Inquiry Channel – Using Data and Building Theories

A Blue-Sky Paper on Research & Inquiry

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When are students or teachers, for that matter, encouraged to build theories? Even as a graduate student, it felt like theory-building was a sacred practice, reserved for ordained 'experts' in the academic field. When exploring what inquiry might mean within the classroom, as an academic leader in PK/JK to twelfth grade, I discovered a range of interpretations and practices. The ones most compelling involved students becoming theory builders.

I recall seeing firsthand students at the *Institute of Child Study* in Toronto collaboratively making meaning using Knowledge Forum software as part of the *CSILE Project*. Students worked in pairs on one screen compiling data and making determinations about whether, or not their findings contributed to an emerging theory, prompted further questions or populated an ongoing bank of data for further consideration. Students were excited about making theories. At the time the software tracked their thinking to a degree, but my recall was more about the dialogue that occurred between the student pairs and the tool that they were using. I was beginning to see that inquiry could be much more than finding stuff and presenting it neatly on a Bristol board for grading.

I was also working with a team of teacher-researchers on a *Spencer Foundation Grant* at OISE-UT. While we were examining our teaching and learning contexts relative to Vygotsky's (1978) theories of social constructivism, our experiences fell short of actual theory-building. In a sense, the action research served to make us all more aware of rigors of peer-reviewed research, the idea of being theorists was for those who had access to data from thousands of schools. The gathering of qualitative data from a few schooled contexts did not seem to qualify as enough to carry a theory. Looking back at these times, my sense is that inquiry must lead somewhere, not just a description. For students and educators to engage in authentic inquiry, it needs to be more than an exercise.

As a curriculum leader in different kinds of schools (public, independent, charter and international), I came across many examples of inquiry-based programming that leaned more toward the 'exercise to present a Bristol board project' kind. The emphasis on process seemed to be the rage, but without a blending of process and product/service, it was no surprise many of the early inquiry-focused programs fizzled out. Many were replaced by problem-based or project-based learning, some with more authentic purpose than others. What seemed optional in most models was the expectations that students create theories.

It was also surprising that not all students were necessarily equipped with a solid understanding and experience with both quantitative and qualitative data within conventional inquiry projects. Furthermore, data management and statistics are featured in most curriculum as a strand of Mathematics, even though the context of inquiry and research makes for a more authentic medium for applying such research methods.

At the Sterling Hall School for boys in Toronto, Canada, we developed the SHARK Program (Sterling Has Action Research Kids) to prepare students for a more immersed inquiry experience.

Within the contexts of Science and Social Studies students in third through fifth grade designed inquiries that involved five steps.

> This inquiry model…helped shape the students' capacity to conduct research by exploring possibilities, narrowing focus, gathering data, analyzing primary and secondary sources, generating findings and educating others. In the 'gathering' stage, students were taught speaking skills from the Language Arts curriculum, specifically to conduct primary source interviews. In addition to making sense of qualitative data, at the 'analyze' stage, students calculated and displayed quantitative data in an application of statistics and data management. Students were taught how to use *Survey Monkey*.

What stood out in this inquiry was the expectation that students were expected to build a theory as part of their conclusion. We realized we had to teach students how to use their qualitative findings to determine themes or categories. I needed to help students group the data, much like my first graduate supervisor helped me makes sense of considerable amount of interview data. I was apprenticing in the world of research by making meaning with my findings. Many students who engaged in this program became very adept at triangulating their evidence to support their various claims.

We adapted this program for a high school in Detroit and an art school in Washington, DC. The model emerged as the ENGAGE Inquiry Model, refereeing to six inquiry actions:

- **E**xplore
- **N**arrow
- **G**ather
- **A**nalyze
- **G**enerate
- **E**ducate

Much like the International Baccalaureate's (IB) extended essay, the ENGAGE Inquiry models embraces project-based work as an immersed and extended experience. While the IB projects have the option of interviewing experts, it is a required featured of ENGAGE inquiry. Student may generate theories in the IB Extended Essay, and may present their findings to a wider audience. The ENGAGE model requires students to build theories based on their findings, as well as educate others about their inquiries. The notion of educating others took many forms. At Sterling Hall, each project report was compiled into a published Inquiry anthology, so that other students could reference student research in future inquiries. We also co-presented with students at the International Boys School Coalition – Students as Action Researchers. This 'educate' phase helped teachers learn about the process of action research through the eyes and voices of students. "The ENGAGE inquiry model was initially designed as a guide for emulating the habits of researchers" (Smith, 2019), but it did much more. It helped teachers realize that if students could do it, they could, too. We adapted the model for use with high

school students. Drake (2012) identified this research course as 'exemplary practice' in her best-selling book, *Creating Standards Based Integrated Curriculum*.

Gathering Information from Experts (Interviewing Primary Sources)

The ENGAGE Inquiry Model requires students to find experts they can interview about their topic. For instance, if students were conducting an inquiry into an environmental problem, they could contact some of the following primary sources of expertise: environmental officials (government), foresters, biologists, ecologists, zoologists, botanists, or officers in environmental organizations. They can also find sources through existing agencies or websites on the Internet. Some sample ecology experts are featured in Figure 1:

Figure 1: Web-link Connections for Ecology Experts

Places to Find Eco-Experts on-line	
☑ United Nation's Environmental Program (http://web.unep.org/)	☑ National Association of Environmental Professionals (http://www.naep.org/)
☑ Worldchanging (http://www.worldchangingcentre.org/)	☑ Biosphere Expeditions (http://www.biosphere-expeditions.org/) - travel
☑ Earth Charter Initiative (http://earthcharter.org/)	☑ BirdLife International (http://www.birdlife.org/)
☑ Mountain Wilderness (http://www.mountainwilderness.org/)	☑ Fauna and Flora International (http://www.fauna-flora.org/)
☑ Friends of Nature (http://www.friends-of-nature.ca/)	☑ Friends of the Earth (https://foecanada.org/en/campaigns/the-bee-cause/;
☑ Green Cross International (http://www.gcint.org/)	☑ Conservation International (Amazon) http://www.conservation.org/stories/vr/Pages/amazon-under-the-canopy-virtual-reality.aspx
☑ Plant A Tree Today Foundation (PATT) http://www.pattfoundation.org/	☑ PRBO Conservation Science (http://www.pointblue.org/)
☑ Project AWARE (http://www.projectaware.org/?q=/homepage/project-aware-homepage)	☑ Rainforest Alliance (http://www.rainforest-alliance.org/)
☑ Sandwatch (http://www.sandwatch.ca/)	☑ Wetlands International (https://www.wetlands.org/)
☑ The Mountain Institute (http://mountain.org/)	☑ The Nature Conservancy (http://www.natureconservancy.ca/en/)
☑ World Land Trust (WLT) (http://www.worldlandtrust.org/)	☑ World Resources Institute (WRI) (http://www.wri.org/)
☑ World Wide Fund for Nature (WWF) (http://www.worldwildlife.org/)	☑ Environmental Studies professors, scientists

A frequent challenge is that not all website remain 'live' forever. Often they can change their web address/name or be dismantled.

Univerisity professors can also be rich sources of expertise. Some university professors have established 'outreach' type programs. They can provide names and links to more experts. Web pages can also provide key biographical information that can let students zero in on people who specifically

can support their research projects. Often, nature artists have also conducted a wealth of research and their illustrations and photography can be noteworthy.

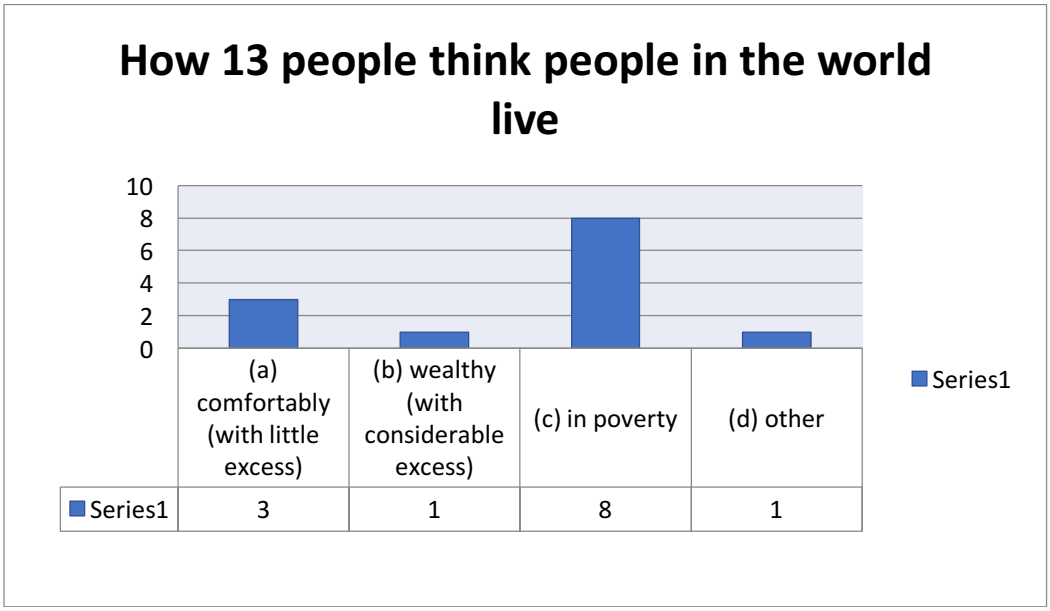
Quantitative Data and Analysis

There are many tools available for gathering survey data from prospective participants in an inquiry. Depending in the question, survey responses can be quantitatively or qualitatively analyzed. When student researchers crunch the raw data to gain numbers and percentages, students have an authentic opportunity to apply their understandings of mean, median, mode, and range, for instance, as part of a statistical analysis. A free and easy way to compile data is by using *Survey Monkey* (https://www.surveymonkey.com/user/sign-up/). Figures 2 and 3 illustrate a sample frequency table and graph for a quantitative question about perceptions of global living conditions.

Figure 2: Sample Frequency Table of Survey Data

How do you think most people in the world live?	**Perceptions/Responses**
(a) comfortable with little excess	3
(b) wealthy (with considerable excess)	1
(c) in poverty	8
(d) other	1

Figure 3: Sample Excel Graph of Survey Data



In order to determine the range, median, mode and mean of the data, it's important to know exactly how to find them. A mini-lesson to teach such concepts might involve integrating powerful anchor charts within student inquiry resources. Figure 4, 5, 6, 7 and 8 illustrate sample teaching posters.

Figure 4: Sample Range Poster

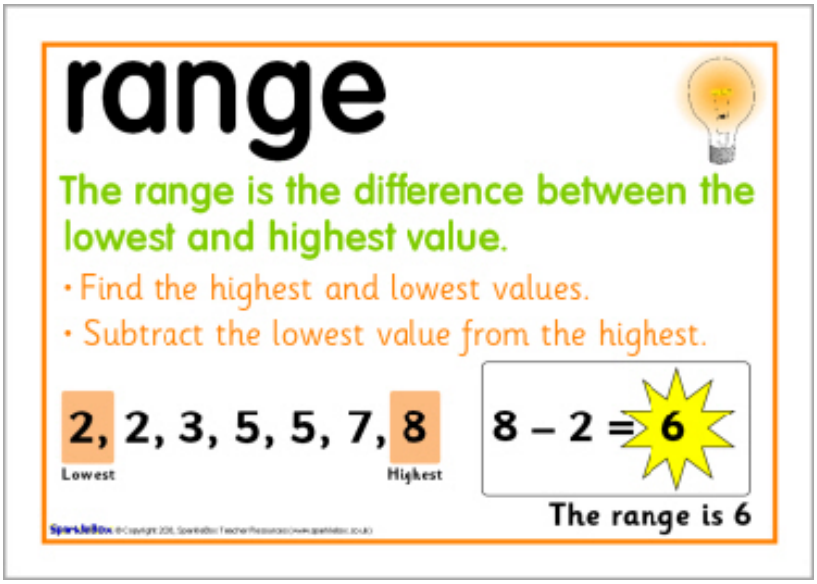
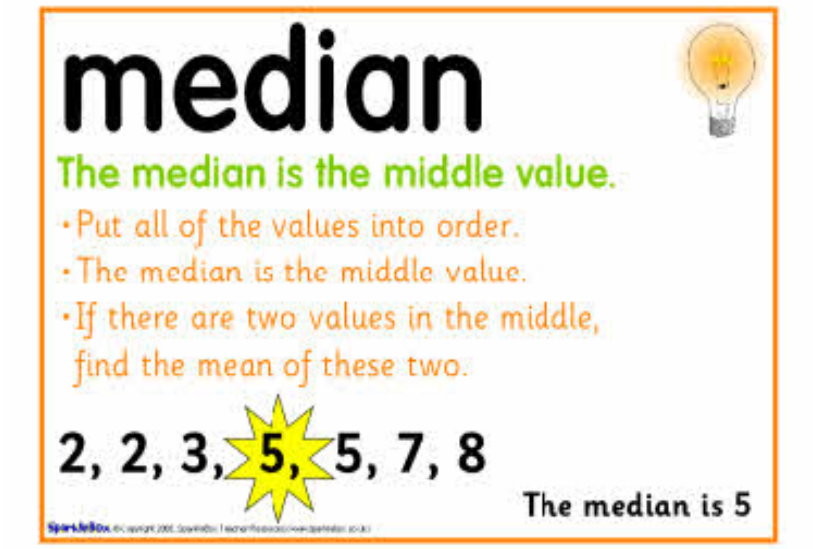


Figure 5: Sample Median Poster



"If we teach today as we taught yesterday, we rob our children of tomorrow." ~ John Dewey

Sample 6: Sample Mode Poster

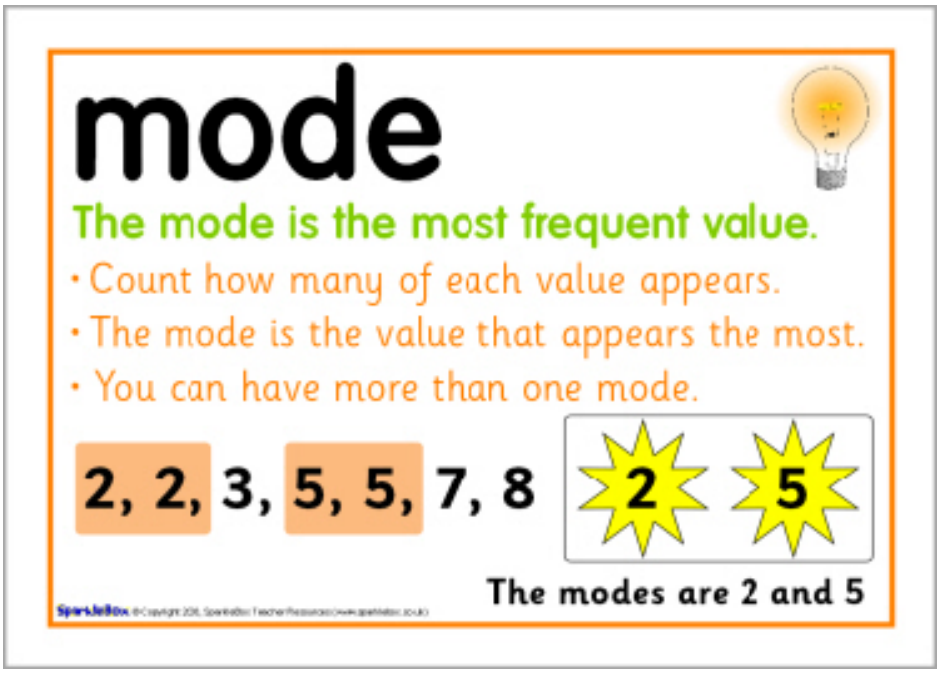


Figure 7: Sample Mean Poster

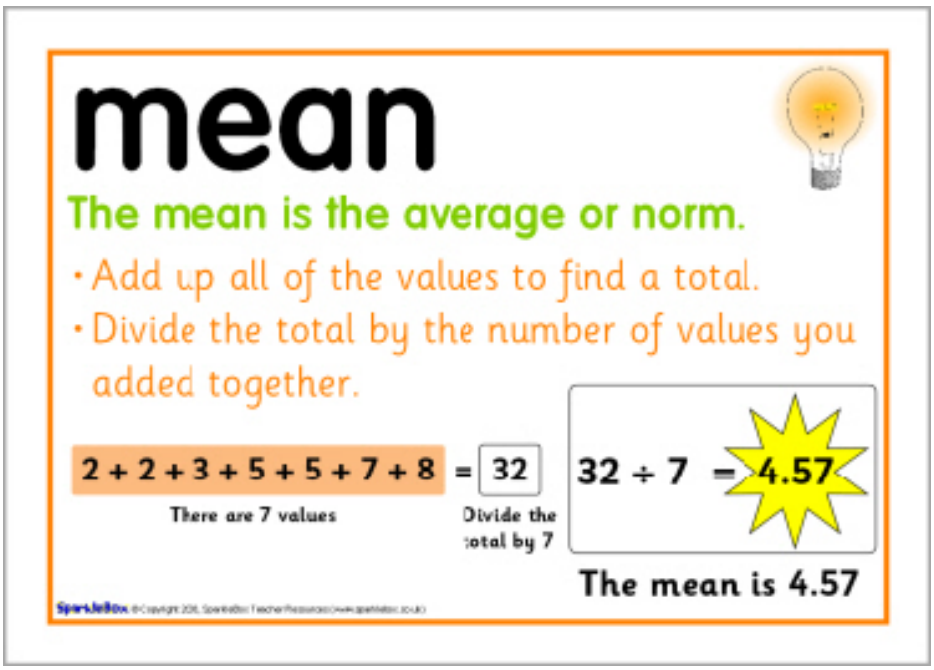


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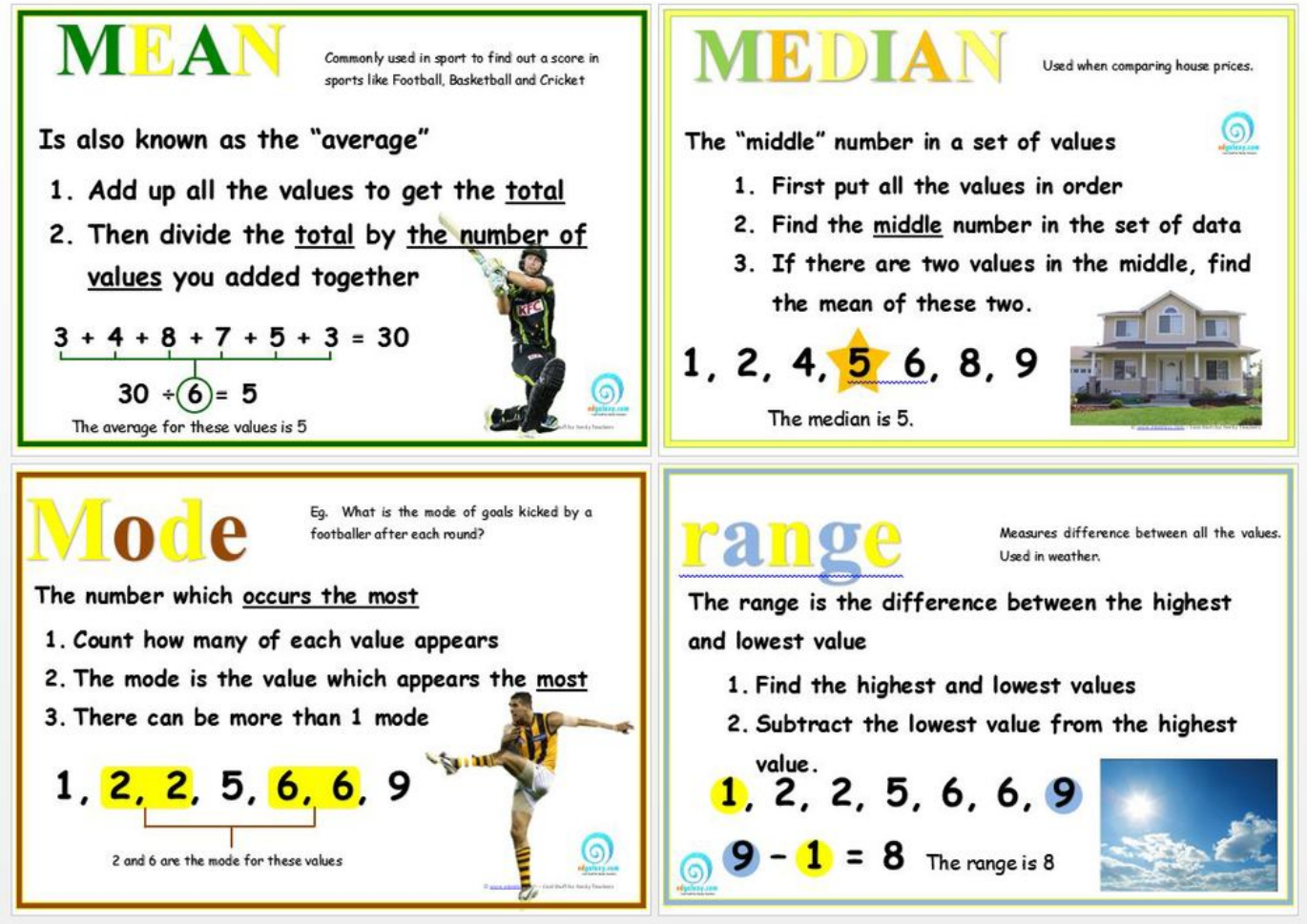
Figure 8: More Mean, Median, Mode and Range Posters



Students can work on activity links to practice calculating statistical data:

- https://www.youtube.com/watch?v=5C9LBF3b65s
- http://www.henryanker.com/Math/Number_Sense/Describing_Numbers/Finding_the_Median_Set_1.swf
- http://www.bbc.co.uk/schools/teachers/ks2_activities/maths/activities/modemedianmean.swf
- http://www.mathplayground.com/howto_mode.html

Qualitative Data Analysis

Open ended questions are important to ask in survey or interview form. When stuent researchers gather the responses, they can then learn how to generate categories, and use such themes, as well as the analysis of quantitiative data to come up with theories about that may make informed predictions rather than random guesses. The *Scientific Method* requires students to make a

hypothesis upfront, whereas, an inquiry-focsed approach places the prediction at the end of the analysis. The theory, in a way, describes what the reearchers might expect to happen next, when student researchers begin a new round of inquiry. The theory in effect, informs the next process.

An open-ended question gives respondents the freedom to respond. The question: "Why do you think there is poverty in the world?" can elicit a variety of responses. All 13 participants may share 13 completely different ideas, but some may be similar. The student researcher needs to back up which comments support any common themes that may emerge. To substantiate a theme or category, at least three responses need to back up the claim. Researchers can then comment on how well the perceptions align with existing studies and findings in published sources.

Technology and Inquiry

Inquiry courses provide a rich opportunity to apply technology skills. At various stages of the SHARK and ENGAGE inquiries students received deliberate instruction for using specific software; students became proficient at Word, Excel, PowerPoint, IMovie, Basic CAD and Web design. Students used technology to gather initial information about their topic; they used technology (Survey Monkey/Excel) to gather and analyze statistical data; and the also used PowerPoint, Video and Web pages to educate others about their findings.

Technology can also be the source of inquiry. The Hole in the Wall Project conducted in Kalkaji, New Delhi, India, involved the placing of a comupeter within an outside wall to see how peple might respond. Mitra (1999) found that the social environment contributed greatly to how well young people learned how to use the device:

> The screen was visible from the street…the PC was available to anyone who passed by. The computer had online access…but no instructions were given for its use. What happened next astonished us. Children came running out of the nearest slum and glued themselves to the computer. They couldn't get enough. They began to click and explore. They began to learn how to use this strange thing. A few hours later, …the children were actually surfing the Web (2012).

It is doubtful the students would have been able to figure out so much about the computer if they were handed individual laptops. As noted:

> Students, who share a computer screen have more opportunities to talk about and negotiate next steps. Social use of technology can be far more constructive than working in isolation on a computer. Students in 'laptop schools' often miss out on co-constructive experiences. Given the potential for increased learning benefits of sharing technology, and the reduction of costs involved, it makes sense for educators and researchers to pay more attention to such innovative approaches to using technology (Smith, 2019).

The negotiation with others was a powerful medium for learning. One year inquiries might be up to the individual, but in other years, it's important to leave the door open for paired inquiries.

Inquiry projects should also not be something wrapped up in a week, or a month. They should be organized with sustained amounts of time to develop something meaningful.

Classroom Assessment and Inquiry

Figure 9 illustrates a sample student (self assessment) and teacher project assessment tool for guiding the ENGAGE Inquiry process.

Figure 9: Sample Students and Teacher Assessment Tool for Ecology Inquiry Project

Self-Assessment (Student)	**Ecology Inquiry Project**	**Points**	**Teacher Score**
	Explore • Image – label and pasted	2	
	Narrow • Know, Wonder, Learn Charts	2	
	Gather • Print and digital sources (8) • Interview source(s) (4) • Survey sources (2)	14	
	Analyze • Data Management (2) • Quality of Sources (2)	4	
	Generate • Theory (2) • Further Questions (2) • Recommendations (2)	6	
	Educate • Detailed Model (2)	2	
	Total	/30	

As part of an integrated English Language Arts (ELA) and Research and Technology course at the Jalen Rose Leadership Academy High School in Detroit, Michigan, we assigned the *Personal College Project* to all students in the ninth grade. As part of a media literacy thrust, students were asked to read and review over 30 different college websites to gather information they cold use to help generate their own theories about what criteria they would use to make their own College Rating Scales. Apart from generating their own tool, they also needed to defend it as well as compare it to existing national and international rating scales. This experience helped students think about and prepare for their future in advance. Figure 10 reveals the sample rubric that guided this particular inquiry.

Figure 10: Personal College Project Rubric

Self-Score I….	**PERSONAL COLLEGE PROJECT Rubric** (1 = started; 2= mastered)	Teacher Score You…
	documented with rationale, initial perspectives about best colleges	
	explained reason for narrowing focus on specific programs at college	
	gathered data about programs in 30 colleges or more from web sites and other sources	
	gathered data from a balance of local and out-of-state or country universities	
	completed a mock common application and made a list of areas of strengths	
	made a list of things to do to help improve a possible future Common application	
	interviewed or surveyed at least one student in college	
	analyzed the strengths and weaknesses of existing college ranking systems	
	critiqued website and marketing of researched colleges	
	generated a personal ranking scale with clearly defined categories to support decisions for choosing a college for self or others	
	prepared a strong argument for college ranking scale using data/details to support ranking categories	
	explained shift in understanding of college choices from beginning to end of college inquiry	
	generated suggestions for filling in college applications (including the Common Application)	
	shared narrative paragraph about own personal college choices	
	shared limitations of inquiry (what could have been improved?)	
	shared Personal College Project findings with classmates using PowerPoint effectively	
	gathered evidence of classmates learning following presentation	
	worked independently on each part of inquiry project	
	asked for help and/or supported others (during the inquiry)	
	asked questions and took notes stayed on task during presentations	
	Total */80*	

When students can be at the center of action research that can influence positive change, so too, can teachers be part of an inquiry-based culture. When schools build their own inquiry channel, they are placing critical and creative thinking at the forefront of a 21st century education.

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