EVALUATION OF PROFESSIONAL DEVELOPMENT PROJECTS

Missouri Department of Higher Education
Improving Teacher Quality Grants

Cycle 2 External Evaluation Report

Executive Summary

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Introduction

The current educational policy climate in the US and in Missouri is focused, in part, on producing high quality teachers for our schools. Too many classrooms are taught by individuals who are not certified in the subject matter they are teaching. The problem of highly qualified teachers is acute in the areas of mathematics and science, where many teachers have less than adequate preparation in content and pedagogy. Effective professional development (PD) for mathematics and science teachers is one solution to the problem. The *No Child Left Behind Act* provided funds to the Missouri Department of Higher Education (MDHE) to institute a program of PD in mathematics and science education.

There is a great deal of agreement about what characterizes effective professional development in mathematics and science education (Loucks-Horsley et al., 2003). Research and policy documents agree that effective PD is long term; involves ongoing collaboration of teachers in planning; is anchored in student learning, curriculum, and pedagogy; and has an explicit goal of improving student learning. Effective professional developers model the kinds of reform-minded instruction that is expected of classroom teachers in order for teachers to build their content and pedagogical knowledge. Effective PD requires the collaboration of schools, universities, and other entities in supporting teacher growth in knowledge and practice. The ultimate goal of PD is to improve student learning.

Overview and Methods

The purpose of the External Evaluation Report is to summarize the evaluation of the nine PD projects funded by Cycle 2 (2004-2005) of the Missouri Department of Higher Education (MDHE) *Improving Teacher Quality Grants* program. The evaluation is based on data collected by the external evaluation team in cooperation with project directors. The external evaluation team collected data about the context of the projects (PI background, project design, participants, and their schools). Secondly, we conducted formative evaluation in the form of site visits to each project's summer institute and follow up activities. Finally we conducted summative evaluation using a variety of instruments at several times throughout each project.

The full report provides demographic data about who the projects served, brief profiles of each funded project which document the quality of implementation and outcomes data, and summary results across the nine projects. The report also responds to seven guiding research questions and provides recommendations for future funding cycles.

Results

1. *What are the characteristics of the funded PD projects? How much variation and similarity exist in philosophy, assumptions, and methods? To what extent do projects achieve goals?*

The Cycle 2 PD projects were based on PI beliefs about teaching and learning which emphasized student-directed and inquiry-oriented instruction. The projects featured the following common delivery mechanisms: 1) held 2-3 week summer institutes, usually on college campuses, that engaged teachers in activities that their students might do and often included technology; 2) asked teachers to write lesson/unit plans; and 3) awarded graduate credit. Projects were more varied in the form and quantity of school year follow-up activities, ranging from no common follow-up sessions to seven Saturday sessions. Unique project follow-up features included a mobile equipment service for teachers to receive laboratory materials, and individual classroom visits with feedback from the PD project team. Projects emphasized

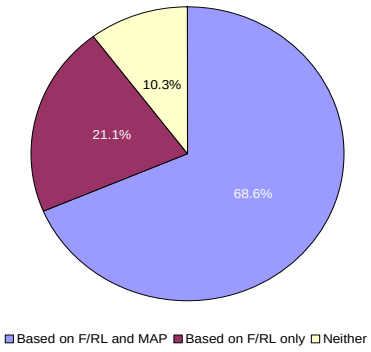
learning both science content and science pedagogy, but most projects failed to demonstrate connections between the content being learned, the curriculum in place in the participating schools, and the instructional and assessment methods that could facilitate student learning of the content.

Overall teachers were satisfied with the PD projects and believed that project PIs/staff achieved their goals. When asked what they valued most about the PD projects, respondents mentioned a range of components, including the quality of the instructional staff, the opportunity to engage in science activities like students, improving their science content knowledge, receiving a stipend, and working with other teachers. When asked what they valued least in the PD projects, common themes included that they did not like scientists to lecture to them; they did not favor activities that used equipment or technologies not available in their schools; and they did not like to feel "left out" when activities emphasized one grade level over another, when subject matter was not aligned to their curriculum, or when more experienced teachers were combined with less experienced.

2. What are the characteristics of the teachers who participate in the PD projects?

Cycle 2 PD projects served a total of 218 total participants, including 203 teachers, 14 pre-service teachers, and 1 principal. A few of the individuals participated in more than one project. The Cycle 2 participants can be characterized as follows:

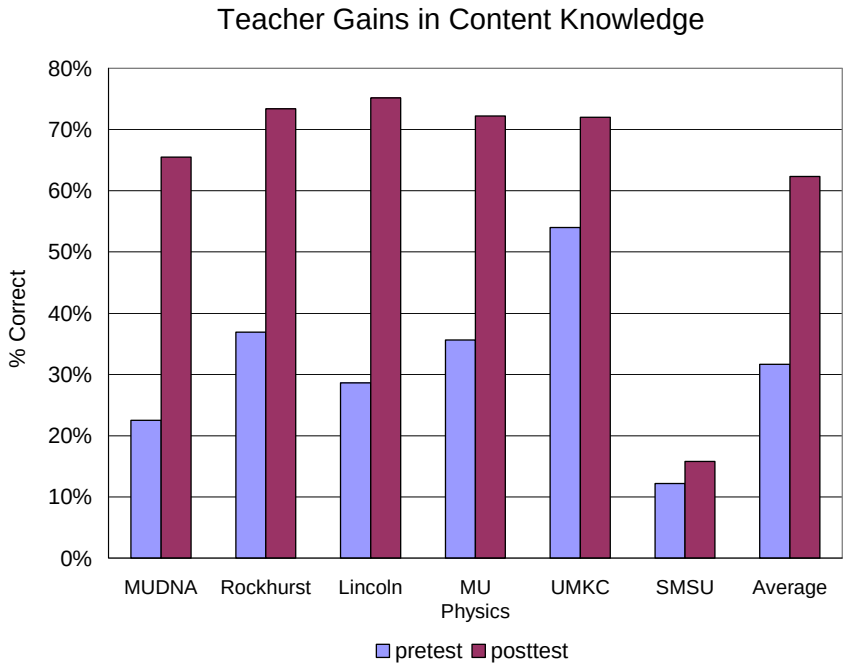
- 62% were female;
- Most taught general science at the middle level, with the next biggest group being high school biology teachers;
- 64% reported over six years of teaching experience, although 54.8% were relatively new to their current school, with 1-5 years of experience there;
- 44.3% held a masters degree or higher, 49.5% held a bachelors, and 6.2% had no degree;
- 40.6% held their first degree in a field other than education;
- Most held regular certification in one or more science teaching fields; individuals teaching with temporary certification accounted for between 2.6% to 8.2% of respondents in each subject field;
- Came from 65 different Missouri school districts and 13 private schools;
- 86.7% came from districts that met at least one of the criteria for high need;
- Directly impacted 17,478 students in 2004-2005.



Percent of Participants from High Needs Districts (n=204)

3. *What teacher learning outcomes (knowledge and understanding of science concepts, knowledge and understanding of inquiry-based pedagogy, and changes in teacher practices) are demonstrated in the PD projects?*

Science content knowledge assessments were administered as pretests and posttests to participating teachers in most of the *Improving Teacher Quality* PD projects. Overall results indicated that teachers' tested science content knowledge increased more than 30 percentage points. Teachers' self-reported ratings of knowledge in each of the science content standards targeted by the PD projects increased more than one scale point in physics topics (about a 25% increase) and nearly one scale point in the living systems domain (a 12 % increase). Some teachers commented that the science concepts they were asked to master during their PD experiences were above and beyond the knowledge they would be teaching their students. Some PD project PIs/staff considered such comments to be an indication that they were successfully challenging the teachers' knowledge horizons and improving teachers' confidence to teach difficult concepts.



Teachers reported low to moderate improvements in teaching practices associated with all components of PD listed on the Satisfaction Surveys (even when a component was not part of a particular PD project). Conducting activities designed for classroom use was the only component with a self-reported impact of "quite a bit" or more. Teachers' responses to questionnaires designed to assess their teaching philosophy and beliefs showed no change in deep-seated beliefs about how students learn best or how instruction should be delivered. Teachers reported that their uses of Seven Principles of Good Teaching Practice increased after their participation in PD projects.

4. *What are the relationships among project characteristics, teacher characteristics, and teacher learning outcomes*?

PD outcomes are related to a host of design and implementation factors. However, a causal sequence from design to implementation to outcomes is difficult to document. In this report, we described the context, processes, and outcomes within and across nine PD projects. The

projects that were most successful linked science content with pedagogical issues, spent more time in follow-up activities including classroom visits, and provided other supports in the form of equipment and/or curriculum materials. During the follow ups, PIs were able to help teachers translate what they had learned in the summer institute into practice and facilitate teachers to learn from each other about effective management strategies. Some follow-up sessions were also able to focus on classroom assessment as aligned with inquiry-oriented instructional strategies. The variability across projects in the time that teachers spent in PD activities is a cause for concern. We expect that greater time on task would lead to greater teacher learning, and have evidence that projects that spent more time in job-embedded follow-up activities with teachers were more successful.

5. *What learning outcomes are demonstrated by students of participating teachers? Are those learning outcomes different than learning outcomes demonstrated by similar students in similar classrooms?*

Teachers in several projects administered pre and posttests to their students, usually in conjunction with delivering a unit of instruction designed as part of their PD experience. These classroom assessments showed that students performed better on posttests than they did on pretests. Since projects did not collect or report comparison data about student performance in other classrooms, we cannot determine if the students in PD teachers' classrooms learned more than other students in their schools.

6. *Do aggregate measures of student achievement based on the Missouri Assessment Program (MAP) and/or other standardized assessments show increases in schools and classrooms of teachers who participate in PD activities?*

Comparisons of school level performance on the science portion of the MAP showed a slight improvement advantage at grade 7 for schools with teachers who participated in Cycle 2 PD projects, although there was no advantage at grade 10. When performance on the specific content standards addressed by each PD project was examined, schools with one or more teachers in the Cycle 2 PD projects tended to have smaller gains and/or larger losses in performance than other schools. Analytical statistical tests showed no statistically significant relationship between teacher participation in the *Improving Teacher Quality* PD program and school level improvements in MAP performance.

7. *How is science education at partnership higher education institutions influenced by PD project activities?*

Only four projects had PIs who responded to the *Higher Education Impact Survey*, which limits the data available regarding the impact of the *Improving Teacher Quality* program on higher education institution science or education coursework or relations with K-12 schools. Based on those who did respond, we learned that the PD projects improved relations with K-12 schools and influenced some changes in science and education teaching on their campuses. Changes to science teaching included the redesign of courses to include inquiry-oriented pedagogy and technology, and in one case the design of a new science course. Another impact on science teaching was the establishment of a university-level discussion group about inquiry teaching and learning. Reported changes to education courses were fewer, perhaps because these courses had previously employed inquiry-based philosophies and methods.

Conclusions

The results from the external evaluation of the nine PD projects funded by Cycle 2 of the *Improving Teacher Quality* program provided data and insights that led to the following conclusions about the design and delivery of projects.

Elements of best practice: The various PD projects in Cycle 2 exhibited certain characteristics that were considered positive by participants and evaluators. For example:

- Developing a true partnership with a high needs school district;
- Designing the PD around school needs as defined by “Clear Access” reports;
- Providing teacher with equipment through a mobile distribution service to ensure that PD activities were used in the classroom;
- Helping teachers develop deep content knowledge;
- Supplying teachers with classroom-relevant activities and inexpensive materials;
- Allowing teachers time to talk about implementation and assessment issues during follow-up sessions;
- Facilitating the development of collegial and collaborative relationships (learning communities) among college faculty members and participating teachers..

Evaluation impacts PD design and delivery: Several Cycle 2 projects were funded and evaluated by the external evaluation team in Cycle 1. We noted that in several cases, recommendations offered in the Cycle 1 evaluation report had been incorporated into the design and delivery of Cycle 2 projects. We also noted that, in several cases, suggestions offered during Cycle 2 formative assessment visits were incorporated into the activities and emphases of subsequent PD activities in several cases. We take these findings as evidence that thoughtful and professional evaluation focused on improving the experiences of teachers who participate in PD projects can influence the design, delivery, and outcomes of those experiences.

Varied approaches to PD instruction: Designing and delivering effective PD is a complicated affair that takes into account PI beliefs and past practices, the setting and participants, and the implementation processes. Although each of these PD projects was structured by a summer institute and some sort of school year follow up, there was a great deal of variability in the processes of the summer institutes and the nature of the follow ups. Although it is difficult to attribute cause to observed outcomes, certain practices have implications for the quality of the PD delivered and the potential to result in teacher learning, and ultimately student learning. The Cycle 2 PD projects can be characterized by what drove PD instruction. We found several approaches, sometimes present within the same project: activity-driven, science concept-driven, pedagogy-driven, curriculum materials-driven, and teacher-driven.

- *The activity-driven approach*. The PIs engage teachers in activities that they hope the teachers will then use with their students. The conceptual or pedagogical value of the activity is not always made explicit—the value is assumed to be in the activity itself. Participating teachers tended to appreciated new activities for their teaching toolkits, as

long as the activities aligned with their teaching assignments and they had access to the supplies and materials needed to conduct the activities in their classrooms.

- *The science concepts-driven approach.* PIs try to help teachers learn new science content and laboratory techniques to enhance teachers' understanding of selected concepts. Sometimes this approach includes science and societal connections. This approach was rated highly by science teachers who believed their content knowledge needed to be improved or updated before they would feel comfortable teaching the concepts to their students.

- *The pedagogy-driven approach.* PIs encourage particular instructional strategies (e.g., whiteboarding, science notebooks, questioning strategies, cooperative learning groups) that will help teachers help students learn. Teachers tended to rate these sessions most effective when combined with relevant activities and integrated with learning science concepts. The relative emphasis on instructional strategies and approaches varied across projects. Participating teachers, especially veterans, were mixed in how they rated the value of this focus in PD projects; some reported transformations in teaching practice while others indicated that they had developed a successful "teaching style" and resisted PD attempts to change how they teach.

- *The curriculum materials-driven approach*. PIs guide participating teachers through lessons and units from nationally or locally developed and tested curriculum materials to help teachers learn to use those materials in their classes. Often participating teachers became the students as lessons were completed and corresponding activities were conducted. Instead of adopting new curricula wholesale, teachers adopted pedagogical strategies modeled in the curriculum materials and adapted activities and materials into units or lessons that were appropriate for their teaching assignments. Teachers tended to rate these projects higher when the curriculum materials were available to them in their schools, relevant to their teaching assignments, well-designed, and consistent with other instruction about science learning and teaching.

- *The teacher-driven approach*. PIs enlist teachers to establish needs, design instruction, and implement instruction. Teacher networking is a major feature in this approach. One Cycle 2 project attempted to be driven by teacher needs by trying to individualize instruction for all participants. However, they lacked a set of expected outcomes for participants or a common vision for science teaching, that would lead to criteria for assessing the quality of teacher products.

Based on our observations, we were able characterize these different approaches within Cycle 2 projects. Most projects used more than one approach at different points in time, or simultaneously. Teachers were more satisfied when multiple approaches were used. We believe that the most successful PD involved more than one approach. Instructional approaches must be selected consciously by PIs for various purposes, and the purposes of the different approaches made explicit to participants.

Partnerships with K-12. Although the Cycle 2 RFP required projects to represent partnerships between higher education and K-12 schools, few projects appeared to be driven by school needs. Building partnerships takes time. Yet to accomplish needs-based PD design, partnerships must be in place during the design phase of the PD program. Proactive partnerships can focus PD activities on the specific needs of their schools, can support follow through after summer institutes end, and can facilitate evaluation processes. Only three projects

included school-based personnel as PIs as they planned and implemented their projects; four projects included no school-based persons on their instructional team. Perhaps partnerships are represented in ways other than membership on project staff. However, the evaluation team believes that many projects could benefit by closer relations with their school-based partners.

Partnerships within higher education. Furthermore, even though the Cycle 2 RFP called for a partnership between the Arts and Sciences unit on a higher education campus and the Teacher Preparation unit, two projects did not include a university educator on their teams. A stronger link between scientists with strong content knowledge and education faculty who understand the nature of K-12 classrooms could benefit some projects. Education faculty can help with curriculum alignment to state standards, quality control of staff and teacher-developed lessons, classroom management ideas, and classroom-based assessments. In some projects, participants noted a disconnect between PD ideals and classroom realities. Teachers encountered constraints when trying to implement inquiry-based strategies in their classrooms (time, equipment, teacher knowledge/skill); project staff need to understand and address these constraints.

Graduate course or professional development? Though all projects provided graduate credit to participating teachers, we note that PD PIs (and participants) have differing perspectives on the kinds of learning experiences delivered and the kinds of expectations demanded. Some summer institutes operated much like extended "teacher workshops" while others looked more like rigorous upper-level college courses in science disciplines. This difference in orientation was accompanied by differences in the emphasis placed on various PD goals, expectations placed on participants for completing assignments outside class time, rationales used to justify content selected for teacher learning, and instructional methods. In projects that we perceived to be more like graduate science courses, participating teachers assumed the role of student and improving understanding of science concepts and their applications appeared to be the primary goal. These projects included some learning experiences aimed at helping teachers improve their teaching, but there was less time and energy devoted to discussions of how activities and other instruction related to specific science concepts could be implemented in teachers' classrooms.

Projects that we characterized as more like teacher workshops placed fewer "graduate course" requirements on participating teachers (such as outside reading, homework, or other assignments not linked to classroom implementation). Participants were expected to engage in the activities and discussions that comprised the PD learning experience, but little outside academic study was required of teachers. Participating teachers were allowed to assume the role of practicing professional and more institute time and energy were invested in soliciting their ideas about how topics and activities could be integrated into classroom practice. The primary purpose of projects exhibiting this orientation was for teachers to take ideas and activities learned during the PD experience back to their classrooms, implement them appropriately, and then reflect on how well the instruction achieved desired goals. These projects included elements designed to improve science content knowledge, but generally the purpose of such learning was couched in terms of improving teaching practice. Achieving a balanced orientation would appear to provide the best opportunity to optimize teacher learning, improvements in teaching practice, and ultimately, student learning in science. PD participants should be accountable for learning science content and pedagogy and should be expected to determine how to apply what is learned and assess the results of that implementation.

Implementing best practices in PD. Increasingly, funding agents demand that PD projects incorporate research-based best practices in teaching and in the design and delivery of PD

itself. Each of the Cycle 2 projects aimed to help teachers implement inquiry-based strategies in their classrooms. However, the degree to which inquiry was represented across the PD projects and their staff members was variable. First, although several projects used a learning cycle/5 E approach to model inquiry, instructors often emphasized the beginning stages of engaging and exploring, and did not get to the end of a cycle, where teachers would be engaged in explaining, justifying explanations, and assessing learning. Second, the critical features of inquiry are often not made explicit by the PD instructional staff. This occurred most often in activity-driven or concept-driven approaches. The lack of explicitness was also observed in the lesson-planning component of several PD projects. Typically, PIs did not make their expectations for the lesson planning clear, nor did they provide much guidance, feedback, or opportunities for revision of the plans. This could be a role for the university or K-12 educators who are members of the PI/staff team in future projects. Third, the views of inquiry held by different members of the instructional staff in an individual PD project were sometimes not cohesive. Participants recognized when some members of the instructional team used didactic instead of inquiry-based approaches and were less satisfied when that occurred. The cohesiveness of the instructional team is thus a critical feature of effective PD.

Follow-up activities. The Cycle 2 PD projects varied greatly on the school year follow-up component. This variability sometimes existed within the same project, when teachers from different grade levels or schools would participate in different types or amounts of follow up activities. Teachers who participate in PD benefit from continuing support of their efforts to implement new ideas and strategies. Not all PD project goals can be accomplished in a short summer institute; school year follow ups can extend teacher learning in a job-embedded context as teachers learn from their teaching and their students' learning. The more effective PD projects found ways to support teachers through providing time to reflect on practice, access to classroom materials and equipment, classroom observations and giving feedback, and group meetings where teachers networked with their peers to share experiences, best practices, and assessment ideas.

Learning to teach science is a lifelong process. Professional development is a key strategy in helping teachers to become more effective so that their students can understand science more deeply, enter science-related careers, and become informed citizens. Cycle 2 PD projects displayed a number of innovative strategies for helping teachers learn. However, the external evaluation also uncovered several areas in which PD projects can improve. In the final section of this report, we make recommendations for PD directors, external evaluators, and the MDHE to build on what we have learned in the spirit of continual quality improvement.

Recommendations

Based on the results reported in the individual project profiles and in the Results section of this report, as well as our experiences conducting Cycle 2 evaluation, we offer the following recommendations for future funding cycles of the *Improving Teacher Quality* program. The recommendations are divided into three sets: recommendations for project directors, recommendations for evaluators, and recommendations for the MDHE staff.

1. For PIs:

- Build stronger partnerships with K-12, beginning with the design of the PD project. This partnership might include K-12 personnel as Co-PIs or instructional staff on projects. Be sure that the PD is aligned with school needs, curricula, and classroom realities. Teachers

need to learn science that is relevant for their teaching (i.e., linked to grade level expectations).

- Capitalize on stronger partnerships with K-12 to identify measures of teacher practice and student learning that can be collected during the school year to provide evidence of outcomes associated with PD participation. When the purpose and focus of PD is aligned with the needs of partner schools, then assessing outcomes associated with PD can inform both partners.

- Build stronger working relations among the PIs and instructional staff. Scientists and educators should capitalize on the expertise of each group in providing high quality PD for teachers. Instructional teams should be cohesive in terms of their views of inquiry, vision for the PD, and implementation strategies. All members of the instructional team should explicitly model the pedagogical strategies that support the project goals.

- Use incentives for teachers to encourage attendance at all PD events and implementation of project activities. One recommendation is to break stipends into two payments, one at the end of the summer institute and one at the end of the PD project, based on attendance, participation, and follow through.

- Balance content and pedagogy. Teachers need to learn science content while they explore methods for helping students understand the science content. The two learning goals should not be separate, but integrated throughout the PD.

- Provide greater emphasis on assessment techniques that are aligned with content goals and inquiry methods. Expect teachers to use these techniques to gather data about their students' learning to improve their teaching and to report on the outcomes of the PD. We also suggest that teachers share results of assessments and review samples of student work to improve their ability to identify misconceptions in student thinking and to more accurately assess learning.

- Incorporate purposeful discussions of the desired outcomes, appropriate contexts, and elements of success for various instructional techniques and strategies modeled during PD. Being explicit about the strategies that various instructional staff members use can lead to greater teacher learning.

- Provide more direct expectations for teachers about post-summer institute activities (e.g., lesson writing, amount and timing of implementation, attendance at follow ups, sharing at follow ups). This means that the PIs and instructional staff will need to establish a clear design plan and communicate it to teachers. More guidance and quality control of lesson writing is essential.

- Support job-embedded PD throughout the academic year, allow opportunities for teachers to reflect on their own practice and share with others, create ways for teachers to develop lessons that adhere to standards and characteristics in alignment with inquiry science teaching, and provide feedback to teachers on their progress.

- Consider the expectations for graduate credit and grading for PD participants, and make these expectations clear.

- Integrate the completion of evaluation instruments into the PD schedule, and encourage teachers to complete the instruments. If teachers understand the value of project evaluation, perhaps response rates will increase.

2. For Evaluators:

- Explore ways to reduce the time and effort required to complete evaluation instruments. This should include reviewing the purposes and usefulness of various measures employed and identifying those data that provide information useful to PD providers, partner schools, and MDHE

- Allow for paper and online versions of instruments for ease of completion when one method is more convenient for a given project. This should improve overall response rates and reduce attrition in evaluation participants.

- Be proactive in working with participants and their schools about how evaluation efforts and findings might assist them.

- Continue to work with PIs through all phases of the evaluation to help them understand the nature, purposes, and processes of evaluation and develop a collaborative spirit regarding evaluation.

3. For MDHE:

- Disseminate evaluation findings to K-12 schools, as well as potential PIs from higher education institutions. This might encourage more school districts to become partners in the *Improving Teacher Quality* PD program and in accompanying evaluation.

- Make a minimum requirement for total hours of PD (in summer institute and in follow ups) that PIs must document. Since time on task is an important factor in learning, there should be some expectations about the time participants should spend in PD activities, even when there is great freedom in how to structure that time.

Reference

Loucks-Horsley, S., Love, N., Stiles, K. E., Mundry, S., Y Hewson, P. W. (2003). *Designing professional development for teachers of science and mathematics* (2nd ed.). Thousand Oaks, CA: Corwin Press.

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Copies of the full report and the Executive Summary are available at:
http://www.pdeval.missouri.edu/cycle_2.html

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