those are explored here. A quick note on process – it is assumed that a questionnaire is mailed to each institution that prepares teachers and then those responses are compiled by a central agency in Maine. It appears that for many years this was conducted by Dr. Amy Johnson at USM but is now under Ángel Loredo of the Maine Department of Education.

A. Average number of clocks hours required *prior* to student teaching

One set of data gathered is the average number of clocks hours required *prior* to student teaching. This ranges from 63 (Bowdoin College) to 256 (St. Joseph's), with a mean of 152.3 hours.

B. Average number of clocks hours required *for* student teaching is also collected from each program

The average number of clocks hours required *for* student teaching is also collected from each program. This ranges from 250 (Colby College) to 936 (University of Southern Maine), with a mean of 568.5 hours. The Maine Department of Education requires one academic semester or a minimum of 15 weeks of full-time student teaching and their regulations (Chapter 125, Section 6.02) defines "an average instructional day is five hours in length". Using these numbers of 5 hours per day for each of 15 weeks equals 375 hours as a minimum. Most teacher preparation programs in Maine report far exceeding this although Bates and Colby report fewer hours. The University of Southern Maine at 936 hours apparently requires greater than 37 weeks of student teaching.

C. Supervision of clinical experiences

Two questions focus on the credentials of the faculty supervising clinical experiences. (Title II defines supervised clinical experiences as a services of supervised field experiences including student teaching that a sequenced, integral part of the preparation program prior to the candidate becoming the teacher of record.) One question has each institution report the number of full-time equivalent *faculty* supervising clinical experiences during this academic year and a second question asks the number of *adjunct faculty* supervising clinical experiences during this academic year.

Regarding full-time equivalent faculty, this ranged from 1 to 11, mirroring the size of the department or college of education at the various institutions. This was a fairly straight forward report criterion.

Quite different data were revealed when asked about adjunct faculty supervising clinical experiences during this academic year. This ranged from zero (at the smaller institutions that probably had FTE faculty conduct supervision) to 143 (University of Maine at Farmington). Since the Title II definition for this included IHE and preK-12 staff), it seems likely that UMF included preK-12 teachers and other educational leaders in this calculation. Husson University reported 82 and probably calculated that number in a similar fashion to UMF.

For this set of data, the US ED Title II suggested three criteria, any one of which would imply inclusion in the count:

- If they spend a number of hours each week observing, supervising or discussing the clinical experiences with the teacher-candidates or other teacher preparation program faculty;
- If they receive a stipend from the teacher preparation program for their participation;
- If they are considered part of the teacher preparation program, in terms of recognition in brochures or other program descriptions provided to the state or general public (US ED Title II Higher Education Act, Title II Tips for Reporting, Supervised Clinical Experiences, https://title2.ed.gov/Public/TA/*SupervisedClinicalExperience*.pdf)

D. Number of students in supervised clinical experience during this academic year (2014-15)

Another statistic "number of students in supervised clinical experience during this academic year (2014-15)" reveals a wide range of numbers. Smaller institutions such as Thomas College (0), Bates and Bowdoin (3 each), University of Maine Farmington (4) report data that seems reasonable and consistent with their teacher preparation production. Other institutions report data that is inconsistent with their production and quite honestly must be a totally different interpretation of the requested data. For example, the University of Maine at Machias that prepared 6 elementary teachers and no secondary teachers in 2014-17 reported that they had 449 students in supervised clinical experience and the University of Maine at Fort Kent that prepared one secondary math teacher in this AY reported 108 students in supervised clinical experience. Conversely, the University of Maine that produced 32 elementary teachers, 1 secondary life teacher, 3 secondary math teachers and 1 secondary physical science teacher reported that they had 9 students in supervised clinical experience.

E. Total number of teacher preparation program completers across all disciplines

When looking across all the teacher preparation programs within an institution of higher education, certainly University of Maine campuses produce the largest number of teachers. The University of Maine, University of Maine at Farmington, and University of Southern Maine produce an order of magnitude more teachers in general than any other institution.

Institution	AY 2012-13	AY 2013-14	AY 2014-15
University of Maine	178	121	105
University of Maine at Farmington	138	134	96
University of Southern Maine	114	108	89

However, it is significant that smaller and sometime private campuses produce more science and math teachers. For example, in AY 204-15, the University of New England produced 4 secondary life science teachers while Colby College, College of the Atlantic, St. Joseph's College, the University of Maine, the University of Maine at Farmington, and the University of Southern Maine each produced only one secondary life science teacher. And in secondary physical science, Bowdoin College, the University of Maine, the University of Maine at Farmington, and the University of New England each produced only one teacher.

VI. Making a teacher

There are several tipping points in the development of a teacher - points at which high quality infusions are possible and could lead to a universally high-quality teaching force.

Clearly a teacher-to-be must have a high school diploma. How that student is taught in K-12, the various experiences they have with effective and less effective teachers, the introduction into the climate of education and the connection of education to the real-world experiences of life and work are crucial to how that prospective teacher will teach.

When she or he enters an undergraduate program, there are two major levers of future success as a teacher. One is the content courses that he or she will take and what material is put forth to learn and how it is to be learned. The latest round of changes to undergraduate content teaching is termed Active Learning and is championed by Nobel Laureate Carl Wieman (see https://teachingcommons.stanford.edu/teaching-talk/carl-wieman-active-learning-it-really-better-traditional-lecturing). This method has been found to not only help students of science learn better but also to help those who teach to teach better. Certainly, this is an innovation that must be adopted by content course faculty if we truly want our students to persist in STEM, to learn better in STEM and to be better teachers of STEM.

The second lever is with the education courses that one takes. Typically, these are termed "methods' courses and are focus on how to teach the particular subject. Here, too, there is room for innovation. For example, currently the Maine Department of Education certification standards for K-8 teachers requires a methods course in mathematics, a methods course in reading, a methods course in language arts, a methods course in science and a methods course is social studies. This segregation does not promote the cross curricular instruction made possible by, for example, the overlap and reinforcement of 'practices' or 'process' of Common Core Math, Common Core ELA and the Next Generation Science Standards.

Within a teacher preparation program, there is a requirement that a prospective teacher spend a significant time in a school as a 'student teacher'. Previous work conducted in Maine found that acknowledged high quality teachers such as those who received the Presidential Award for Excellence in Science and Mathematics Teaching and National Board Certification in science or math or had had extensive professional development such as those attending MMSA's Governor's Academy in Science, Math or STEM Education Leadership rarely were assigned student teachers. Maine is missing a golden opportunity to help prospective teachers by placing them in classrooms of acknowledged outstanding teachers and to help those teachers grow even further by being mentors.

VII. Limitations and Generalizability

A. Quantitative data only

This analysis is hampered by the lack of qualitative data. It is somewhat useful to know the numbers of teachers being produced and the institutions that are producing them. In fact, this has led to some startling statements, such as the undergraduate programs at private institutions preparing the majority of secondary science teachers in Maine.

But having qualitative data on teachers emerging from these programs would be extremely valuable. Perhaps this could be gathered with a survey to principals asking them how prepared they found fist year teachers from each of the 15 teacher preparation programs, or by following how long these teachers persisted in the field.

It is recognized that these are small numbers which makes the analysis highly variable and endangers the personal identity of these prospective teachers.

B. Publicly available data

This report centered on the five years of data available from the US Department of Education. No doubt institutions are gathering data and undertaking evaluation of their educator preparation programs, and this may be part of the Maine Department of Education program review process. But these are not publicly available.

C. Variation in US ED Title 2 data interpretations or reporting

Despite the codebook issued by the US ED, there are probably a variety of data interpretations that leads to the report of data that cannot be used reliably. For example, the University of Southern Maine reported 936 hours for student teaching. This was far beyond any other institution and could be a result of a different preparation model, for example with a year of student teaching/internship. Without a line for explanation, there is no way of knowing. In addition, the University of Maine at Presque Isle reported 122 K-8 teacher program completers in 2013-14 and this is at least three times their usual reported number.

These data are available only for Bachelor's level programs. The impact of program completers at the Masters or higher level degrees should be investigated.

D. Lack of accessible data at the MDOE

Without knowing the actual replacement numbers of K-8, secondary math, secondary life science and secondary physical science teachers, this whole exercise is blunted. These data describe supply only; demand is anecdotal. Certainly, there are calls for more teachers of math and science, but actual data would be helpful.

Other useful data that apparently are not accessible include current numbers of K-8, secondary life science, secondary physical science and secondary math teachers. With these data, one could roughly approximate demand.

But annual recruitment data would be very helpful.

E. Other data sources

No doubt there are other data sources, and even similar reports. The Maine Education Policy and Research Institute has done outstanding work in these areas. The Maine Education Association may have new teacher/recruitment data. The Teacher Educator Association of Maine may have undertaken a similar analysis since they are comprised of all of the teacher preparation programs in Maine.

Such sources have not been located.

VIII. Bibliography

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