Impact Report

Missouri Improving Teacher Quality Grant Program
- Cycle 10 -
Program Evaluation

Summary

November 2013

MDHE
Missouri Department of Higher Education
Building Missouri's future... by degrees

M.A. HENRY
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1. Introduction

In simple terms, the success of a program such as the Missouri Department of Higher Education *Improving Teacher Quality Grant (ITQG) Program* depends on how well its stated objectives are met. However, in the complexity of real-world teacher professional development projects like those implemented in the program's Cycle 10, with six multi-grade projects and teams across the state in urban, rural, and suburban settings, working with more than 200 teachers and other education professionals throughout the year, including more than 50 school districts, directly touching more than 13,000 students, and aiming at various science or math content, a simple measure of success is challenging and likely unhelpful. At the same time, accessible and understandable evidence-based information to inform the public, funders, and the project teams is needed, whether to refine future activities or to validate the methods used.

The program evaluation described in this and associated reports addresses formative/process and summative concerns. This means that the evaluation considered both the organization and implementation of projects – what they intended to do and what they actually did – and the impact they accomplished, compared to what they believed they would be able to accomplish. Program-wide, overriding issues of interest were evaluated in a combined way, again, considering the process as well as the apparent effects.

As this was the second ITQG cycle evaluated by M.A. Henry Consulting, LLC, the evaluators attempted to refine their approach to data collection and assessment in order to focus even closer on matters of internal evaluation (what projects did to evaluate their own performance and results), implementation practice (both administrative best practice and alignment with Missouri Department of Higher Education standards), and meaningful results of the program as a whole. In doing so, the evaluators have acquired an even greater respect and professional appreciation for the daunting tasks the project teams set for themselves. They also continued to listen to teacher participants, who expressed their own appreciation for their projects' efforts. Finally, the evaluators worked to sustain a high degree of application of best practices for their own evaluation methods, recognizing that in the end that contextualizing measures of impact across the program objectives to actual conditions in the field is crucial for understanding and future planning for such work.

The evaluators thank the project teams, staff at the Missouri Department of Higher Education – the grant funder through which the U.S. Department of Education funding sources is granted, the Missouri Department of Elementary and Secondary Education, which provided access to data and support for analyses, and the many teachers and others who assisted in the evaluation.

This summary serves as the general report of the ITQG evaluation. As in Cycle 9, a more detailed technical summative report is available that provides additional information about results from the ITQG program's 10th cycle.

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2. ITQG Cycle 10 Profile

The Missouri Department of Higher Education's Improving Teacher Quality Grant Program – Cycle 10 comprised six science or math teacher professional development projects led by universities/colleges or regional professional development centers, covering schools and school districts reaching most regions of Missouri.

Cycle 10 Projects and Their Schools and Districts

As Figure 1 shows, Cycle-10 projects touched both the two major metropolitan areas of St. Louis and Kansas City, the central, south-central and southwest regions of the state, and a portion of the rural east area north of St. Louis. Teacher and school locations clustered, predictably, around the six lead universities, although greater distances were traveled by rural teachers in many cases and the University of Missouri-Columbia continued to draw teachers from the broader central-and-eastern area. The northern part of the state remained uninvolved; the evaluators understand the efforts by MDHE ITQG staff to support projects from the institutions of higher education in that region. The southeast part of the state has been reached through subsequent funding in Cycle 11, already under way as this report is prepared. Schools came from 53 public school districts plus 1 charter school and 1 parochial/private school. Table 1 provides additional background information about each project in Cycle 10. Sixty-five percent (36 of 55) of all school districts and charter/private district proxies were high-need.

Figure 1. Location of Schools in ITQG Cycle 10 Projects by Zip Cod (some locations have >1 school)

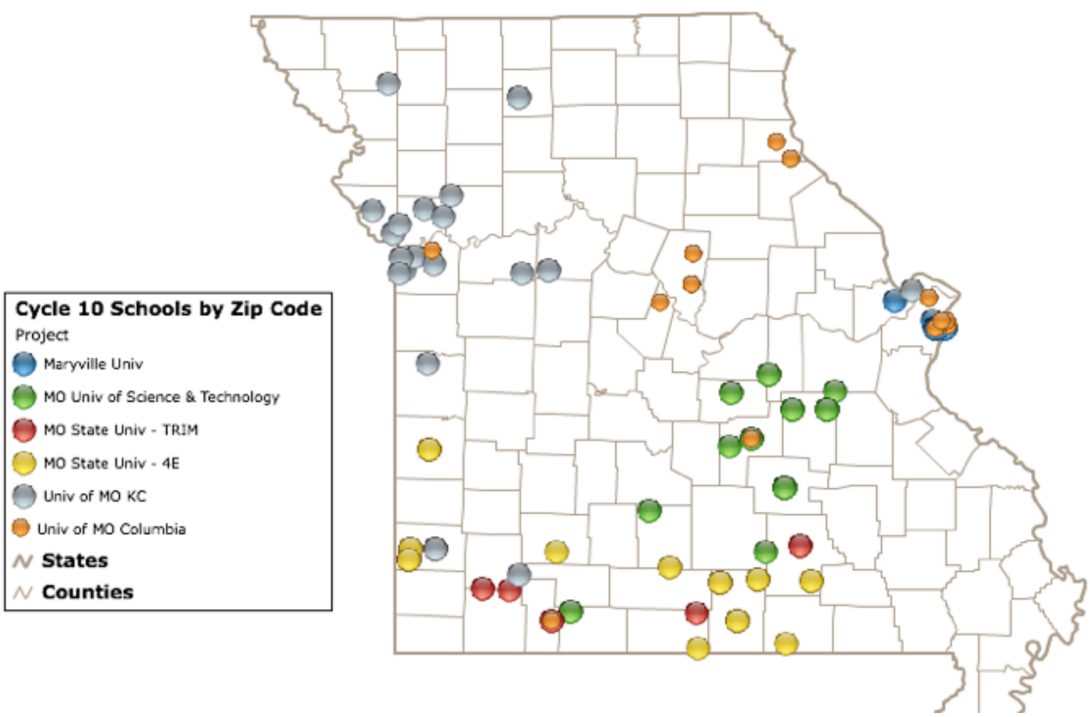
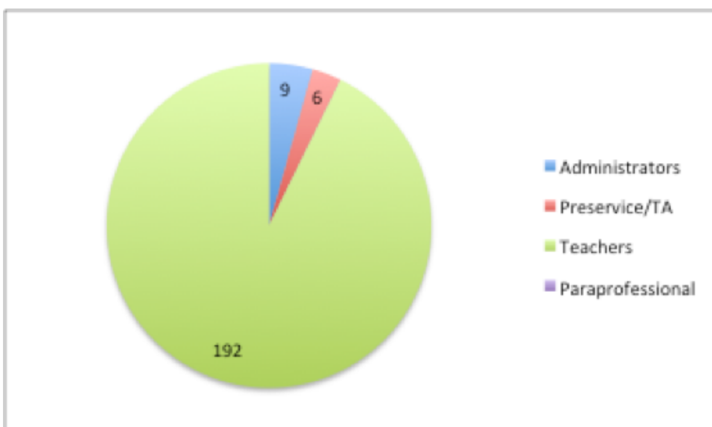


Table 1. ITQG Cycle 10 Projects

Project Title	Lead Institution	Grade Levels	Focus	Years	Primary Region	Participants	% of Projected Participation
Constructivist Early Childhood Science: Building Inquiring Minds (BIM)	Maryville University	K-4	Science	2 of 2	St. Louis	40	74%
Early Education Environmental Education: Field Based Approach (4E)	Missouri State University (MSU2)	K-4	Science	1 of 1	South Central	29	97%
QUEST: Quality Elementary Science Teaching	University of Missouri - Columbia	K-6	Science	2 of 3	Central, St. Louis, & Northeast	48	96%
Science Education and Quantitative Literacy: An Inquiry-based Approach (SEQL)	Missouri University of Science & Technology	5, 6, 7	Math & Science	2 of 3	South Central	39	98%
Science in Cycles of Observation, Reasoning, and Experiment in Kansas City (SCORE-KC)	University of Missouri Kansas City	6-12	Science	1 of 1	West Central, St. Charles	30	100%
Transforming Mathematics Instruction Using Inquiry and One-to-One Environments (TRIM I+121)	Missouri State University (MSU1)	9-12	Math	1 of 3	Southwest	25	71%

Individual projects covered math and/or science content areas across a range of grade levels. Projects new to the ITQG in Cycle 10 were to meaningfully incorporate environmental education into their curriculum. Also, all projects were to involve a minimum of 20 teacher participants, with at least half coming from high-need school districts. All projects but one attained or nearly attained the latter criterion. Loss of a high-need partner school in that project reduced high-need teacher participation. Across the whole ITQG program, 76% of teachers were from high-need public school districts, up from 72% in the previous cycle.

Figure 2. Numbers and Types of Participants in ITQG Cycle 10



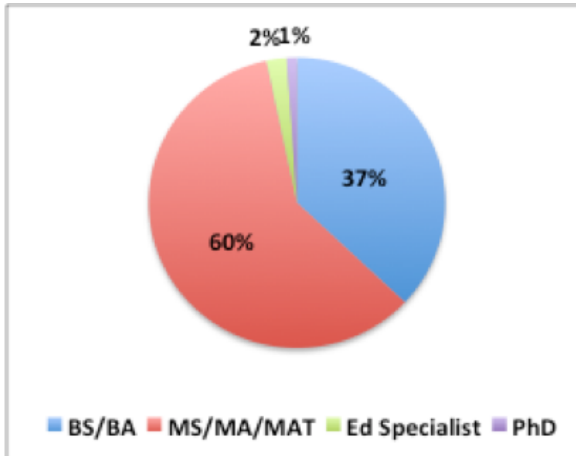
Who Participated?

A total of 207 educators participated in Cycle 10. The largest proportion 192 (93%), were teachers. Nine administrators and six preservice teachers/TA participants also participated in project activities at some degree of intensity. The number of teachers has ranged from 155 to 369 in previous cycles. Also, throughout this report and across individual project reporting, slight differences in totals may appear owing to fluctuations in participant counts over the cycle.

Teacher Characteristics

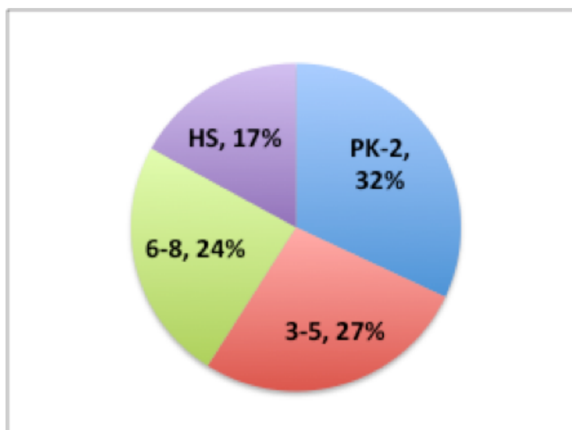
Cycle 10 teachers reporting their teaching experience averaged 12.5 years in the classroom, compared to 11 years in Cycle 9. Teachers continue to represent an experienced group of educators, although new teachers and less-experienced teachers did participate. Sixty percent of those reporting educational attainment had master's level degrees, up from 54% in Cycle 9. Figure 3 shows the distribution of teachers' education levels.

Figure 3. Teachers' Educational Attainment in ITQG Cycle 10
(reported n=181)



The grade levels taught by Cycle 10 teachers remained well distributed across grades. As in the part, many teachers taught at more than one grade level. For example, high school level math and science teachers very often taught more than one grade, as did middle school teachers. Higher-grade teachers are more likely to be science- or math-focused, while earlier-grade teachers often are generalists working across subjects. As Figure 4 shows, when all grades taught by teachers are considered, a fair distribution across grade groupings can be seen. Individual schools and school districts at times use junior high school or other organizations of grade grouping, but the effect remains: ITQG Cycle 10 projects, considered together, reached the full range of grades targeted by the program. In Cycle 10 the smallest proportion appeared among high schools, with 17% of teachers.

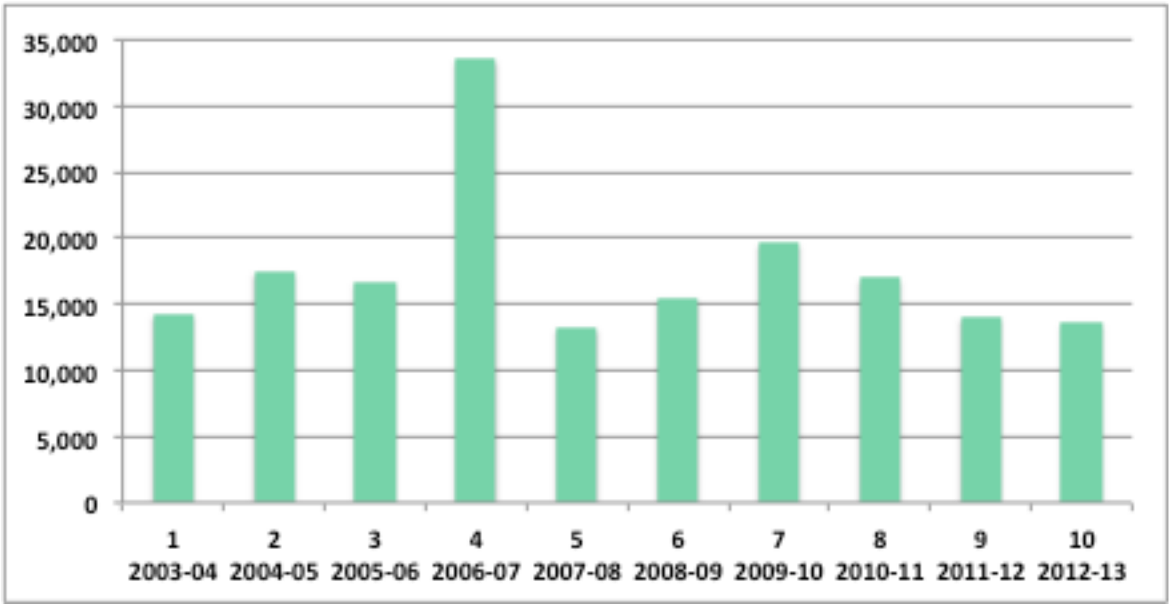
Figure 4. Percent of Teachers Teaching at Various Grade Levels in ITQG Cycle 10
(reported n=192)



Students Affected by Cycle 10 Projects

The reported number of students directly affected by the ITQG in Cycle 10 totaled 13,650. Teachers taught an average of 59 students each in Cycle 10, down from 68 students each in Cycle 9, likely resulting from wa smaller proportion of high-school teachers who often teach more students. Students per teacher vary widely with class size, school size, grade level and content focus. Also, some projects did not report these data well; 20% of teachers had no such data reported. Figure 5 compares Cycle 10's student counts with those reported in previous cycles. Over time numbers of students were affected by such factors as funding level, number of projects and teachers, and grade level, with Cycle 4 being an obvious outlier because of many small one-year projects funded for that cycle.

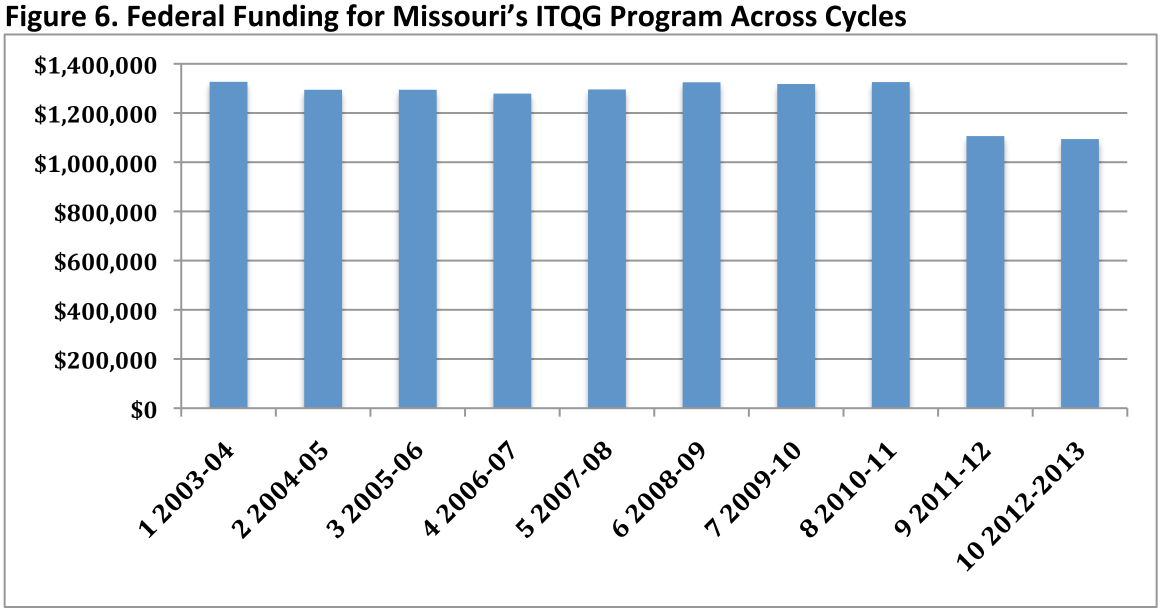
Figure 5. Number of Missouri Students Reported to Be Directly Affected by ITQG, by Cycle



Costs per Teacher and Student

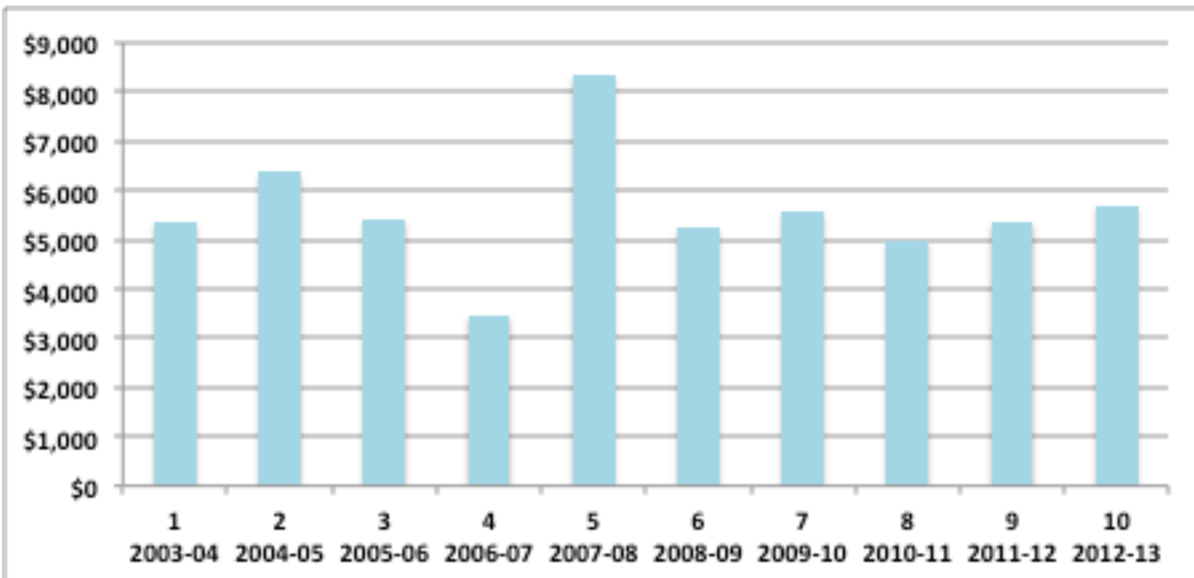
Comparing funding and mean cost per teacher and affected students is another way to measure the reach of the ITGQ. Figure 6 presents total ITQG Program funding granted to Missouri projects through the Federal Title II, Part A Improving Teacher Quality Grant program, operating under the No Child Left Behind (NCLB) Act of 2001 (CFDA 84.367). As can be seen, the $1,106,200 available in Cycle 10 was the least of all cycles.

Figure 6. Federal Funding for Missouri's ITQG Program Across Cycles



Calculating cost by participating teacher offers a better comparison across cycles on how funding for all the diversely budgeted projects in the program compare. This statistic does not assess the specific dollars offered as stipends to participating teachers, or other spending details. Rather, the mean cost per teacher displays how differing funding levels and recruitment levels contrast. As can be seen, the mean cost per teacher of $5,370 in Cycle 10 represents the fourth year of relatively stable results, as a balance has been struck between federal funding, number of projects, teachers recruited per project and, inferentially, the grade-spread of teachers reached by the program. The mean cost per teacher for Cycles 1 through 8 was $5,600, further indicating Cycle 10's representative standing.

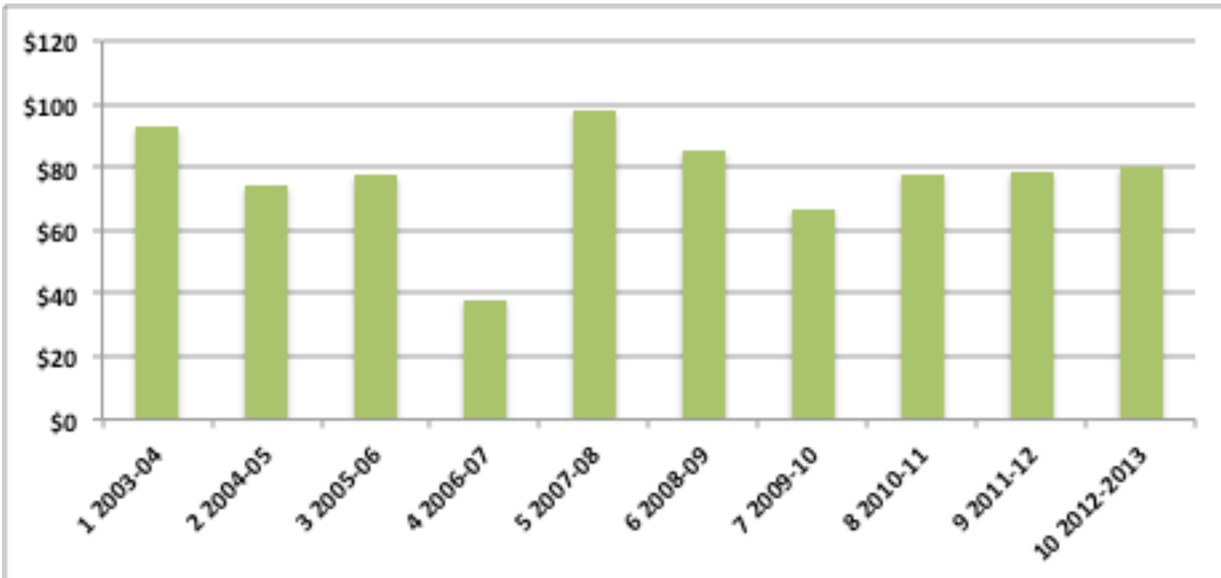
Figure 7. Mean Cost of ITQG per Teacher Across Cycles (Total Budget Divided by # of Teacher Participants)



An additional method of considering comparative value of the Cycle 10 experience is to consider the mean cost per student, by averaging the budget by the total number of students directly affected (taught by participating teachers) in each cycle. Figure 8 presents this information.

Greater values indicate years in which fewer students and larger funding combined to drive up mean "costs per student." Lower values represent years with greater numbers of students compared to relatively lower funding levels. As can be seen, as with Figure 7, experience in the last five cycles indicates a balance being found among the various components of available funding and projects' reach into schools and school districts. The mean cost per student in Cycle 10 of $80, compared to $79 in Cycle 9 and $78 in Cycle 8, represents an interesting consistency despite varying funding amounts and number of projects over the period. Given these variations over time, it can be said that the commitment of the MDHE ITQG in terms of funds applied to reach students has been remarkable.

Figure 8. Mean Cost of ITQG per Student Across Cycles (Total Budget Divided by # of Affected Students)



Analysis of Project Activities for Formative/Process Purposes

As described in greater detail in the report section on classroom observations, the Inside the Classroom Observation and Analytic Protocol used for observing the projects' activities provides for specific scoring in items across four domains that align with classroom observations: Design, Implementation, Math/Science Content, and Classroom Culture. Each domain closes with a Synthesis Rating determined by the observer that generalizes what was observed for that domain, and the entire protocol closes with a Capsule Rating that applies a single score to the entire professional development activity observed.

Table 2 shows the results of observations of each project's summer academies by three observers. Project appeared to perform best in the areas of content and classroom culture, where ratings of 3 and 4 predominate. It is in the area of Design and Implementation that projects tended to perform with somewhat less efficacy, based on the evaluators' observations.

Unlike in Cycle 9, no projects rated below 3 on the Capsule rating – the overall rating of the professional development experience. Ratings of 3 or above represent good to proficient professional development, to be expected for projects with mature, experienced leadership as represented in most of these projects. These data will be used as baseline for academic year observations.

Table 2. Frequency of "Synthesis" or Summary Rating Scored for Each Domain during Cycle 10 Project Activity Observations, June-August, 2012 (N=6)

Domain	Number of Times Rating Scored as Summary for Domain				
	1 (Lowest)	2	3	4	5 (Highest)
Design	0	2	2	2	0
Implementation	0	3	3	0	0
Math/Science Content	0	1	2	3	0
Classroom Culture	0	0	4	2	0
Capsule	0	0	5	1	0

For the three returning projects and for the one project that is continuing in this year due to refunding for Cycle 10, results are the same as their ratings at the start of the Cycle 9 project. These four projects had Capsule ratings of 3's (3 projects) and one 4. It is problematic that movement upward in the ratings for projects that have been in place for one to seven years is not evident as indicated in these four projects. Evaluators are mindful that there are elements that are not observed. Each session is evaluated on its own terms without an expectation that an entire summer academy's worth of implementation will be packed into one day.

As in Cycle 9, scores in the areas of Implementation (pedagogy) and Design in large part reflect a tendency for professional developers not to infuse their lesson design and delivery consistently with the underlying goals and objectives at hand. An example of special importance to the ITQG program is the area of pedagogy, and the inquiry-based framework called for. Consistent with Cycle 9, evaluators, while observing frequent discussion about inquiry, did not necessarily observe faculty modeling inquiry or, again, *infusing* inquiry in the implementation of their professional development. Such modeling is specifically called for in the ITQG RFP as a requirement. MDHE has expressed concern about how to change faculty's pedagogy to model appropriate methods additional to talking about them. Cycle 10 observations support MDHE's concern. In fact, the need for more sustained modeling across project team members of pedagogical practices more closely aligning to an inquiry approach (possible even in a more traditional lecture format) remains the biggest area the evaluators urge projects to focus on.

At the same time, the evaluators wish to point out the high scores seen in other domains, and note that most projects evidence at a minimum proficient, standard teacher professional development that is of a quality comparable to that observed in other settings. At their best, the projects have presented extremely well-integrated, well-aligned professional development opportunities for teachers that encompass environmental education more intentionally than Cycle 9 and diverse ways to approach student data analysis methods. The evaluators also note that all projects are staffed by professionals engaged in their work and, again, they have heard no teacher complaints at all concerning the value of time spent in the summer academies.

Formative and Process Evaluation Comments

The ITQG Cycle 9 evaluation represented a change in direction for evaluation practice for the program, both in terms of MDHE's expectations on internal evaluation coverage by the projects and for external evaluation. The latter covers a program-wide consideration of implementation alignment and summative results, seeking to ensure that projects are conducting their work as planned so that their intended impact can be maximized (given that professional development designs proved efficacious).

Some projects in Cycle 9 had continued from earlier cycles with other approaches to program (and internal project) evaluation standards and performance, and some of these projects continued into Cycle 10. Other new projects in Cycle 10 represented project teams funded in the past, who in some cases re-entered the ITQG with rather fixed notions of evaluation and accountability, based on earlier experience or other factors. This resulted in extensive additional communication, explanation, and attempts to secure cooperation in some places with what are, in the evaluators' experience, standard best and common-sense practices in implementation and subsequent assurance of value and efficacy in evaluating impact. The evaluators appreciate the good-faith effort usually experienced, and commend those projects that undertook refinements in the collaborative spirit with which they were based.

As this section of the report has described, the structural components of Cycle 10 in most regards fit within the historical patterns already seen in the MDHE ITQG. In terms of scope of reach, project characteristics, school/school districts, participants and students, and application of funding resources across projects and participating, close comparability has been seen.

As the aim of the external evaluation described in this report is to consider program-wide matters, most project-specific details have been placed in the technical section of the final report. However, Cycle 10 saw the implementation of a group of diverse, focused and committed projects addressing the topics contained in their action plans. All projects met the at least the basic requirements of their grants in terms of number and type of activities, and in all cases a professional, experienced, connected implementation served to satisfy all teachers with whom the evaluators spoke that their time was well spent.

As participant satisfaction is a useful bridge between formative and process concerns and a more evidence-based consideration of impact, the balance of this report will consider the available data concerning the impact of these efforts for the ITQG Program as a whole in Cycle 10. Each major objective is considered and evaluated for summative results after a year's professional development intervention.

3. The Impact of Missouri's ITQG Program: Goals and Objectives

ITQG's Impact: What It Strives for and How It Seeks to Accomplish It

The purpose of the Improving Teacher Quality Grant program is to increase the academic achievement of students by helping schools and districts improve K-12 teacher and principal quality and helping to ensure that all K-12 teachers are highly qualified. Through originating and sustaining budgetary legislation, the Missouri Department of Higher Education receives funds on a formula basis to administer to granted projects.

Elementary, middle school and high school teachers teaching science or mathematics have been targeted for participation in various ways over time. Usually, professional development has been focused in an intensive summer session, with academic-year follow-up sessions totaling a minimum of 120 hours. Projects have been one-, two-, or three-year enterprises. Some cycles have identified specific school districts for funding.

Projects are to represent multi-institution partnerships led by university content and education faculty and including high-need and other school districts, STEM business representatives, other educational and community organizations. In addition to public school districts, charter school and non-public/private schools are included. School administrators and other staff may be included. Pre-service teacher students also have a role in the program, with an ITQG objective to improve pedagogy and science and mathematics courses in teacher preparation programs and other higher education courses.

Table 3. Improving Teacher Quality Grant Program Objectives Cycle 9

Objective 1: *Improve student achievement in targeted mathematics and/or science content areas.*

Objective 2: *Increase teachers' knowledge and understanding of key concepts in targeted mathematics and/or science content areas.*

Objective 3: *Improve teachers' pedagogical knowledge and practices that utilize scientifically-based research findings and best practices in inquiry-based instruction.*

Objective 4: *Improve teachers' knowledge and skills in designing and implementing assessment tools and use of assessment data to monitor the effectiveness of their instruction.*

Objective 5: *Improve the preparation of pre-service teachers through improvements in mathematics and/or science content and/or pedagogy courses.*

ITQG Program Goals, Objectives, and Schema for Success

The underlying aims and objectives of the ITQG in Cycle 10 were unchanged from previous years: Improve teacher knowledge of mathematics and/or science content and their pedagogical knowledge and practice, and thereby improve student achievement in these subjects. Also, improve teacher assessment skills so they can better understand their students' needs. Finally, for the universities leading the projects, extend better practice into the schools' pre-service teaching programs and STEM content courses, to aid students preparing to enter the teaching profession. Table 3 on the preceding page shows the specific language of the ITQG objectives.

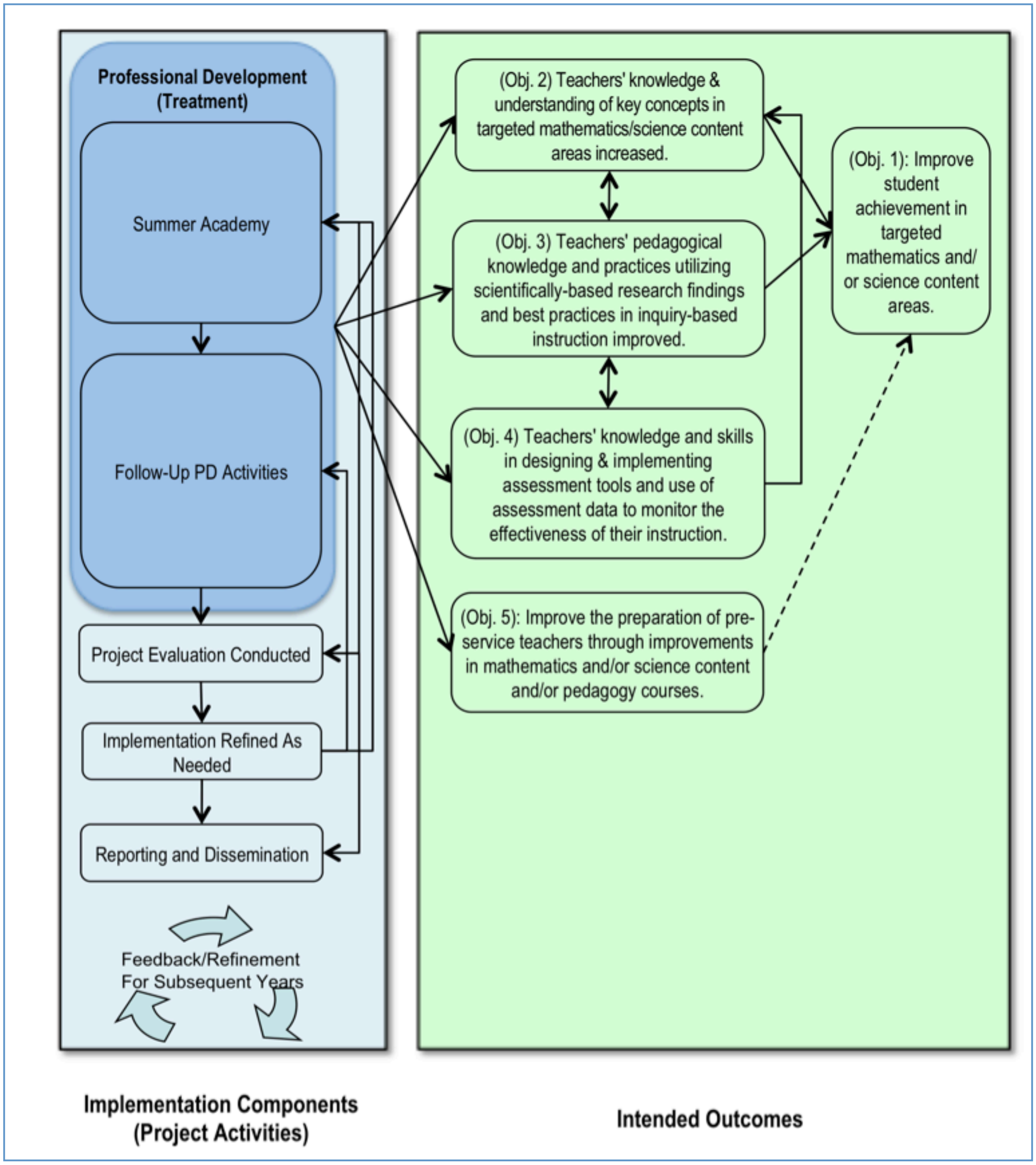
Figure 9 depicts in greater detail the optimal flow envisioned in the ITQG Program Theory, from implementation of sound professional development aligned with project objectives and practices through achievement of intended effects among teachers, students, and participating institutions.

Projects' professional development, in intense summer sessions, follow-up sessions and other contacts, seeks to improve teachers' content knowledge, classroom practice and use of data and assessment tools. Lesson enhancement, resources and support networks combine to support teachers in improving performance. ITQG's vision of exemplary pedagogical practice is grounded in inquiry-based instruction, with emphasis on modeling and meaningful activities in math and science that promote students' learning and are integrated within individual schools and school districts' curriculum, Show-Me Standards, Grade-Level and Course-Level Expectations, Model Core Teaching Standards and North American Association for Environmental Education recommendations. Environmental education and/or data systems competency also were components of some projects' work in Cycle 10.

All this work with teachers is intended to improve the achievement of their students, which is the ultimate aim of this professional development program in terms of engagement of existing teachers.

Finally, concerning new teachers, an objective exists to improve the preparation of pre-service teachers by applying the same content and pedagogy strategies in the courses offered at the ITQG institutions of higher education.

Figure 9. ITQG Program Theory (Flow from Activities to Outcomes)



4. ITQG's Impact on Teachers

Teachers' Significant Gains in Content Knowledge

Teachers on a program level showed statistically significant gains in content knowledge acquisition as a consequence of their participation in the ITQG's Cycle 10, based on the results of pre/post testing developed and delivered by the external evaluators. Teachers in each project made some gains on the test, which framed mathematics and science content in a problem-solving framework grounded in an environmental education context.

Projects comprised a complicated math/science content mix. Teachers taught at a broad range of grade levels with a variety of teaching focuses. Their own educational backgrounds were diverse; the needs for math at the Kindergarten level differ from those of a high school math teacher teaching calculus.

The evaluators constructed a test with content relevant in some way to most of the range of math and science coursework teachers were teaching. By framing the content in a problem-solving schema, the test aimed at assessing change in teachers' approach to thinking through content-related questions, which would be an outgrowth of the pedagogical practice to be exemplified by the projects. The test underwent construct and content validity testing with a team of authorities, followed by reliability analyses and convergent validity testing. A Cronbach's coefficient alpha of .55 on the pretest and .56 on the posttest indicated that the items were somewhat correlated and tended to be measuring the same construct. Additional analyses suggested that these results stemmed at least in part to test design rather than specific items, and the testing for Cycle 11 has accommodated these results.

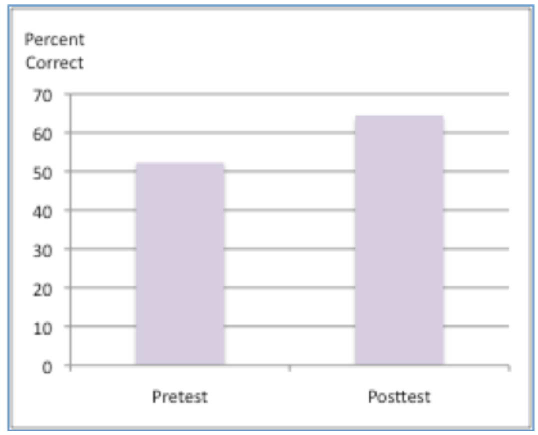
These content tests were delivered at the start of the Cycle 10 summer academy and again in the following spring during projects' follow-up sessions or at a time convenient for teachers when projects did not provide testing time. Analyses on gains yielded the results seen in Table 4 and Figure 10. For the 133 teachers taking both the pretest and posttest, significant gains in content knowledge, as measured by the test, were seen. The mean gain for teachers was 6.9 percentage points.

Table 4. ITQG Cycle 10 Teacher Content Test Results (N=152)

Cycle 10	N	Mean Pretest	Mean Posttest	Mean Difference	*sd*	*t*	Sig (2-tailed)	Effect Size
Total	133	57.2	64.1	6.9	16.5	1.4	0.000*	0.19

*p≤ 0.05

Figure 10. ITQG Cycle 9 Teacher Pretest and Posttest Scores (N=133)



Important to consider is that the test was not a simple assessment requiring teachers to reflect back specific information they had garnered from their experience in the projects. The content, including both math and science, incorporated material considered appropriate for an adult learner and relevant to the types of information covered in Missouri classrooms. Also, the gains seen, coming in STEM problem-solving testing, indicate that ITQG teachers had increased their ability to "figure things out," a crucial feature of the ITQG pedagogical model. This result occurs in the context of the evaluators' earlier comments on the desirability of enhancement of inquiry modeling in project activities; it may be noted that while some project faculty are not evidencing pedagogical practice consistently in the manner wanted, teachers are applying themselves within their own knowledge base to improve their "thinking" skills. However, it is not necessarily true that such gains would be seen among students whose teachers are not themselves modeling the ITQG-preferred pedagogical practice, because students lack the grounding and professional knowledge of the teachers.

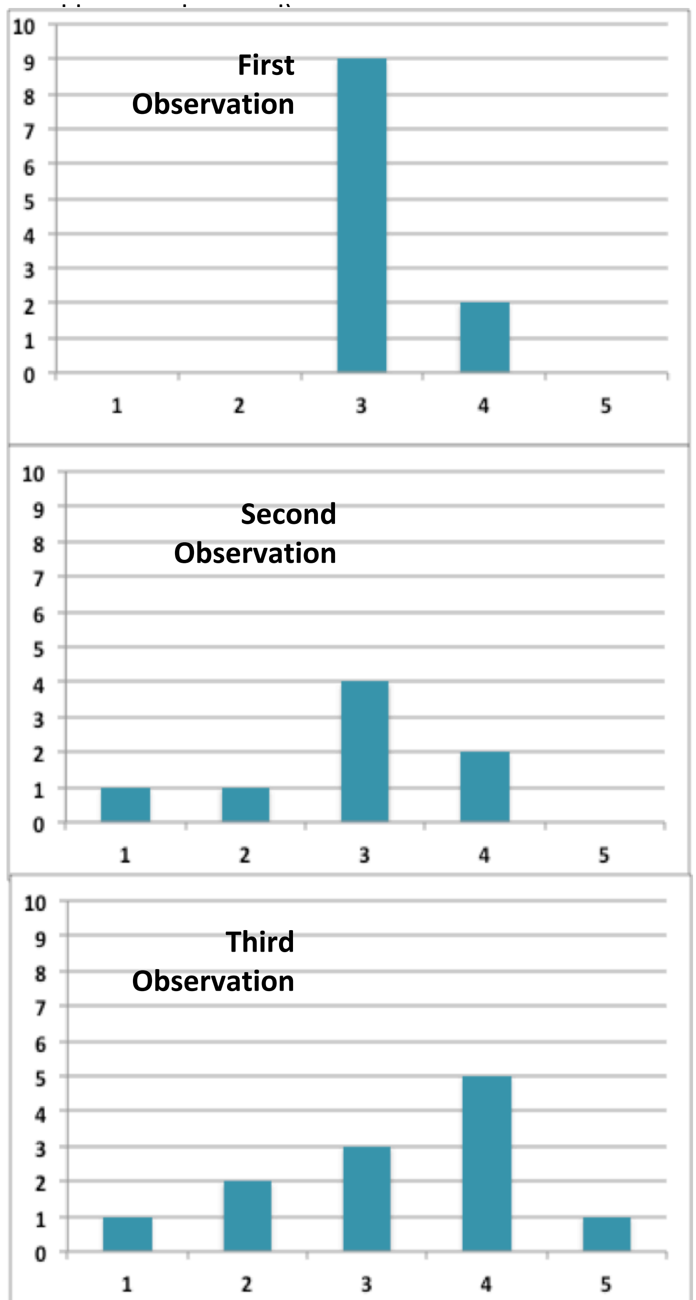
Content knowledge gains were statistically significant to a high degree. The effect size shown in the table, a measure of the strength of the relationship seen, was .19 standard deviation units, considered a small effect size. An effect size of .25 is considered non-trivial, which the test results approached. Finally, some projects were less supportive of testing than others; a greater proportion of teachers taking both pretests and posttests would have increased the N as well as offered a stronger sense of representativeness across teacher participants. While individual teacher participation in evaluative testing remains necessarily and appropriately voluntary, the active support of project teams in external evaluation activities is a critical factor in ensuring the best results.

Addressing changes in classroom practice among participating teachers also presented challenges. Relying on teachers' impressions of their own classroom practice changes lacks objectivity and easily can introduce bias. Not all project teams observe in classrooms, and their focuses and approaches in doing so are not the same as those of external evaluators. Also, relying on projects' data would lack standardization. Resources were not available for the costly and time-intensive task of observing all teachers at their work. The evaluators therefore decided to work with a group of "focus teachers," two per project, who were selected based on their comprising a fair representation of the entire teacher group in terms of experience, school setting, content focus and grade level.

These teachers were observed in their classrooms up to three times during the school year. Returning focus teachers had two observations. The *Inside the Classroom Observation and Analytic Protocol* (ITC) (Horizon Research, Inc., 2002) was used.

As introduced earlier, the ITC observation tool is divided into four domains: design, implementation, mathematics or science content, classroom culture. Each domain has numerous items that are coded according to a 1 through 5 ("not at all" to "a great extent") schema, and a "synthesis rating" is applied to each domain. Finally, a capsule rating with a different coding system but also with scores of 1 through 5 (again, lowest to highest) is used to rate the lesson overall.

Figure 11. Capsule Ratings of Classroom Observations for ITQG Cycle 9 (N=12 teachers, 31



Ratings: 1=ineffective instruction, 2=elements of effective instruction, 3=beginning stages of effective instruction, 4=accomplished, effective instruction, 5=exemplary instruction.

Evaluators observed a total of 31 focus teacher lessons in Cycle 10. A variety of lesson types were observed, from open-ended inquiry with student experiments to semi-directed group activities to directed inquiry with guided activities, to question-and-answer sessions, content reviews, and lecture-based instruction.

As Figure 11 suggests, teachers generally improved in capsule ratings for the lessons observed over the course of the school year. Second-observation scores dipped a bit, but a clearer differentiation can be seen between scores for the final observations and those preceding them, with a greater number of teachers rating 4 (accomplished, effective instruction) or even 5 (exemplary instruction).

As some focus teachers were in new projects and others were returning from previous projects active in Cycle 9, a comparison of their observation scores may suggest the relative standing of longer-term versus shorter-term ITQG. As the Ns are small, it is admitted that this look will offer only descriptive information that may be useful to consider. Table 5 compares results for the five returning Cycle 9 teachers in the two cycles.

Table 5. Comparison of Observation Scores for Five Focus Teachers In Cycles 9 and 10

	Cycle 9			Cycle 10	
Capsule Rating	**Obs 1**	**Obs 2**	**Obs 3**	**Obs 4**	**Obs 5**
1(Lowest)	1	2	1	0	1
2	0	1	0	0	0
3	1	3	1	4	1
4	2	0	2	0	2
5 (Highest)	1	0	1	1	1

The results do not show a smooth continuation of Cycle 9 improvements into Cycle 10. What is seen, rather, is a slight retrenchment of sorts in the first observation in Cycle 10, followed by a move into better performance that left the results the same as those at the end of Cycle 9. This pattern, again based on small Ns, may suggest a number of things. First, teacher pedagogical practice, even where improving over the long term, naturally rises and falls with individual lessons on individual days. While the evaluators are confident that sporadic observations tell the truth of a teacher's general practice, daily nuances occur. Second, the second year of a project does not entail mere repetition of content. Therefore, attempts to adopt or change practice may challenge performance in each fall after the intensive summer academy. Also, there may be a seasonal effect, in which teachers at the start of the school year are naturally less proficient than they become with the work of an entire school year. Finally, to contextualize matters, the evaluators continue to hear some confusion from teachers about what practice they are to be adopting and modeling. Some teachers continue to focus on activities without the inquiry concentration. Some do not seem to know what "inquiry" means in terms of their own lesson planning. Therefore, some changes seen may reflect a complex partial adoption of project tools and practices filtered through a teacher's own understanding and individual pressures. However, it can be noted that these scores are not based on specific application of ITQG project content, activities, technology, lesson plans or resources. They are based on teachers' actual practice in situ.

The Challenge of Systematically Incorporating Assessment Data

As in the past, all projects in Cycle 10 shared an objective to improve teachers' knowledge and skills in the design and implementation of assessment tools and the use of assessment data to monitor the effectiveness of their instruction. Projects continued to address the objective in different ways, interpreting the requirement of integrating "data-driven assessment" across a range of possibilities.

Fewer projects brought in outside experts than in the previous cycle. These outside experts tend to address the subject from a rather broad perspective, encouraging development of data teams and discussing emerging large-scale assessment systems and requirements.

As an alternative, most projects embedded the subject more integrally within project curriculum and worked with development of assessment tools aligned with teacher-identified curricular and classroom needs. Approaches included teachers working as data teams within their schools and promoting action research among individual teachers. Some projects specifically focused on teacher-identified issues in assessment, attempting to identify particular issues within the teacher's school context.

Assessment (not necessarily "data-driven") also was incorporated by having teachers create their own assessment instruments for project-developed lesson plans. An intention to apply such instruments as part of internal project evaluation created some questions about adequacy of results to inform project impact on students. Lack of validity and reliability testing, or inclusion of such methods as a part of substantiating assessment tools for evaluation purposes, hampered the usefulness of this approach. While teachers appreciated the need for refinement of assessment practices and described wanting to integrate project-related assessment work into ongoing assessment activities at their schools, they often seemed unprepared to incorporate technology or more refined methods into their actual practice.

Classroom observations did indicate thoughtfulness among some teachers about how to apply assessment within the larger instructional context, with a more dynamic, collegial and inquiry-based approach to working with quizzes and their results. Adoption of pretest/posttest assessment methods, already in place in some schools, added to a more focused and specific way to understand knowledge and understanding gains.

A particularly strong example of the incorporation of student data into instruction continued to be seen in a project working primarily with one school district. The project's teachers, with administrators, worked to coordinate district and standardized state test data both vertically and horizontally across grades. Discussion on how to apply this information directly in instruction in remedial ways amplified the usefulness of this work. However, driving assessment to link classroom assessment with available district data to pinpoint specific areas to address in instructional decision-making appears to remain uncommon. This approach is time-consuming and in a multi-district project requires substantial commitment and oversight.

Project leadership could incorporate the gathering and use of student data in a more systematic way to better meet this objective. It is possible that discussion between the MDHE ITQG staff and project teams on how best to prioritize and implement this component would be of assistance in enhancing its effectiveness within the ITQG program.

5. ITQG's Impact on Students

Analysis of standardized math and science test results from Missouri Assessment Program (MAP) and End of Course (EOC) tests by grade compared scores for students of ITQG teachers by grade with those for a carefully matched comparison group of students of Missouri teachers. In Cycle 10, analysis results showed no statistically significant ($p \leq 05$) differences between students of ITQG teachers and students in the comparison group.

However, in almost every grade from grades 3 through high school (testing starts in grade 3; grade 5 was the only exception in a numerically positive effect seen), students of ITQG teachers experienced a numerically positive effect in either math or science compared to non-ITQG students. While the extent of this effect was not statistically significant, it provides a descriptive indication that, despite the fact that MAP tests were being delivered towards the end of the same academic year that Cycle 10 was being implemented, ITQG was making an immediate difference in the classroom that touched students' content achievement.

While no statistically significant students effects were seen in Cycle 10, every grade but one saw numerically higher effects among students of ITQG teachers than students in a comparison group.

The evaluators do not mean to overstate this point, but any indication of a student effect remains remarkable, given not only the rapidity involved but the stringency of the methods applied in these results, both for selecting comparison groups and in the specific analyses used. Likely the greatest challenge, statistically, is in the relatively small n's for teachers available by grade, since ITQG reaches from early childhood and Kindergarten through senior year of high school. MAP and EOC tests are highly focused on individual grades and the very specific content expectations developed for them by subject.

The need to be as inclusive as possible for all grades and all projects in order to maximize analytical power when it comes to evaluation activities underscores the challenges presented if a project does not promote evaluative participation among teachers. The lack of numerous teachers in one project in Cycle 10 could have affected the results of the necessarily rigorous methods required. Nevertheless, the predominantly positive effects seen do tend to support the idea that, despite the complexity of the issue, ITQG makes a difference, in a short-term way.

Applying the same analysis methods, Cycle 9 did see various statistically significant differences between students of ITQG teachers and their comparison groups, supporting ITQG effectiveness. In grades 6 and 7 for math and grade 5 for science, significantly positive gains were experienced. Interestingly, the effects approaching closest to significance in Cycle 10 were seen in grades 6 and 7 math. Note that different projects were implementing in Cycle 9, although some have continued in the current cycle.

Detailed student content impact information is included in the Impact Report's *Missouri Improving Teacher Quality Grant Program - Cycle 10 Program Evaluation Technical Report* that accompanies this summary.

6. ITQG's Institutional Impact

The Improving Teacher Quality Program represents a partnership model of professional development. The university-based science and math content faculty and educators guiding the projects in Cycle 10 – across all seven projects – bring considerable experience in working with school districts in their regions and beyond. Projects largely are based on earlier iterations of professional development programs conducted by the teams, somewhat modified to include ITQG-specific components in varying degrees of intensity. The project teams are familiar with their constituent school districts, having worked with them over long periods of time. They also are knowledgeable about the practical challenges in their own institutions' teacher preparations programs.

The capacity of the ITQG projects to sustain their efforts after funding or to effect institutional change either at the university or school district level is practically limited. The overwhelming focus of energy is given to working with teachers on their needs.

Maintaining Effective Learning Networks

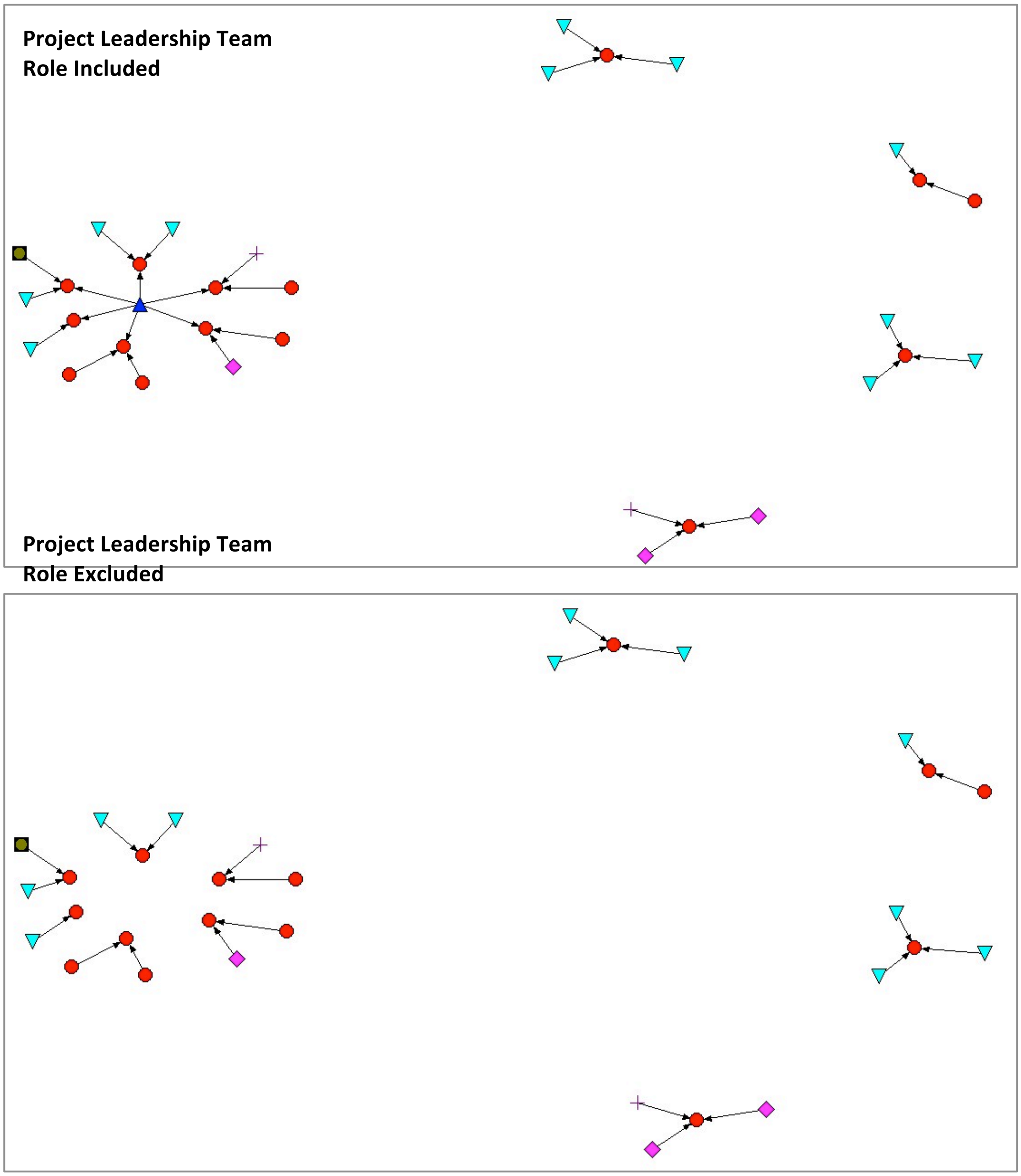
One element of sustaining the ITQG project's efforts is enhancing the professional networks teachers can rely on to share information and resources, seek and find support, and otherwise build on their capacity as teachers. Many teachers, especially in rural areas, are limited in the number of peer colleagues, and strengthening support networks.

Social network analysis permits viewing where teachers go for information, and who comes to them. Figure 12 shows a typical example of what is being seen with ITQG projects for content, and Figure 13 shows pedagogy. Faculty Leadership team and staff (▼) most frequently serve as ad hoc centers of content and pedagogical support for teachers (●), usually with the project director representing the major content. At the same time, existing networks continue.

Removal of project leadership team and staff from the mix demonstrates the relative isolation of many teachers. Some reported no go-to source for content and pedagogical support. While this does not mean they do not in fact have people to whom they turn, or come to them for assistance, no one came to their minds as a major or frequent source of such assistance. Their apparent isolation within the projects also is evident. At the same time, the results of deleting the faculty connections from the network shows to what extent existing sub-networks often rely on a single point of contact to larger pools of potential support.

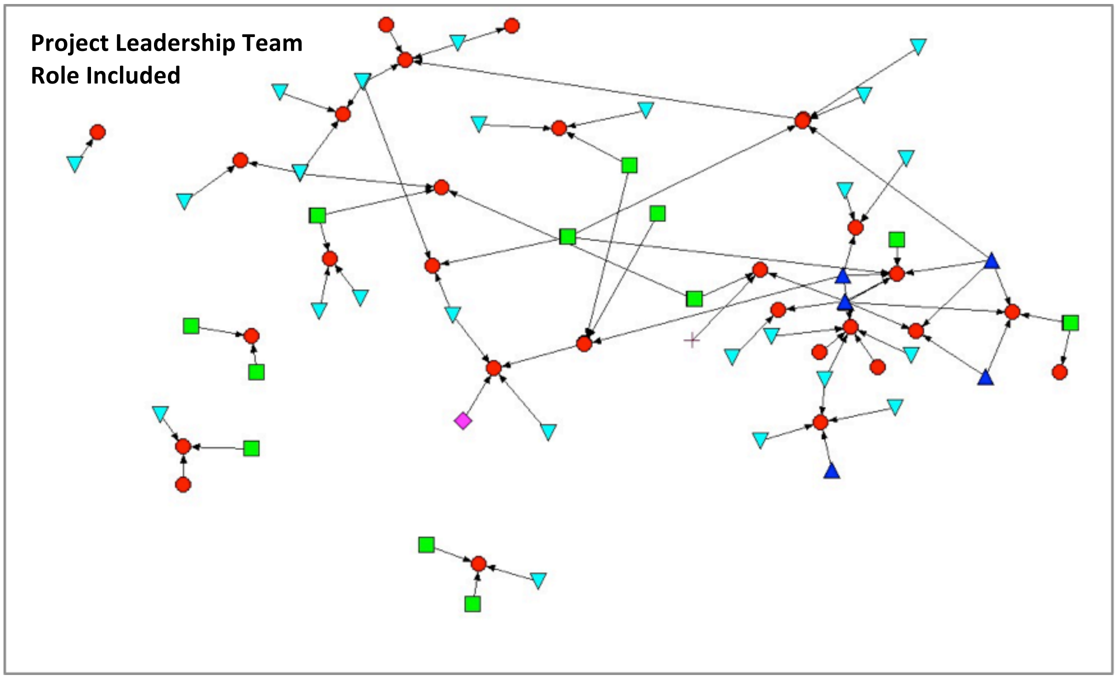
A consideration of teachers who "go to each other" indicates the strongest core support relationships; these often are colleagues at their school. In small schools no potential for comparable routine exchanges exist.

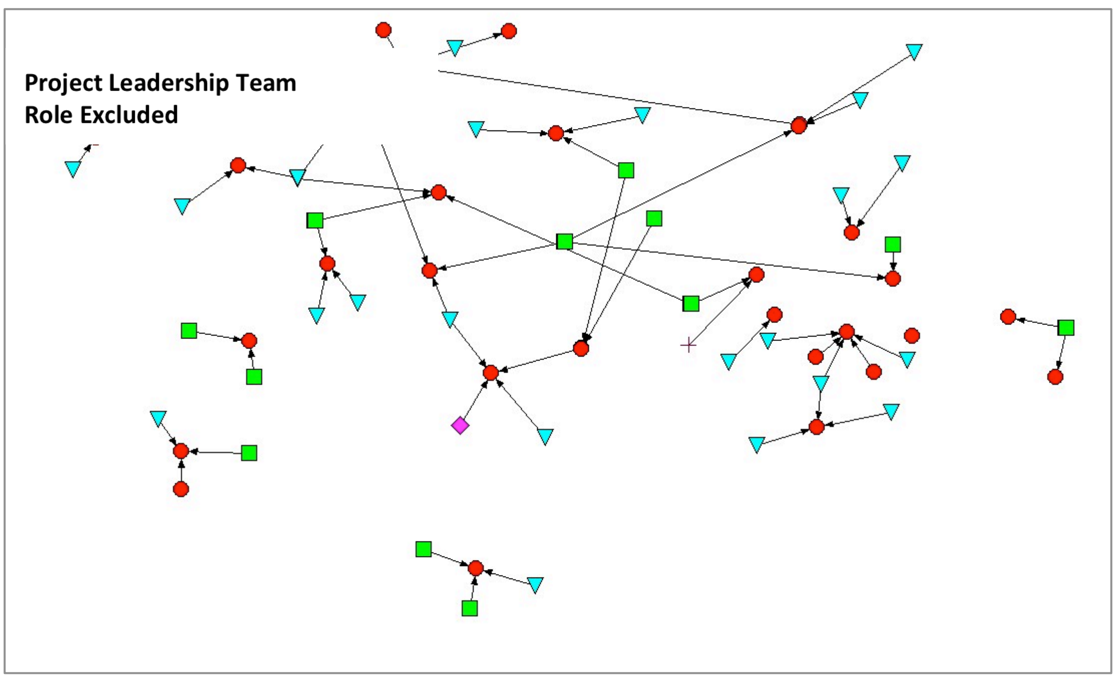
Figure 12. Representative ITQG Cycle 10 Project Social Networks for Content Support, with Project Leadership Role Included and Excluded



Key to the symbols: Circles = Project Teachers, Squares = Administrators of the schools, Triangles = Project Leadership, Down Triangles = Other Teachers in schools, not in theprojects; Diamonds are Relatives of the Project Participants, Circle within a Square = Government Employees (Conservation Staff, DNR Staff, etc), Plus Sign = Other People

Figure 13. Representative ITQG Cycle 9 Project Social Networks for Pedagogy Support, with Project Leadership Role Included and Deleted





Key to the symbols: Circles = Project Teachers, Squares = Administrators of the schools, Triangles = Project Leadership, Down Triangles = Other Teachers in schools, not in theprojects; Diamonds are Relatives of the Project Participants, Circle within a Square = Government Employees (Conservation Staff, DNR Staff, etc), Plus Sign = Other People

7. Evaluation Comments and Recommendations

The Improving Teacher Quality Grant Program in Cycle 10 represents an established source of teacher professional development in Missouri that many teachers, schools and school districts have come to rely on to augment in-district efforts to maintain quality math and science curricular programs. Participating schools and districts largely represent high-need areas, where challenges exist in achieving desirable standards of achievement. A commitment to reach as much of the state as possible helps ensure that many rural areas, not usually a focus of such professional development, are included. Cycle 10, which reaches most parts of Missouri in its six projects, demonstrates the relative success of meeting this aim.

Across the program, project teams are qualified, experienced professional developers who understand the needs of participating teachers and, with a few exceptions, the full range of expectations that come with ITQG project funding. With extremely variable support at institutions of higher education for their faculty undertaking such complex educational projects, the motivations of the project directors and their teams are fully focused on the goal of assisting teachers to be better teachers. The extraneous rewards for this work are relatively limited, and the requirements for implementation in terms of coverage and logistics are substantial.

The projects, in various ways, all succeeded in Cycle 10. Participating teachers were overwhelmingly satisfied with their projects' curricula. The evaluators encountered no negative comments among administrators contacted, but heard of general support for their teachers' professional development efforts even in those cases when administrators did not recall the specifics of the program. All projects but one saw their teachers experiencing statistically significant gains in content, and the fact that the content was not focused specifically on the projects' own curriculum show that teachers were learning as much about how to think about science and mathematics as they were about particular content. These results align with the ITQG's pedagogical expectations.

Student analysis results offered strong indications that IQTG projects are reaching students through participating teachers, with results approaching a statistically significant impact at the high school level through End-of-Course test results immediately apparent. In other words, high school students whose teachers participated in the ITQG Program showed gains in content knowledge achievement greater than did the students of teachers who weren't in the program. Students at earlier grades, with analyses based on MAP test scores, a different dataset, showed similar results in the middle grades. However, the nature of the MAP tests, in the evaluators' view, could conflate outcomes in the types of analyses required.

To the evaluators' knowledge, this represents a significant finding supporting the efficacy of the ITQG program in such an objective, stringently evaluated way. The linkage of institutions of higher education with school districts in a teacher professional development setting focusing on

STEM content and pedagogy, including specific school district needs, can be seen to work and, in some cases, work rapidly.

Evaluative challenges largely focused on formative and process concerns. Some projects were slower to adapt to the updated evaluation models, and had become accustomed to a pattern of less direct engagement in ensuring alignment of implementation to ITQG expectations and to projects' action plans. The fact that the Missouri Department of Higher Education is seeking to integrate projects' results within a unified vision for the ITQG also presented some challenges, as some project teams continue to see their ITQG funding as a means to support their own pre-planned, ongoing professional development efforts.

With these comments in mind, the external evaluators offer the following recommendations for helping to ensure continued success in moving the ITQG forward – in implementation and in securing objective evidence of each project's impact.

Major Program Recommendations

- Project teams would best support the achievement of their objectives by ensuring that recommended pedagogical practice is consistently modeled by all presenters in every opportunity.
- Project teams must continue to enhance their internal evaluation plans; prepare responsible, validated and reliable pre/post teacher tests; develop objective measures for tracking student achievement effects; and designate responsible, experienced personnel to secure the best results from internal evaluation efforts.
- Appropriate social science statistical analysis of internal evaluation results would better reflect project effects.
- For project teams previously funded by the ITQG, care must be applied to avoid repetition in curriculum or a tendency to serve the same teachers as in past implementations with the same curriculum.
- Multi-year projects would be served by developing retention strategies to ensure that the best teacher retention results are secured, and that if new teachers enter the project in a second or third year their project experience does not suffer from partial intervention.
- If MDHE considers serving high need schools a priority, increased emphasis and consequences to projects not meeting minimum requirements may improve such participation. Clarification of high need schools classification prior to proposal submission and renewal will assist in this task for projects.
- Use support staff such as GRAs/TAs in an integrated, consistent fashion that ensures their presence and support in the project where needed.
- Additional staff resources at the Missouri Department of Elementary and Secondary Education would permit an expansion of the agency's data collection and quality control system and processes. With so much emphasis placed on the results of testing, the completeness and accuracy of these data are more important than ever. Recognizing that

funding for staffing is dependent on the state's budget process, the evaluators strongly urge those responsible to provide the agency with the funds required to support the existing professionals on the staff and expand the data system's capacity.