

**Making a Difference in K12 Math and Science:
Collaboration is the Key to Responding to No Child Left Behind**

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The Engineers Club of Dayton has organized and funded a program to provide Miami Valley math and science teachers with a twenty hour workshop based on the Ohio Resource Center (ORC) online database of materials. The ORC site contains state and national standards, development aids and best practice lessons indexed by grade , subject and state standard. The six workshops conducted to date have produced excellent results.

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Collaboration is the Key to Responding to No Child Left Behind

No Child Left Behind (NCLB) requires statistical evidence that students are improving their content mastery. Each state department of education is developing procedures to obtain those measures. While these measures are being developed, teachers are becoming anxious that more classroom instructional time will be sacrificed to standardized testing in order to provide data for school reports. In addition, teachers are spending hours of their personal time and their school planning time developing strategies to teach students how to be successful test takers. Issues surrounding “teaching to the test” are major concerns for teachers and administrators that affect instructional time, content depth, curriculum planning, and the scope and sequence of content as teachers prepare their yearly courses of instruction. How can teachers do what they were trained to do – teach – and respond to increasing demands to prepare students for multiple high stakes tests? The Engineers Club of Dayton, Ohio, the Ohio Resource Center (ORC) and a mathematics education professor joined forces to organize workshops that would help teachers learn to use a new internet resource and to analyze their practice with data from their students’ work.

Most states require teachers to pass standardized tests such as the Educational Testing Service qualifying tests Praxis I, II, III or the Interstate New Teacher Assessment and Support Consortium (INTASC) to prove that they know their content and how to present that content to students. Passing these tests is required prior to being licensed or certificated by state departments of education. Teachers continue with their professional development by obtaining a master’s degree while they are teaching. Professional training focuses on knowing the learner, providing a proper environment, presentation of lessons, and professional relationships and development (Danielson, 1996; Lasley, 2001). The intent of the federal legislation, NCLB, required yearly standardized testing to measure student achievement. However, as the college entrance examinations scores have been used for more purposes than the design intended, such as measuring the academic achievement of high schools and school districts, teachers know that the results of high stakes testing will be interpreted in ways yet to be identified or explained to school districts. Thus, it is imperative that teachers understand: 1) how to collect data about their teaching; 2) how to analyze that data to improve their practice; 3) how to measure student success using data analysis. This workshop adapted the Japanese lesson study model (Pong, Chik, Tang, n.d.)

(http://iediis4.ied.edu.hk/cidv/webdata/documents/medward202p1math/medward202p1m_report.pdf) to lessons selected from the ORC to enable teachers to collect and analyze data regarding their teaching strengths and areas that need improvement as well as to help them analyze student achievement.

Background

The collaboration of educational groups, a professional business group, and a university mathematics educator created this series of professional development workshops. Each group brought an essential element to the project that was valuable as a single entity, but potent when put in combination. The collaborators were the ORC, the Ohio Mathematics and Science Coalition, the Ohio Board of Regents, the Dayton Engineers Club, and the University of Dayton. The collective wisdom of these groups produced a workshop that enhances student achievement through teacher professional development.

The Ohio Board of Regents, at the suggestion of the State University Education Deans, established a unique system for teachers to access best practice lesson plans in mathematics, science, and reading naming that system the ORC. The ORC mission is to provide peer-reviewed best and promising practice lesson plans for mathematics, reading, and science instruction. When posted lessons link to a question from the National Assessment of Educational Progress (NAEP) test, a hotlink to the NAEP web site is available. All lessons are linked to state and national standards. Video clips of lessons are available on many of the website connections that allow teachers to see the selected lesson presented to a class. The ORC is a web site that anyone with access to the internet can reach at www.ohiorc.org.

The Dayton Engineers Club is a professional organization that promotes mathematics and science through multiple community service projects. Through the intervention of the Ohio Mathematics and Science Coalition, an independent advocacy group from business, education, and government that works to improve PK -16 mathematics and science education for Ohio, the ORC, and the Dayton Engineers Club were introduced. The groups joined forces to provide funding to train teachers in the use of the ORC. The university faculty member created the delivery method of a monthly workshop that met for three to four times. The workshop trained teachers in the use of the ORC and to strengthen teachers' skills to analyze classroom practice using databased decisions.

Lesson study in its classic form is the development of a lesson over an extended time period with input from multiple teachers. Lewis (2002) summarized the lesson study format as a spiral in which teachers present and perfect a specific lesson. The cycle of development starts with teachers' recognition of the learning styles of their students. It moves to the development of a lesson that presents specific content while addressing those identified student needs. The teacher presents the lesson with peer reviewers observing. A review of the student responses is done by the peer reviewers. A discussion of the lesson elements for effectiveness and those parts of the lesson that need to be changed occurs after the lesson presentation. A number of teachers in the group present the same lesson and with each presentation, a review process happens.

Japanese lesson study (web site) dealt with one lesson presentation by a single teacher. There is a collection of data starting with the lesson pretest that demonstrates student prior knowledge on the content presented. A posttest is given and the results are compared to the pretest scores.

Analysis of the results provides the teachers with information about which aspects of the content the students grasped and which need further examination.

Methodology

The main purpose of this project was to provide professional development focused on the use of technology, collecting data and analyzing data. This workshop was designed for teachers to create their own means to collect data on student learning and on their teaching using technology and data analysis within a limited timeframe. The design of the project combined two pedagogical methods with a technology resource: the use of Japanese lesson study; the pretest-post test methodology; and lesson plans from the ORC. In the first meeting, the focus was on using technology to enhance student achievement. The teachers were introduced to the history, purpose, and functions of the ORC web site. The workshop required each group of teachers to develop two lesson plans with all the data collection points and reports. When searching the ORC web site, the teachers found a lesson pertinent to their curriculum. The teachers discussed learning styles and preferences of their students that required lesson adaptations. A review of the rubric used in the ORC peer review of lessons that qualify a lesson for listing on the ORC web site led to a discussion of the essential lesson elements that need to be present to qualify the lesson as best practice. The second meeting focused on data analysis. Scored pretests and post tests were brought to the second session. From their first developed lesson, the group reviewed: the use of spreadsheets; how to record data; and how to produce charts to demonstrate data results. The final session centered on using the collected data in reportable formats. The teachers shared the second lesson that they taught, their data analysis, conclusions that they reached about student achievement and their teaching methods. The lessons learned during teacher collaboration moved teachers to examine their individual analysis of where they used best practices and helped them to address the learning needs of more students. According to the pretest and post test graphs these lessons increased the achievement levels of their students. The purpose of this project was to share with teachers an effective means of using technology to increase student achievement, collect data, analyze that data and peer review of their pedagogical methods of teaching the material. The sole source for lessons was the ORC web site. Teachers were required to review their curriculum sequence and their daily content pacing charts to select two timely lesson plans from the ORC web site, which the teacher groups would develop for their students.

Participants

The workshop was presented twice in an urban school district and once in a suburban district in 2003. Approximately 65 teachers attended these programs. On the first day of the workshop, after a brief definition of the workshop and the ORC components, a questionnaire was administered to gather data regarding the prior knowledge the teachers had about: the ORC, using computer programs, application of academic content standards to lessons, and demographic information. The mathematics educator used this information to tailor the workshop to the needs of the attending teachers. She focused the grade level web sites, academic content standards, and grouping of the teachers on the majority grade level represented at the workshop.

The school districts chose the focus population of middle school teachers for participants in the workshops. There were several secondary level teachers and special needs teachers in attendance. While the teachers' primary content area was mathematics, other content areas were represented such as science, reading, and health. All participants were volunteers who were awarded with course credit or funds for classroom materials for participation. The teachers ranged in years of experience from first year teachers to those who were in their 32nd year of the profession. The mean number of years of experience was 14.2 years of classroom teaching. Thirty of the teachers were at the bachelor's degree level and 35 held master's degrees. There were very low numbers of males in each group. The first group had 10% males, the second group had 8%, and the last group had 20% male participants. Of the 65 participants, 24 teachers reported that their best computer access was their home computer with 41 teachers preferring to use their school computers. Slightly more than half of the teachers had knowledge of the ORC web site prior to the workshop. Forty-seven of the teachers were interested in using the whole lesson plan found on the web site; whereas only 18 viewed the web site as a source of lesson parts. All the teachers identified the importance of the ORC linking lessons to academic content standards as helpful to their lesson planning.

Procedure

The workshop was designed to encourage teachers to use pedagogical methods that are best for students and to collect valuable data that would lead to productive reflection on student achievement and the practice of the teachers. The workshop began with a discussion focused on what constitutes best practice for teachers of mathematics, science, and reading preceded by an overview of the rubric used by ORC lesson reviewers to classify lessons. Before moving forward to using the internet, the teachers were encouraged to work with partners or in groups in order to have conversations about their presentation and how the lessons were affecting student learning. The teachers went on line to select one lesson that suits their curriculum topics. They modify the lesson to appeal to the needs and backgrounds of their students. From the content of the selected ORC lesson, they constructed a pretest of five to ten questions that were not overwhelming to students, but challenging enough to be used as the lesson content post test. At the end of the first day, the teachers took their pretests and modified ORC lessons to their classes to teach.

Between the first and second sessions, the teachers pretested their students, taught the lesson, post tested their students using their developed lesson content. At the second session of the workshop, the teachers brought in their pretest and post test data. The whole group shared conversations about what lessons were selected, what adaptations needed to be made, how the teaching process progressed, and what content was covered in the selected lessons. Questions were asked freely about presentation styles, depth of content presented, student engagement, the amount of time the lesson took to complete. The teachers shared successes and those lesson elements that were not so successful. Together, we examined what elements were needed for successful presentation of the material and why some lessons were not what was needed for the students they were serving. We reviewed the use of EXCEL spreadsheets regarding how to enter student scores and how to express those results in graphic format. Our discussions at this point

focused on multiple methods of statistical representations. The teachers experimented with data entry and modes of presenting the material graphically. The suggested form for data collection by the Japanese Lesson Study () was to examine each question and identify the problem as right or wrong, allowing for no partial credit. The graphed data was cumulative for the whole class. It identified how many students answered the problems incorrectly. These scores were then graphed for the pretest and the post test on the same graph to display to represent how each tested question changed by improving or regressing in student understanding. The Japanese scoring was done as a whole class. To provide evidence that the teachers could read the graphical information that they created, reporting forms were the final stage of the workshop. The reports were tailored to specific groups. The teachers composed separate reports about the lesson data for administrators, parents, and local professional development committees, which presented and explained the graphical data.

The final session of the workshop was summative. A second lesson was completed, data examined, reports finalized and presented to the group. During the teacher presentations, several web sites were identified as noteworthy and shared with the whole group. Summary statements were written regarding the usefulness of the workshops, and exit surveys conducted.

Results

The teachers participated with great energy. They enjoyed learning new approaches to lesson presentation, data collection and earning their professional development credits while doing work that would enhance their classes. The teachers stated in their exit reports that they were excited to find a web site that would save them time searching for teaching materials that aligned with the Ohio Academic Content Standards and were engaging for students. Some teachers had difficulty using the computers, but with peer assistance and the workshop presenter motivating the teachers, they pushed themselves to learn how to access the ORC, search the site, find and extract lesson plans, and graph the results.

The lesson adaptations made by the urban teachers for their students were cultural and responded to urban student strengths. These adaptations included choral reading, additional group work, and oral reporting formats. The suburban teachers extended the lessons with additional assignments for those in their classes that needed to be challenged. Both groups of teachers added written assignments during the lessons in response to the Ohio Academic Content Standards requirements.

Several teachers were hesitant using the EXCEL program. They never used a spreadsheet program or forgot the procedural sequence for using the program. The workshop provided step-by-step instructions, which the teachers followed using their own student data to create a single graph of the pretest and post test results for each lesson. After practicing with EXCEL, the teachers became comfortable with the system, if not at ease with how to record data and present it in graphical form. The collection and analysis of data was not the final step. Reporting formats were required that would provide detailed information for administrators and parents. The reporting forms were designed to provide data-based evidence that the teachers clearly understood their collected and recorded data. The reporting form for parents required the

teachers to do a great deal of work translating pedagogical information into lay terminology. While these reports took time, communication with parents is key to academic success for students. Providing reports to parents enabled on going communication between parents and teachers about what was happening academically in the classroom and what the students understood about a specific lesson. These reports were clear demonstrations of what the teachers understood of the workshop process and data analysis.

The post workshop questionnaire consisted of the following statements that were responded to by circling Yes or NO (with the exception of statement #2):

- 1) The Ohio Resource Center web site helps me develop lesson plans focused on standards.
- 2) The lessons found on this web site match my students' learning levels
 - a. Perfect match
 - b. Close match
 - c. Need some additional work by me
 - d. Need a lot of work by me
 - e. No help at all
- 3) The lessons on the ORC can be used for measuring student learning.
- 4) Lesson study is a tool that I plan to use in the future.
- 5) I would recommend the ORC to other teachers as a resource for lesson plans.
- 6) I can calculate my pretests and post tests on a graph for comparison purposes.
- 7) I can interpret my student data in order to report increases/decreases in student learning.
- 8) Working with another teacher made this experience better.
- 9) I plan to use the ORC lessons in my lesson planning.

Almost all 65 teachers responded to each question with a Yes response except question #2. The participants selected *b. Close Match* as the most common response to question #2. Selection *c. Need some additional work by me* was the second preferred response.

The Dayton Engineers Club and the ORC requested that the participants write comments on the pertinence of the workshop to their teaching. The comments generally fell into four categories: ORC comments (ORC Lesson Plans), use of lesson study format (Lesson Study); how teachers plan to utilize the information from the workshop (Utilization); how the workshop encouraged teacher interactions and camaraderie (Camaraderie). These four categories were listed on the following chart to share with National Council of Supervisors of Mathematics (NCSM) members what the teachers' opinions were of this extended type of professional development that involved classroom practice, subsequent review, and reflection on the data that represented student learning and teacher lesson presentation.

Table 1. Teacher Comments at the conclusion of the workshop

ORC Lesson Plans	Lesson Study	Utilization	Camaraderie
1. I thought best practice lessons would be more complete.	1. The lesson study format taught to us will be a boost to my professional development.	1. I will definitely continue to use the ORC.	1. Teachers need to know that there are people that care and support them.
2. The workshop provided a wealth of resources for teachers.	2. The workshop provided excellent opportunities for teachers to brainstorm lesson plans and their components.	2. I will share the ORC with my department.	2. The workshop provided collaboration among teachers to share and learn across the curriculum.
3. I have seen a lot of lesson plans, but the ORC are the best.	3. I can actually go into my computer and do graphs on each student.	3. I hold myself accountable to present this material to my department.	3. The workshop brought together teachers socially and in sharing academic ideas.
4. My students were impressed with the information I found in the lessons.	4. The ability to analyze the results will be of great value.	4. Using best practice lessons will better prepare students for their futures.	4. It is enjoyable to view the lessons of others and to adapt them to the needs of my students.
5. The ORC offers lessons rich in content and links to others.	5. I feel this will take time to get use to.	5. Directly utilizing so much information from the web was awesome.	5. Workshops are sometimes the only time that I can associate with other math teachers in the district.
6. The ORC is useful in giving teachers ideas to write their own standards-based lessons.	6. It was helpful in representing student data graphically to see gains in learning.	6. Basically, I will use this workshop as a catalyst to use the internet.	
7. It was beneficial to see what resources are available to them to reduce their time creating lessons.	7. By doing a lesson study, teachers can look at areas for remediation and plan activities.	7. Teachers need to share this information with their colleagues and students in order to improve the whole educational process.	
8. I thought the ORC lessons would have pretests and post tests in each lesson.	8. The refresher on plotting in Excel was most informative.	8. I plan to continue to communicate my findings to administrators and parents.	
		9. As department chair, I plan to share the ORC with my teachers and encourage their use of it.	

Discussion

The question to be examined in the future should focus on: Did the teachers who attended these sessions continue to use the format presented to examine their teaching and their student learning? The teachers who took part in these workshops could be surveyed in a year's time to be asked if they employed the methodology presented in this workshop and, if so, how did they use the process, for what purpose, and what modifications did they make to the process to best serve their purposes? Darling-Hammond, et al () have noted that professional development can not be done in a one shot experience if new applications to pedagogical practice are to become embedded in daily practice. The collaborators in this project recognized the importance of working over time to help teachers develop habits of mind that would lead to enhanced professionalism and higher student achievement. The Dayton Engineers Club and the ORC donated their monies based on this workshop having multiple sessions to train teachers how to use a new technology resource and examine its effectiveness using data. Specifically, developing new applications and techniques over time, practice with those techniques to perfect their use, and the applications of the new materials to their teaching styles required several sessions. The university faculty member who developed the workshop content was well aware of the background research on effective professional development for teachers having completed three earlier studies on the Local Professional Development Committees in Ohio (O'Connor & author, 1999, author & O'Connor, 2003, author & O'Connor, 2004). Many teachers commented that the workshop was the most productive one they had attended. The collaboration of the business, government, and educational communities resulted in a workshop that enhanced teacher professional development and demonstrated to teachers that they are valued by the community.

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