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USING TEACHER ACTION RESEARCH IN HIGH SCHOOL CHEMISTRY TO DEVELOP NOVEL ASSESSMENT TOOLS

Chad Husting

Sycamore High School, Cincinnati, OH

Jordan Harshman, Ph.D.

University of Nebraska - Lincoln

Ellen Yezierski, Ph.D.

Miami University

Abstract The analysis of three years of reflecting on teaching practices in a blog lead a teacher to realize that assessment plays a critical role in day to day teaching and could be improved in his classroom. The literature does not provide very much on the "nuts and bolts" of using assessment data to inform teaching; however, data-driven inquiry provides a useful framework for addressing this problem. A method and tool were developed to facilitate rapid and meaningful student data collection, scoring, and instructional decision-making in a high school chemistry setting. The tool captures groups of students' knowledge, understandings, and misconceptions at the beginning of the year in an efficient and effective manner by leveraging easily accessible software (Excel). The student data are linked to tested and research-driven curriculum materials with a strong basis in chemistry education theory. The assessment methods and tool, its impetus, design considerations, functionality, and implementation are described with hope of introducing teachers to approaches that can improve how they coordinate assessment with curriculum and instruction to improve student learning.

Keywords: assessment, formative assessment, data-driven inquiry, teacher action research, collaborative action research, blogging, qualitative analysis, high school, science, chemistry

Introduction

For almost one hundred years, critical reflection on teaching has been noted as one of the most important processes for improving instruction (e.g., Dewey, 1933; Yost, Sentler, Forenza-Bailey, 2000). Recently, scholars have examined web logs or “blogs” as tools to promote and facilitate teacher reflection (Ray & Hocutt, 2006; Loving, Schroeder, Kang, Shimek & Herbert, 2007; Killeavy & Moloney, 2010; Luik, Voltri, Taimalu & Kalk, 2011). Although blogs have been shown to be good for critical events, they may not elicit deep reflection without explicit prompting (Wopereis, Sloep & Poortman, 2010). Blogging has also been used as a research tool in ethnographic fieldwork (Saka, 2008), which provides a useful framework for the analysis of teacher blogs. This study incorporates blogging and qualitative analysis within the framework of teacher (or action) research, which has been shown to be a highly effective means of promoting teacher growth and has been a common component of professional development (e.g., Lytle & Cochran-Smith, 1992).

Literature Review

In Tobias and Baffert’s work (2009), they have recently highlighted the need for elevating the professional status of science and mathematics teachers. Action research may also be a vehicle for this end, as teacher research has been viewed by Burton and Bartlett (2005) and Zeichner and Noffke (2001) as a highly effective means of collaborating with teachers to improve their professionalism and the status of the teaching profession in general. Zeichner and Noffke (2001) also found that teacher research contributes to the knowledge base. Such findings suggest that action research can produce many intellectual and social benefits to the teacher as well as their students and the academic community. The similarity between teaching and research has been called out by Huberman (1996) and Freeman (1998) and has recently framed a key work by Meijer, Oolbekkink, Meirink, and Lockhorst (2013). Meijer *et al.* (2013) describes how the linkages between teaching and research parallel key ideas in higher education first introduced by Boyer (1990) who coined “the scholarship of teaching of learning” thus expanding the traditional idea of research as only the scholarship of discovery to four areas. Coppola, Banaszak Holl, and Karbstein (2007) describe how teaching and research are integrated and informed, intentional, impermanent, and inheritable. However, when the researcher is not the classroom teacher, much can be missing from the research. Teachers have the knowledge of the students, classroom, and school environment as well as the needs of all stakeholders including themselves (Meijer, Oolbekkink, Meirink, & Lockhorst, 2013). To improve teacher learning, research quality, scholarly impact, authenticity, and impact on students, collaborative action research, in particular, is highly valued (Meijer, Oolbekkink, Meirink, & Lockhorst, 2013), in which teachers work with science education research faculty.

The study here details a collaborative action research project carried out by a high school chemistry teacher and a chemistry education research faculty member and graduate student. The study was guided by Anderson and Herr’s (1999) five validity types for practitioner research (outcome, democratic, catalytic, dialogic, and process validity) with a major emphasis on outcome validity, “whether the research undertaken leads to outcomes for teachers and for the school." As such, we will not only present the methods and findings of the study in a traditional manner, but we also reveal the major consequence of the knowledge generated by this collaborative endeavor. The aim of this last piece is not only to demonstrate outcome validity but also is to provide a rarely seen product in reports of action research. The description of how the teacher responded to the research findings and the product inspired by the findings are presented at the end of this article.

The impetus for the action research project theoretically lies in increasing the quality and quantity of teacher reflection (Dewey, 1986). Specifically, how employing descriptive, critical, and comparative reflection (Jay & Johnson, 2002), can help teachers identify, unpack, and overcome important classroom learning problems. The impetus for the project more practically comes from the first author's participation in the Master Teacher Program sponsored the state of Ohio. Teachers were provided time to meet in groups throughout the year to create portfolios. The portfolios focused on evidence that examined what the teachers were doing before, during, and after a lesson to help students. It also focused on evidence that demonstrated communication with students, parents and community involvement. The following year, in attempt to continue reflecting on teaching and documenting evidence for student learning, the first author began creating blog entries focusing on the same themes from the master teacher program the previous year. Each blog entry focused on examining, constructing, and developing evidence that demonstrated student achievement in the classroom. Another major influence for teacher change and reflection in the blog was the author's participation in the Target Inquiry Program at Miami University, Oxford Ohio (TIMU). This was an intensive two and a half year program funded by the National Science Foundation. It focused on chemistry teachers doing the scientific process and translating this into their teaching by developing and implementing inquiry labs and studying their impacts on student learning (http://targetinquirymu.org/).

Methodology

The research question that guided this study was: How can a teacher researcher's qualitative analysis of blog entries be used to focus instructional improvement strategies?

Setting. This study was carried out at a suburban public school in southwest Ohio. Of the approximately 1800 students, 73% of the students are White, about 8% are Black, about 10% are Asian/Pacific Islander, about 3% are Hispanic and about 5% are two or more races. The instructor (first author) has a master's degree and is considered "Highly Qualified" by the State of Ohio. He has 24 years of teaching experience, mostly in chemistry. Over the course of this study (3.5 years), the teacher schedule consisted of two classes of Accelerated Chemistry and three classes of Academic Chemistry. Accelerated Chemistry students were primarily tenth graders with a few eleventh graders who were considering future science classes in high school and college. The Academic Chemistry classes consisted mainly of eleventh graders with a few twelfth graders who are college bound but not necessarily considering taking science classes in their future.

Data Collection. Beginning in 2011-12, the first author began writing a weekly blog responding to these questions:

1. What am I doing to help kids achieve?
2. How do I know when they are there?
3. What is the evidence?

The blog entries were posted on http://simpleteach.blogspot.com/ and aimed to be more than a personal reflection because they focused on the evidence used to reach conclusions about and the teacher's role in student learning. There were 97 entries (averaging 329 words each) collected between December 2012 and June 2015.

Data Analysis. The blog entries were printed and read multiple times. With collaboration from a first year college student, entries were placed into categories. The first author generated category names and descriptions to serve as codes. Each entry was coded such that it had exactly one code assigned to be most descriptive. Approximately 10% of the entries were coded by the third author and found that the descriptions were not detailed enough to attribute only code to each blog entry. As such, the first author revised the descriptions and selected 12 random blog entries. These entries along with the category names and descriptions were given to a new rater. Ten of this rater's assignment of entries to categories matched with the first author's assignments for this subset of the data corpus. The final category names, descriptions, and frequencies of occurrence in the data set are found in Appendix A. In subsequent analyses, we grouped the categories into themes. The emergent themes describing the data are presented in the Results.

Results and Discussion

The researchers grouped the codes into themes based on the Data-Driven Inquiry (DDI) framework. These themes represent the products of three of the four steps of the DDI process: assessment (collect evidence), reflection (make conclusions), and activities (take action). Although goal determination is a critical part of the DDI process, the blog entries did not focus on curriculum, which is likely why this theme did not emerge in the data analysis. Figure 1 displays a concept map that shows the connections among the blog entry categories and questions guiding the blog and how they are subordinate to major emergent themes.

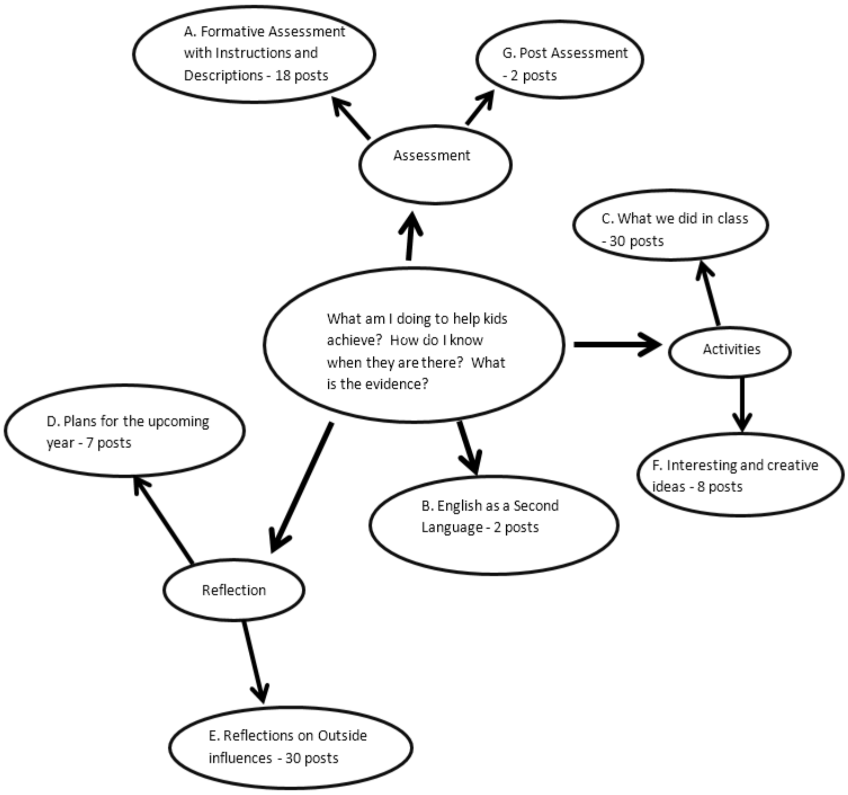


Figure 1: Concept map of blog questions, categories from coding, and emergent themes. A much more detailed concept map of block entries may be found in the supplemental information.

After examining 97 blog entries and the most frequently occurring categories, assessment emerged as a major theme. As such, the first author chose this as a focus for instructional improvement. This choice is strongly aligned with the Next Generation Science Standards, which are built upon the expectation that teachers must rely on assessment information that guides instruction (National Research Council, 2012). Specifically, he wanted to find a way to create formative and summative assessments in the most effective and efficient way possible. This was particularly timely since during the 2014-15 school year students were subjected to a significant increase in state mandated assessments. The challenge identified by the qualitative data analysis process was to improve assessment without increasing time spent on formal assessment activities. This warranted applying a new theoretical and practical lens to this initiative, and data driven inquiry served this need.

Viewing Results through the Lens of Data Driven Inquiry (DDI). Data from our own students is one of the best sources of information for us as teachers to make instructional decisions. This process is familiar to most teachers, and in a recent literature review has been described (Harshman & Yezierski, in press). The process goes by multiple names in the literature (U.S. Department of Education, 2008; 2011; Institute of Education Sciences, 2009; Calfee and Masuda, 1997) but will be referred to as Data Driven Inquiry (DDI). The steps are:

1. Determine goals.
2. Collect evidence.
3. Make conclusions.
4. Take Action (Harshman & Yezierski, in press).

Although there seems to be an abundance of research that shows that teachers should use data driven inquiry, the practicality of implementing the use of assessment to inform instruction on a day to day basis has not been well studied (Harshman & Yezierski, 2014, Harshman & Yezierski, in press). Although 20 out of 97 blog entries directly pertained to assessment, examination of the other categories (particularly what we did in class, plans for next year, and interesting and creative teaching ideas) in light of a DDI framework shows how assessment was pervasive in the data set. This is not surprising upon a re-examination of the questions guiding every blog entry:

1. What am I doing to help kids achieve?
2. How do I know when they are there?
3. What is the evidence?

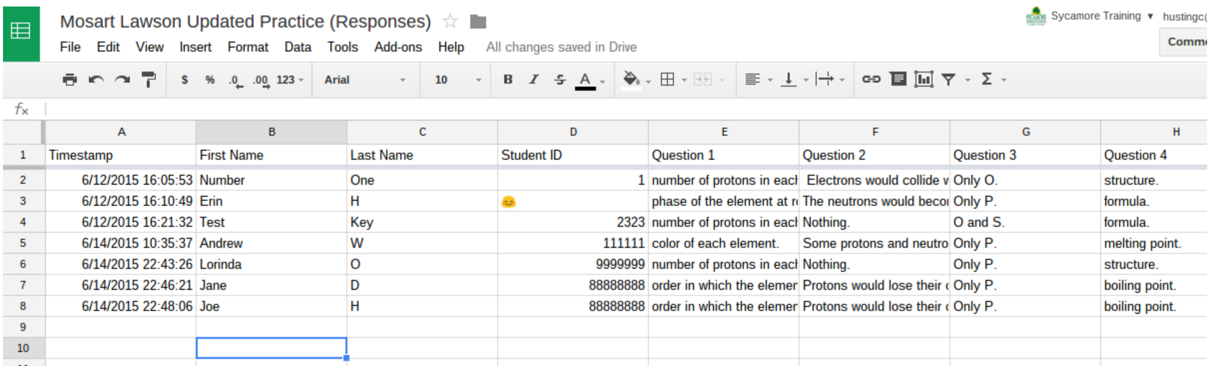
The similarities among the above questions and the components of DDI highlight how the first author has converged on assessment as a means to improve overall instruction. With the DDI process in mind, we have developed a tool to improve teaching and learning with an assessment focus.

Using Results: Developing a Tool to Meet Need Identified in Blog Analysis. The following considerations, which emerged from the analysis of the blog entries, guided the development of a tool to effectively and efficiently collect and use student data. The goal was to identify and use high quality assessments developed through research that could be delivered to students in such a way that scoring was quick and the collation/analysis of data enabled the teacher to put results to use immediately.

Assessment: First, the aim was to select multiple-choice chemistry questions that could evaluate conceptual knowledge (a higher level than just rote memorization). Questions that could provide information about a student's developmental level were particularly desirable, and it was essential that questions were aligned with the content and goals of the chemistry curriculum of the school and district. As mentioned before, it was also critical that the assessments were developed based on sound educational theory and evidence. The three tests used were the Lawson Classroom Test of Scientific Reasoning (LCTSR) (Lawson, 1978), the Chemistry 9-12 Misconception Oriented Standards Based Resource for Teachers (MOSART) from the Science Education Department of the Harvard-Smithsonian Center for

Astrophysics (Sadler, Coyle, Smith & Miller, 2006), and two-tiered chemistry questions that directly aligned with the curriculum to be taught.

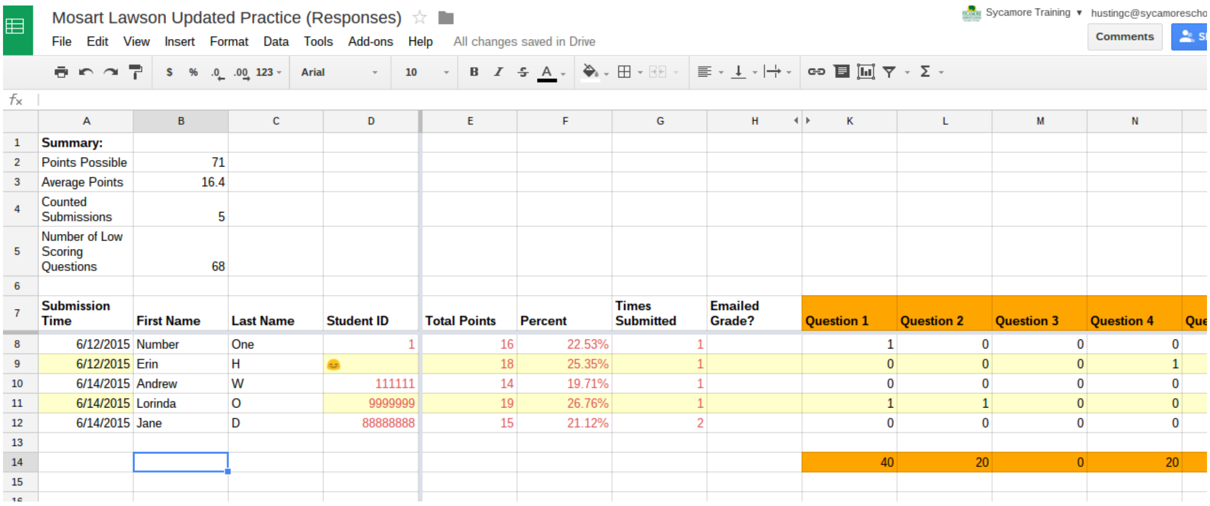
Efficiency: The next step was to develop a method of delivery. Pen and paper, Scantrons and “bubbling in” answers is time consuming and cumbersome. A fast, effective, inexpensive method that that would provide quick and reliable student data was needed. Permission was granted from test authors to develop electronic versions of the LCTSR and MOSART tests as long as they were secured. All of the questions from the two tests and the other questions developed were written into a single Google Form. Advantages to this method are the link can be easily and securely shared with students, it works on multiple devices, and the teacher can easily collect responses into a Google Sheet. Another advantage to the Google Form is that there is a free add-on called “Flubaroo” (https://chrome.google.com/webstore/detail/flubaroo/mjkbmijfpphoabkogbdmdkolcnaenaia?hl=en-US). As students submit their data, the Flubaroo add-on grades it instantly. The graded sheet by Flubaroo provides a teacher with possible points, average points, and time of submission. An excerpt of student responses in the Google Sheet (Figure 2) is followed by a sample of the graded Flubaroo sheet (Figure 3).



Mosart Lawson Updated Practice (Responses)

	Timestamp	First Name	Last Name	Student ID	Question 1	Question 2	Question 3	Question 4
2	6/12/2015 16:05:53	Number	One	1	number of protons in eacl	Electrons would collide v	Only O.	structure.
3	6/12/2015 16:10:49	Erin	H		phase of the element at r	The neutrons would becoi	Only P.	formula.
4	6/12/2015 16:21:32	Test	Key	2323	number of protons in eacl	Nothing.	O and S.	formula.
5	6/14/2015 10:35:37	Andrew	W	111111	color of each element.	Some protons and neutro	Only P.	melting point.
6	6/14/2015 22:43:26	Lorinda	O	9999999	number of protons in eacl	Nothing.	Only P.	structure.
7	6/14/2015 22:46:21	Jane	D	88888888	order in which the elemer	Protons would lose their (	Only P.	boiling point.
8	6/14/2015 22:48:06	Joe	H	88888888	order in which the elemer	Protons would lose their (	Only P.	boiling point.

Figure 2. Raw response data from two tests collected with a Google Form and displayed via Google Sheet.

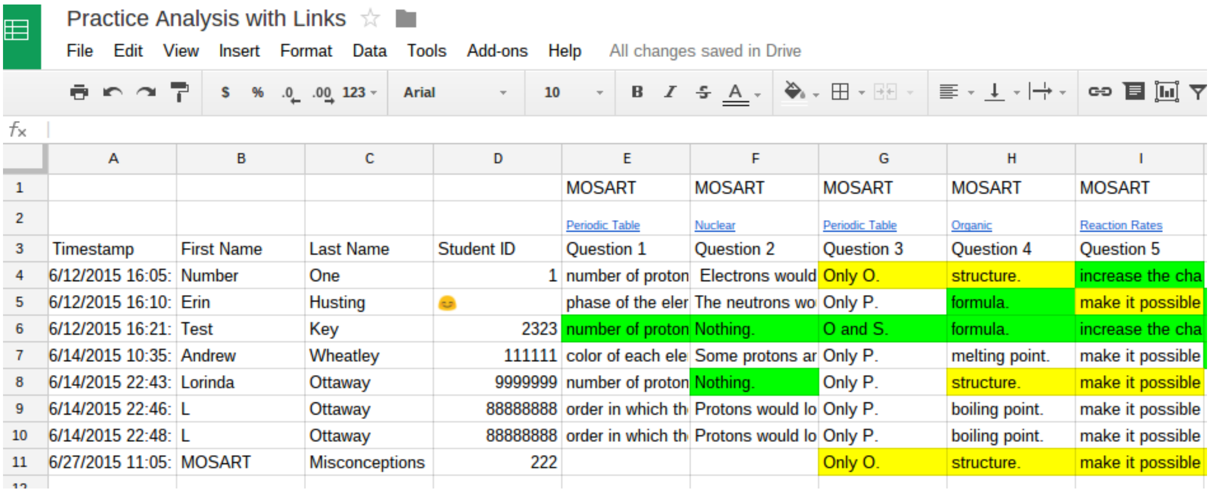


	A	B	C	D	E	F	G	H	K	L	M	N
1	**Summary:**											
2	Points Possible	71										
3	Average Points	16.4										
4	Counted Submissions	5										
5	Number of Low Scoring Questions	68										
6												
7	**Submission Time**	**First Name**	**Last Name**	**Student ID**	**Total Points**	**Percent**	**Times Submitted**	**Emailed Grade?**	**Question 1**	**Question 2**	**Question 3**	**Question 4**
8	6/12/2015	Number	One	1	16	22.53%	1		1	0	0	0
9	6/12/2015	Erin	H		18	25.35%	1		0	0	0	1
10	6/14/2015	Andrew	W	111111	14	19.71%	1		0	0	0	0
11	6/14/2015	Lorinda	O	9999999	19	26.76%	1		1	1	0	0
12	6/14/2015	Jane	D	88888888	15	21.12%	2		0	0	0	0
13												
14									40	20	0	20
15												

Figure 3. Student responses and percentage correct as graded with a key by Fluberoo in the same Google Sheet as Figure 2.

The aforementioned online data collection process reduces time filling out Scantrons, grading them, and preparing to analyze the data by organizing it in a spreadsheet. It is possible to have the graded data before students leave the classroom.

Action. Although the speedy data collection improves efficiency in collecting the data, there needed to be a method to simplify data analysis. Two formatted Google Sheets were developed to automate data analysis. Raw data are cut, copied and pasted in one of the formatted sheets and the graded results from Flubaroo in the other. What makes these new sheets different is the conditional formatting. Figure 4 shows the Raw Data (similar to the information in Figure 2) that has been pasted into the new formatted sheet.



	A	B	C	D	E	F	G	H	I
1					MOSART	MOSART	MOSART	MOSART	MOSART
2					Periodic Table	Nuclear	Periodic Table	Organic	Reaction Rates
3	Timestamp	First Name	Last Name	Student ID	Question 1	Question 2	Question 3	Question 4	Question 5
4	6/12/2015 16:05:	Number	One	1	number of proton	Electrons would	Only O.	structure.	increase the cha
5	6/12/2015 16:10:	Erin	Husting	😊	phase of the eler	The neutrons wo	Only P.	formula.	make it possible
6	6/12/2015 16:21:	Test	Key	2323	number of proton	Nothing.	O and S.	formula.	increase the cha
7	6/14/2015 10:35:	Andrew	Wheatley	111111	color of each ele	Some protons ar	Only P.	melting point.	make it possible
8	6/14/2015 22:43:	Lorinda	Ottaway	9999999	number of proton	Nothing.	Only P.	structure.	make it possible
9	6/14/2015 22:46:	L	Ottaway	88888888	order in which th	Protons would lo	Only P.	boiling point.	make it possible
10	6/14/2015 22:48:	L	Ottaway	88888888	order in which th	Protons would lo	Only P.	boiling point.	make it possible
11	6/27/2015 11:05:	MOSART	Misconceptions	222			Only O.	structure.	make it possible

Figure 4. Graded responses from Figure 2 subjected to conditional formatting in Google Sheet based on these criteria: Green = correct; yellow = popular misconception; white = incorrect.

The sheet shown in Figure 4 is conditionally formatted in a way that allows the teacher to quickly get a sense of multiple aspects of student performances to make teaching decisions based on the data. First, each question column labels the test type. The question is assigned to the type of assessment it came from such as "MOSART," "LAWSON" or "Gen Chem." The next cell down is a word or words that identifies the targeted content topic of that question. If you look carefully, you will notice that each of these words are links. There is a web site (https://sites.google.com/site/simpleinqchem/home) that has a page for each topic. The page provides inquiry activities that have been developed through researched chemistry education principles and teacher tested as discussed earlier. Some of these activities include Target Inquiry from Grand Valley State University and Miami University (TIMU), Process Oriented Guided Inquiry Learning (POGIL, 2012), Modeling and Inquiry labs from reputable sources. The goal was to only use materials that were vetted by educators and researchers. As in Figure 4, cells with student answers automatically fill with colors based on particular criteria. If it is white, the answer is wrong. If it is yellow, this answer has been identified by the authors of the MOSART test to be a popular misconception. If the answer is green, the response is correct.

To compile individual students' results to examine question performance across an entire class, a Flubaroo formatted sheet was constructed using conditional formatting to color code levels of performance by question. The Flubaroo formatted graded sheet (Figure 5) has the question type, content, and link at the top of each question column. It also has a color-coded percentage correct at the bottom. If 75% or greater of the students in the class correctly answered the item, the percentage cell is green. If 40 to 74% of the students score correctly on the item, the cell with the percentage is yellow, and anything below 40% is red.

		MOSART	MOSART	MOSART	MOSART	MOSART	MOSART	MOSART	MOSART	MOSART	MOSART
		Periodic Table	Nuclear	Periodic Table	Organic	Reaction Rates	Nuclear	Nuclear	Energy	Atomic Theory	Reactions
Feedback for S	FOR FLUBAROO	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10
		1	0	0	0	1	0	0	0	0	0
		1	0	0	1	0	1	0	0	1	0
		1	0	0	0	0	1	1	0	0	0
		1	1	0	0	0	0	0	1	0	0
		1	0	0	0	0	0	1	0	0	0
	Per Questions->	100	20	0	20	20	40	40	20	20	0

Figure 5. Conditional formatting by item to examine whole-class performance on MOSART items.

Implications

The assessment tool was implemented in the first author's class in fall 2015. Students took the assessment at the beginning of the year. Since students have experienced visiting a doctor, this analogy was useful in conveying the meaning of a "diagnostic" tool. The doctor or nurse first takes their temperature, blood pressure, height, and weight. These measurements are not necessarily seen as a test. One cannot really "pass" or "fail" any of these measurements, but they serve as diagnostic tools to guide the doctor in providing the best care possible. For the assessment, if everyone does well on the questions about the periodic table, the instructor should respect the students and spend less time addressing what they already know. Setting the proper tone and culture helped students take the assessment seriously.

Once students took the assessment, it was graded with Flubaroo and pasted into formatted google sheets. The DDI framework guided how formatted Flubaroo results were used. First, data from the Lawson test were examined. Heterogeneous student groups were established from their Lawson scores. It has been shown that once a student reaches a developmental milestone, the chances of them changing greatly within a school year are slim (Lawson, 1978). However, constant exposure to the other levels of reasoning might be helpful.

Next, the instructor focused on data from the MOSART and the Gen Chem questions. He spent limited class time on topics in which 75% or more of the class already demonstrated mastery. More instructional time was spent on the yellow questions, ones for which 40-74% of the students earned correct answers. These cutoffs are somewhat arbitrary; however, the green threshold (75%) reflects the percentage of students who demonstrate competency when the first author typically moves on in the curriculum. For anything in red, where less than 40% of the class scored correct answers, the instructor assumes that students know little to nothing and starts with basic ideas. It is encouraged that should any other teacher use this tool, s/he consider percentages that best meet the needs of his/her students.

An example is the instructor response to question 9 on the pre assessment. It is clear from the initial raw data that the majority of students do not know basic information about isotopes. Only thirteen percent of students from all three classes answered correctly. The analysis shows that about half had no idea and half had popular misconceptions. This indicated to the instructor that the content, including common misconceptions, needed to be addressed. As part of the lesson on isotopes, the instructor used a POGIL activity. Students had to not only answer the questions but had verbally respond to instructor "checkpoints."

Next the formatted raw data, particularly the MOSART questions, were examined to use the incorrect answer choices to guide instruction. Popular ideas aligned with misconceptions (formatted in yellow) should be treated differently than incorrect ones (formatted in white). As an example, there is a question that asks students if the distances change between the three atoms of a water molecule when water goes from a solid to a liquid. The correct answer is that the distance does not change. The answer that is a popular misconception is that the distance between the atoms in the molecule gets larger. In the commentary section of the MOSART, test authors note that the relationship between macroscopic changes and microscopic particles is evaluated by this item (Sadler et al., 2006). Clicking on the link "Molecular Shapes" at the top of the column for this question links to a site with several possible activities to teach molecular shapes. The action of the instructor should be to pick an activity that stresses the particulate nature of matter. Not only can the instructor clearly define goals and align them with the curriculum, assessments can be identified and added to the links.

When students are not meeting the objectives of the unit, the initial assessment data can be used on a student-by-student basis. For example, the Lawson test provides information about a student's scientific reasoning ability. If a student is struggling with proportional reasoning in stoichiometry, the instructor may choose to narrow the goal and address some basic skill development around proportional reasoning. Other features of items may provide insights. The MOSART test, along with some of the author-developed general chemistry items, addresses specific levels of chemical knowledge (macroscopic, particulate, or symbolic). As such, the responses to the initial assessment questions may help the teacher identify problematic domains for the students. Since some questions stress one level more than another, the instructor may wish to identify different activities that address the same chemistry topic but emphasize specific levels.

The DDI process requires a careful examination of evidence of student knowledge, making a reasonable decision based on that evidence, and then carrying out instruction that is supported by current chemistry educational theory to be effective. The tool employs these processes and aims to synthesize high-quality assessments and curriculum materials into actions that respond to high-quality student data. We have evidenced the effectiveness of these novel tools by tracking how responses to available questions change from pre (first semester) to post (second semester) administrations. Incorporating the feedback from his own blogs and novel assessment tools, the teacher observed improvements with all but two of his students (Figure 6, left). These differences were statistically significant [$t = 12.3(44)$, $p < 0.001$, $d = 1.8$] and the change in quartiles are shown below (Figure 6, right). These results indicate that students improved their scores dramatically on account of the instruction received, which contained the novel tools discussed here.

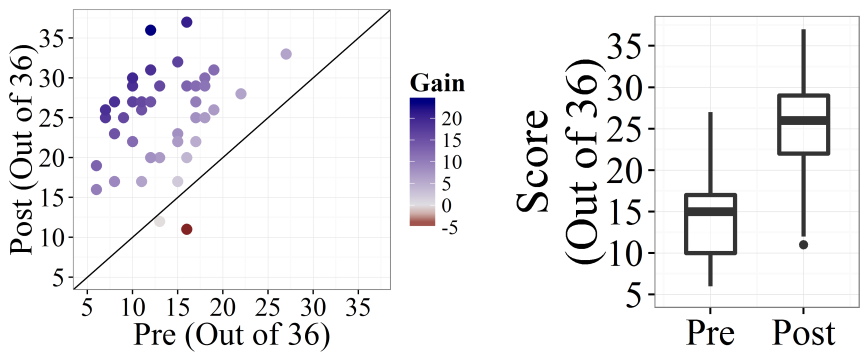


Figure 6: Pre and post scores for each individual student (left) and aggregated boxplots (right) demonstrate the large gains made by students during the year the tool was implemented.

Conclusion

Today's classroom teacher faces an avalanche of activity the minute they walk into the building. Students ask for help, daily emails, unexpected interruptions, labs that need to be prepared, meetings with parents, phone calls, endless grading of papers, unfunded state and federal mandates all add up to the point where, literally, it is now not uncommon to hear the words, "I don't even have time to use the bathroom." In the chorus of chaos, the simple act of documenting reflection forces a teacher to provide a small sliver of information about what is really important. Furthermore, systematic and valid research methods help to mine the blog information to help focus the teacher on what really matters when trying to help improve student learning.

We examined almost 100 blog entries by a single educator that always focused on the same three questions that dealt with student learning and evidence for it. Although several themes emerged from analyzing the blog entries, assessment was a central theme. Based on these findings and a DDI framework, a novel tool was created to collect data to inform and guide daily instruction in the most efficient and effective way possible. Using the tool helps and respects students' prior knowledge and leverages readily available technology. The research and practical outcomes presented here demonstrate how a classroom teacher and a researcher can effectively collaborate to combine teacher's knowledge of the students, classroom, and school environment during professional development to study and improve instruction while maintaining research quality and authenticity. Further research would be greatly beneficial in detailing the effectiveness of this particular strategy in specific topics.

As our scope was to introduce the idea of developing a tool that can be used to generally inform activities, studies that use this strategy and measure outcomes on specific topics would yield valuable insights on the pragmatic challenges, effectiveness, and tips on how to implement at a topic-specific level. As mentioned previously, these day-to-day details are scarcely found in relevant literature but crucial for successful adaptation of strategies such as the one proposed here.

Rather than ending the discussion here, we invite readers to use social media to view the ongoing project, examine its progress in real time, and converse with the first author/practitioner. The first author's progress can be tracked on his blog at https://www.chemedx.org/blogs/chad-husting. Additionally, inquiries are welcome from educators who wish to adopt the curricular activities embedded in the tool and/or discuss employing DDI strategies their classrooms.

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About the Authors

Chad Husting teaches in a diverse suburban high school of about 1800 students in a suburb of Cincinnati, Ohio. Mr. Husting is a member of the American Association of Chemistry Teachers and has written for *Solutions*. He has a blog you can follow at https://www.chemedx.org/blogs/chad-husting. Email: hustingc@sycamoreschools.org

Jordan Harshman, Ph.D., is a postdoctoral research associate in the Department of Chemistry at the University of Nebraska – Lincoln. Dr. Harshman has worked with professional development for instructors both in his graduate experiences at Miami University and his current postdoctoral position.

Ellen Yezierski, Ph.D., is a professor of chemistry at Miami University and director of the NSF-funded professional development and research project, Target Inquiry at Miami University. Dr. Yezierski's research group investigates chemistry instruction in a variety of learning environments. Email: yeziere@miamioh.edu.

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Appendix A: Final Category Names, Descriptions, and Frequencies of the Occurrence in the Data Set

	Name	Description	Frequency
A	Formative assessment with instructions and descriptions	This category attempts to describe some type of formative assessment and then provides instructions on how to carry this out in the classroom. Often this is done at the beginning of a unit or assignment and usually not for a grade. It is then used to inform my instruction.	18
B	English as a second language	ESL teaching techniques can help all students. These techniques use other methods besides of instruction and assessment besides words. It is helpful with students who either struggle with English or have been raised speaking a foreign language.	2
C	What we did in class	These are actual labs and activities we are doing or are going to try to do in class. Most of these center around inquiry. A theme with these labs is that many are performance assessment. Students ultimately should be able to predict an outcome or some type of end measurement. It is not something they could look up on Google.	30
D	Plans for next year	After reflecting and having a set of experiences, these are plans and "big ideas" that I hope to guide my instruction in the future current year or following year. I have had a set of experiences and am trying to look at guiding principles to guide my future teaching.	7
E	Reflections on outside influences	These entries are not about classroom incidences. These are about events that have happened outside the classroom (classes I am taking, books I have read, talks I have heard). Furthermore, I have reflected on these events and this could influence my teaching.	30
F	Interesting and creative teaching ideas:	These are ideas that I have gotten from outside sources. I hope to use or have used that seem like student-centered creative ideas. They focus on hands on manipulatives that students can do as labs, projects or in some cases, manipulatives that I can use as a type of assessment.	8
G	Post assessment	This is an assessment that is at the end of an activity and is similar to, but not as detailed, as a formal summative assessment. It is fast, simple and at the end of an activity.	2