Discovering Patterns in the Natural World Through Student Inquiry with Quaardvark

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Project Summary

Quaardvark is a structured search tool and inquiry support environment specifically for inquiry into natural history data. Collaborating faculty create, integrate, and test effectiveness of inquiry activities aimed at exploring issues in evolution and ecology. These can be fully integrated into curricula of widely taught organismal biology courses, and we are focusing on 1) introductory biology, 2) ecology, and 3) several related classes centered on vertebrate biology and natural history.

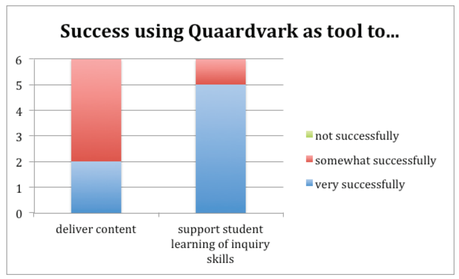
In the winter/spring 2012 semester, around 450 students at 9 different institutions used Quaardvark; in the fall semester, 400 students at 8 universities. Analysis of fall data is still ongoing, so results reported here refer to the initial implementation. Among faculty, all respondents felt that Quaardvark was very important for promoting active learning. Although there was some difficulty integrating Quaardvark activities into the curriculum so that the activities clearly related to the rest of the course, both faculty and students mentioned that using real-world data enhanced students' learning. We are continuing to partner with faculty on identifying and implementing best practices.

Faculty

21 faculty at 19 undergraduate institutions are collaborating with us to create query activities that support specific learning objectives in commonly taught courses. Through workshops and training webinars, they are developing Quaardvark-based inquiry activities to use in their own courses. The current set of activities can be found at: animaldiversity.ummz.umich.edu/quaardvark/examples/

Surveys at the beginning and end of the term help us understand what draws faculty members to use these activities and how they perceive the effectiveness and benefits of ADW instructional once used.

On the pre-survey, faculty felt that activities would be very important for promoting active learning, and most indicated that the activities were very important for testing students' scientific reasoning ability and inquiry skills and integrating data analysis into assignments. Afterwards, instructors reflected they were successfully able to use Quaardvark activities to support students' learning of inquiry skills.



Faculty members noted that clear, easy-to- follow instructions are key to successful use of the activities, and testing the activities before assigning them to students can prevent "glitches" or "hiccups" that may discourage or slow down students' progress.

Faculty say...

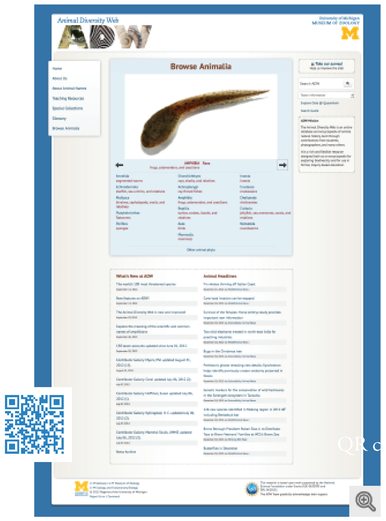
The information ... relates to core concepts of my course (e.g., geographic distributions, life history traits, habitat preferences). Thus, I can use Quaardvark as a means to get the students to actively apply their knowledge to new questions. Once they become familiar with using Quaardvark, they will generate and test their own hypotheses, building their inquiry skills.

The activities encouraged them to actively explore concepts we'd covered in class, while also developing their critical thinking and analytical skills. Quaardvark provided a great active learning opportunity.

Students were able to access real zoological data and apply real statistics to data sets that could and did illustrate actual concepts discussed in class!

Quaardvark and the Animal Diversity Web

http://animaldiversity.org/



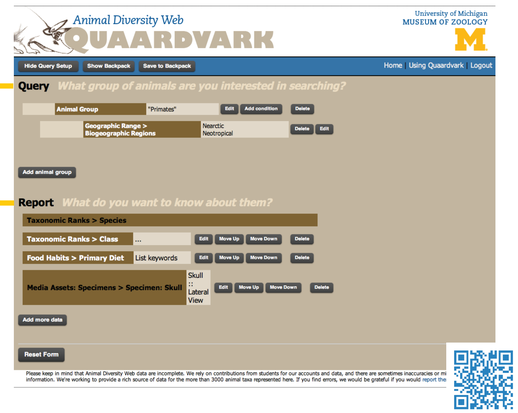
The Animal Diversity Web is one of the most widely used online natural history databases. Monthly, the ADW serves
- over 2 million pages
- over 300,000 users
- 70% visits for educational purposes (2006 survey)

The ADW has:
- 3379 full taxon accounts
- 2627 data only accounts
- 22,421 images
- 2892 specimen images
- 708 sound files

and is ever expanding!

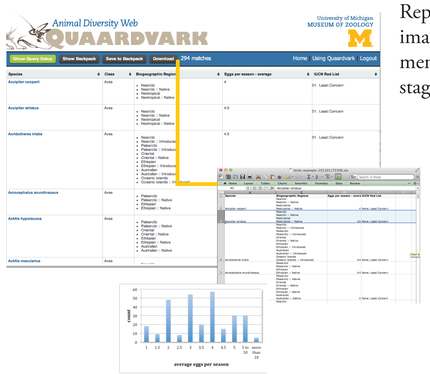
Students across North America have helped build the ADW through a valuable writing experience by using a structured online template.

http://animaldiversity.org/q/



The Quaardvark query tool is structured as:
a query - narrow your search to taxa with particular characteristics, and
a report - natural history data for the taxa of interest.

The results appear in tabular form. They can be downloaded in spreadsheet formats for statistical and graphical manipulation.



Reports can also include images depicting specimens, behaviors, life stages, or anatomies.

The biggest benefit of our highly structured data format is that it can be reused in Quaardvark, our powerful search tool developed with NSF funding. Students use the ADW Quaardvark query engine to discover patterns in natural history on their own.

Hypothesis testing in real data is more powerful as the data become more extensive and complete. With current funding, we are integrating other online resources, such as YouTHERIA, into Quaardvark. This has allowed us to expand the searchable database by over 70% so far. One of the biggest obstacles to expansion is the fact that many online sources do not have an easily harvested structured format. We will explore this problem this summer in a workshop that will include both a number of organizations that provide on-line data and others that, like Quaardvark, harvest these data for teaching (RCN-UBE DBI 1247821).

Students

Students were asked to rate their levels of confidence, knowledge, and skill for four competencies that the Quaardvark activities are intended to promote. They showed overall significant gains in their perceptions of their knowledge and skill levels in each of the four competencies. The largest average increase from pre-survey to post-survey was in students' self-reported level of *knowledge to search for evidence to improve their understanding of biology*.

In the post-survey, students were also asked about Quaardvark activities and interface. The table below summarizes student post-survey ratings. (scale of 1 to 5, where 1=Strongly disagree and 5=Strongly agree)

Quaardvark activities…	mean (n=368)
helped me learn to interpret & evaluate evidence	3.82
helped me … understand patterns in biology	3.76
taught me to synthesize info from diff sources	3.68
taught me how to test hypotheses in biology	3.45
Q. was helpful to my learning in the course	3.75
Activities related to the rest of the course	3.94
The interface was easy to use and navigate	3.70

Despite some inevitable difficulties and frustrations, students recognized the value of Quaardvark as a tool for learning biology. Students who are more familiar with ADW species accounts (usually from writing their own) are perhaps better prepared to make powerful use of the search tool.

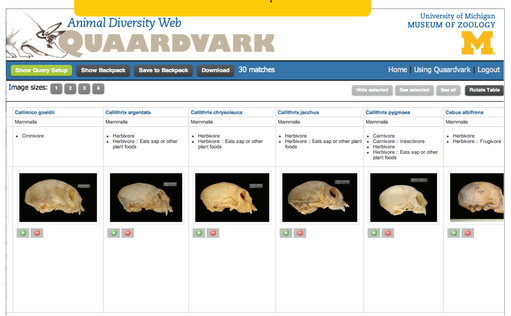
Students say...

It provided for a different dynamic in the class; rather than just it being a lecture, I had to apply what I learned to my project.

I like having such a huge database to use and work with. It is nice that I can type in a specific criteria and get a plethora of results.

It allowed us to test hypotheses from within the classroom relating to worldwide data. By having the flexibility to choose queries ourselves, it reinforced topics lectured in class in a more 'practical' and hands-on experience.

I liked the primates lab where we looked at morphological differences between skull structure of different primates.



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