An OK-AR Section Initiative in the Mathematical Preparation of Teachers:

A Synopsis of the Evolution of a Special Session of the Annual Conference

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The Oklahoma-Arkansas Section of the Mathematical Association of America, at its 2008 Annual Conference, provided a Special Session for a (TYC-MPT) forum on the role of two-**b**ear colleges in the mathematical preparation of teachers of school mathematics. Because that session provided a replicable model for regional initiatives toward improving teacher education programs at two year colleges, this author had earlier promised to later circulate a synopsis of the proceedings. This report is published in fulfillment, thereof.

What happened *before and after* that forum is far more important than what actually happened during it.

A distinguishing feature of the TYC-MPT FORUM was its context of three overlapping areas of concerns for higher education in mathematics – (1) collegiate education in mathematics, as attended by the MAA's (CUPM) Committee on the Undergraduate Program in Mathematics; (2) education of teachers of mathematics, as attended by the national (AMTE) Association of Mathematics Teacher Educators; and (3) two-year college programs, as attended by the Teacher Preparation Committee of the (AMATYC) American Mathematical Association of Two-Year Colleges.

The forum was staged to promote liaison and collaboration among regional constituents of those three national organizations. Recent trends in curricular mathematics education in the schools have heightened nationwide concerns about the mathematical preparation of American teachers. Concurrently, there is a visible trend of pre-service teachers receiving much of their mathematical education (and often all of it) through two-year colleges – whereby, inter-institutional coordination and articulation have become increasingly problematic.

As the nation's state governments increasingly exercise controls on school programs in mathematics, state-level proceedings also is where the issues of teacher education in mathematics tend to erupt and congeal. So, growing concerns about articulation, certification, and the amounts and quality of teacher preparation are stimulating regional collegiate mathematics organizations to become more assertive. But their regional effectiveness will be greatly increased as they come to conjoin and to collaborate.

At the national level, the MAA, the AMTE, and the AMATYC often cooperate through special committees or events. But nationwide, regional chapters/affiliates of the separate organizations historically have typically been aloof from each other – despite their mutual interests and concerns. The OK-AR Section event was to promote closer liaison and collaboration among the regional organizations.

The OK-AR Section's TYC-MPT forum was prompted by AMTE's 2008 Annual Conference, earlier held in Tulsa – where AMATYC's Teacher Preparation Committee was represented by its Southwest Regional Representative. There, it soon became evident that the national community of mathematics teacher educators is becoming increasingly troubled and concerned about growing needs for effectively integrating two year colleges into the American system of teacher preparation in mathematics. So, the AMATYC representative subsequently appealed to the OK-AR Section to address the TYC-MPT dilemma by using its own 2008 Annual Conference to promote regional coordination – by inviting all concerned to participate in a Special Session forum about the teacher-education roles of two year colleges.

In so doing, the OK-AR Section presented a de facto model for how other MAA Sections might likewise initiate regional collaboration on the issues of teacher education in two year colleges. Accordingly, information about the OK-AR Section's emerging "model" was widely circulated in advance of the forum – to regional mathematics organizations throughout AMATYC's Southwest Region – and to the national and regional leadership of the MAA, of the AMTE, and of the AMATYC. That alert included the promise to disclose the processes, outcomes, and potentials of the OK-AR model.

Mathematics heads of all four-year and two-year colleges in the two states were e-mail invited to send their representatives to the forum, and each of the two states' regional professional mathematics organizations were e-mail invited to provide panelists for the forum.

However, this is Arkansas and Oklahoma. As expected, actual attendance at the Section's forum was very small. Most persons who attended the forum were mathematics faculty who routinely attend OK-AR MAA Section Conferences. The special publicity and the appeals for participation failed to attract many additional persons to attend the Section meeting.

Far more important than the actual attendance numbers was the widespread publicity in advance of the TYC-MPT forum. For an MAA Section to dedicate a Special Session to the issues of teacher education in mathematics, as provided by two year colleges, raised a flag for heightened awareness of the growing importance of that arena of mathematics education – and sent out an alert to the presence of troubles, within that arena.

Some post-Conference resonations of the intended kind began to surface even during 2008. In September, the fall meeting of AMATYC's Oklahoma affiliate, OKMATYC, allocated a major part of its brief program to discussions of two year college mathematics courses for teachers.

In contrast to the OK-AR Section forum – which was hoped to immediately engage faculties from all three professional communities (MAA, AMTE, AMATYC) – the OKMATYC forum was publicized only to its own members. The most striking occurrence within that OK forum was how rapidly the discussants focused on what appeared to be the single most pressing issue in Oklahoma. That evolution predicts that state-level organizations can apply a very different and more proactive kind of leverage. Were OKMATYC to lead Oklahoma's two-year colleges to converge onto any single problematic arena, that community then would be in a strong position to insist that other regional professional communities cooperate on alleviating the dilemma.

It is a model worth attending. Any TYC-MPT forum so convened by a state affiliate of AMATYC is likely to so

converge – to identify and focus on a single arena of concern – although the top priority topics might widely vary among the states. Of critical importance, any such discussion, so focused on a single arena of strong concern, paves the way for follow-through regional initiatives toward resolving those issues.

The OK discussants quickly centered onto Oklahoma's maladies of ***vertical articulation*** – the difficulties entailed in "transferring" two-year college mathematics courses for teachers, into various universities' respective teacher education programs. One major source of Oklahoma's difficulties appears to be weak ***horizontal articulation*** among the state universities' programs of teacher education in mathematics. Variations among university programs seem to preclude the seemingly natural mechanism of simply replicating first-two-year university courses, within the programs of the two year colleges.

For the OK forum, time constraints precluded the achievement of an action plan for effectively addressing the problem. However, a communications network was initiated, and it might yet become fruitful. In that sense, the OK evolution might yet evolve also into a model for how to catalyze regional initiatives by professional associations.

Not all concerns are of such strictly regional scope. Even many "national" dilemmas can be effectively addressed at regional levels. Underlying Oklahoma's dilemmas of poor institutional articulation – and greatly contributing to those dilemmas – is a nationwide absence of professorial agreement about just what mathematics should be known by pre-service and in-service school teachers of mathematics. But there is no need for any state to await a nationwide agreement on that matter. Effective pursuit of at least statewide agreement on what mathematics school teachers should know can go far toward enabling Oklahoma o anyother state to determine what mathematical knowledge the two year colleges should provide for teachers – and for transfer students.

Even before the OK-AR Section's TYC-MPT forum, the Section had made a 2008, formal commitment toward improving the mathematical education of school teachers. That opened the way for the Section's future collaboration with other regional organizations, on matters of teacher education. Included, of course, would be matters pertaining specifically to teacher preparation through the two year colleges.

For years, the OK-AR Section Conferences had routinely included presentations about mathematics instruction – and less frequent presentations about the mathematical education of school teachers. But the Section had no notable history of previously striving, as a professional organization, to help guide the evolution of regional programs for educating school teachers of mathematics.

The Section had taken an earlier step in that direction, in 2007, when it voiced to educational leaders, some concerns about alternative certification of school teachers of mathematics. But in 2008, the Section promised, by formal passage of a business meeting resolution, to begin more seriously attending the arena of teacher education in mathematics.

No claim can be made that occurrence of the TYC-MPT forum ***caused*** passage of the Section's resolution. But it is easy to believe that the earlier strong publicity for the forum – and its appearance on the Conference's printed program – must have helped accelerate the 2008 surfacing of Section interests in teacher education.

As passed, the Section's resolution is as follows.

RESOLVED::

Whereas:

A high percentage of teachers of school mathematics are sorely under-educated in, about, and through mathematics; and

Whereas:

The Mathematics Association of America long has sought to address that dilemma at the national level through various committees, projects, and collaborations; and

Whereas:

In the states of Arkansas and Oklahoma, many mechanisms, orientations, and proceedings of scholastic instruction in mathematics recently have been changing with little guidance from the community of mathematicians in those states; and

Whereas:

The responsibility for progressive improvement of the levels of professional mathematical intelligence of pre-service, in-service, and home-service teachers of mathematics in those states ultimately rests with colleges and universities of those states; and

Whereas:

Any responsible response to that challenge, on the part of the Oklahoma-Arkansas Section of the MAA, must be made through deliberations far deeper than can be achieved through annual Business Meetings of the Section:

It hereby is resolved:

That the Section newly commit itself to providing dynamic leadership in actively addressing the need for elevating the mathematical preparation of all teachers of core-curricular mathematics; and

That the Section authorize its Executive Committee: (1) to establish a MATHEMATICAL TASK FORCE ON TEACHER EDUCATION; (2) to appoint a STEERING COMMITTEE to activate that taskforce and to develop procedures for recruiting its members and for its operations; and (3) charge that taskforce with developing proposals for Section INITIATIVES aimed at so alleviating the under-education of teachers of mathematics.

Enacted March 29, 2008,
by the Oklahoma-Arkansas Section
of The Mathematical Association of America

The Section's formal commitment does not speak specifically about attending the teacher education role of the two states' two year colleges. But if/when an OK-AR Section Taskforce emerges, it will be a natural mechanism through which the Section can help to resolve the TYC-MPT issues within its two states.

Like OKMATYC's later forum, the OK-AR Section's earlier forum opened with a summary of the TYC-MPT issues that even earlier were surfaced during AMTE's 2008 Annual Conference in Tulsa. Unlike the

OKMATYC discussants, the Section discussants did not converge onto a single, top priority dilemma. Instead, they did some sharing about some unusual modes of articulation – and scanned across several areas of inter-related concerns.

If any one arena could be identified as a vortex for the Section forum discussions, it would have to be the issues about how well TYC mathematics faculty are (or are not) qualified for educating other teachers of mathematics. TYC mathematics courses that are intended specifically for teachers lie within a specialized arena of ***vocational*** mathematics – wherein much of the content is in ***mathematical foundations*** areas in which most TYC mathematics teachers have never studied. Many of those areas lie very close to the "instructional methods" arena … e.g. the vector algebra of the English phonics for the whole numbers.

Other than through specialized teacher-education courses in mathematics, most teachers learn how to teach mathematics from how it was taught to them. So, every TYC mathematics instructor intrinsically serves future teachers as a "model" for how mathematics "should" be taught. Most of the TYC courses in mathematics serve, in fact, as teacher-education courses. Thereby, the TYC's role of teacher-preparation is informally distributed among most of the TYC mathematics faculty.

Most TYC mathematics teachers are not attentive to the fact that they are educating future mathematics teachers for elementary, middle, or high schools or even for colleges – much less knowing what to do for prospective teachers. Most merely follow textbooks – which typically are horrid examples of how NOT to make mathematics comprehensible to students. So, maximal improvement of the TYC's teacher-education program entails improvements in the designs and proceedings of all mathematics courses that prospective teachers might take – from "developmental" arithmetic, through curricular foundations, statistics, calculus, differential equations, linear algebra, and computer mathematics.

Of course, such a broad view of teachers' mathematical education applies equally well to baccalaureate and graduate programs. It remains to be seen whether an OK-AR Section Taskforce (if it ever happens) would dare to exercise such a comprehensive perspective on the mathematical preparation of teachers, or instead focus only on mathematics courses offered specifically for the teaching vocations.

This synopsis would not be complete without listing some of the TYC-MPT issues that motivated the request for an OK-AR Section TYC-MPT forum – issues gleaned for the AMATYC Teacher Preparation Committee, from proceedings of a 2008 AMTE Conference half-day pre-session – issues that were raised as a preface both for the Section forum and for the OK forum.

So, this Synopsis concludes with a hindsight glimpse of some issues surfaced through those AMTE proceedings. By no means is this list complete, and its scope probably is myopic. But it served the initial purposes of catalyzing some sorely needed dialog – which might yet generate some beneficial actions.

Such issues provide the rationale for generating such forums, and for circulating synopses, thereof. The first step toward improving the operating state of any mechanism is to identify where beneficial improvements are needed, are conceivable, are desirable, or are possible. A teacher-education forum can be an experience that has many kinds of benefits for its participants – without actually leading to an agenda for beneficial actions. But if the forum is intended to serve a catalyst – by serving an "intelligence" function of disclosing directions for possible future actions – then its initial task is to get the issues surfaced as a context for analysis and planning. Hopefully, the list,

below, will help planners to conceive and to pursue progress initiatives of the needed kinds.

- Nationwide, increasing percentages of undergraduate students who seek credentials for teaching are "transfer" students whose college education in mathematics is acquired partly or wholly through two year colleges.

- Current trends in the evolution of school mathematics curricula, and new knowledge about the mathematics needed for teaching, will manifest as massive needs for mathematics institutes for updating in-service teachers – and the national network of two year colleges is in the best geographic position to meet that challenge – if the schools were to insist that their teacher obtain such enlightenment – but the colleges would need new kinds of mathematics-for-teachers materials, technologies, and programs.

- Many two year colleges offer mathematics courses designed specifically for prospective elementary school teachers – for which their students expect to receive "transfer" credit within their baccalaureate and certifications programs – but which often are not so acceptable to the baccalaureate institutions which the students will transfer.

- For prospective elementary school teachers, some two year colleges offer mathematics courses which are described as combining "mathematical content" with "instructional methods" – thus following a model that is widely used by baccalaureate institutions – but offered by TYC's probably only when vertical articulation is assured.
- It is widely believed that most two year colleges do not have faculty who are fully qualified to educate teachers about professional methods for teaching mathematics – and the TYC's role thereby is typically limited to educating teachers in and about mathematical theories, mathematical methods, and mathematical arts.

- As yet, there is no nationwide agreement on what knowledge in and about mathematics (theory, fluency, methods, arts, philosophy, psychology) "should" be known by expert teachers of mathematics – so there likewise is no nationwide agreement on what parts of such knowledge should be offered by two year colleges.

- Recently, some universities and professorial circles have given limited attention to "the mathematics needed for teaching" – but as yet, no such body of mathematical knowledge has been delineated and assembled into forms that could be locally implemented, nationwide, by individual two year colleges.

- Eventually definitive knowledge about just what mathematics is needed for effective teaching of mathematics will provide a mathematical basis from which TYC teachers of mathematics can provide mathematically respectable courses in the mathematical foundations of curricular mathematics. But even courses of that kind will have to be quite similar to courses offered by baccalaureate institutions to which TYC students will transfer.

- Large numbers of future school teachers of mathematics begin their collegiate preparation in mathematics through "developmental courses" for remediation in school mathematics – typically taught for access to College Algebra courses, rather than for broad and deep conceptual understanding of school mathematics.

- Large numbers of prospective elementary school teachers enter their two year colleges as moderate-to-severe (MLD) victims of Mathematics-Learning Distress – which must be relieved by their TYC programs, if they are to effectively study mathematics through those programs.

- Few two year colleges offer mathematics courses that are designed specifically for future high school or middle school teachers of mathematics. So, whatever those students learn from two year colleges – in or about the mathematics that they will be teaching – typically comes solely through core courses designed for students in STEM programs (science, technology, engineering, mathematics) – having missions, orientations, directions, and clientele quite different from what is needed for the preparation of teachers. Often, the TYC STEM courses are the future teachers' ONLY college courses in mathematics.

- As an area of human functioning, mathematics is an art of learning through reasoning – together with the mathematical knowledge generated through performance of that art. Core-curricular STEM courses traditionally focus primarily on developing students' knowledge of the products … often only very superficial knowledge. But effective teaching of school mathematics must aim also at developing students' deep understanding and personal mathematical powers – dimensions of mathematical-growth that commonly are neglected, ignored, or undermined by core-curricular instruction in STEM-oriented courses.

- Current CRAFTY efforts (for Curriculum Reform Across the First Two Years) have focused primarily on reforms of traditional courses in calculus and college algebra – with one aim being to provide non-STEM students with other alternatives that are more relevant to their educational and career paths. As yet, CRAFTY has not yet pressed for such "vocational" reforms of the first two years of teacher-education through developmental and core-courses in mathematics.

- The evolving teacher-preparation roles of two year colleges fall within an overlapping scope of purview by several national organizations – but effective processes of change in the MPT (mathematical preparation of teachers) operations of local TYC's are more directly led by regional initiatives and by individual colleges who emerge as "demonstration models" of beneficial innovations.

- Prospective teachers of mathematics presently gain most of their knowledge about how to teach mathematics, from what they have experienced as students in mathematics courses – whereby, the mathematics instructional proceedings within two year colleges are a major influence in shaping how mathematics will be taught in the future.

- The National Council of Teachers of Mathematics has recently launched an initiative for re-focusing school mathematics instruction, so that mathematics courses will guide students to learn the subject through "reasoning and sense making" – which implies that all college mathematics courses taken by prospective or in-service teachers likewise should be made rationally sensible to the students, themselves.

- TYC mathematics faculty members commonly regard themselves as being teachers of mathematics, and not as educators of teachers – even though many of their students are prospective teachers who take most of their mathematics (and perhaps all of it) at their TYC's

- Most two year colleges prefer that their full-time mathematics faculty have at least a master's degree in some mathematics-related area – which often means that TYC courses are taught by persons whose formal education in mathematics, as such, is more comparable to a STEM-oriented undergraduate major (or minor) in mathematics – a constraint which can seriously delimit the kind of mathematical perspectives that TYC faculty can shower onto prospective teachers.