Beyond Explanation

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Using research and insight to design and implement scaffolds for writing scientific explanations in an urban school

Abstract

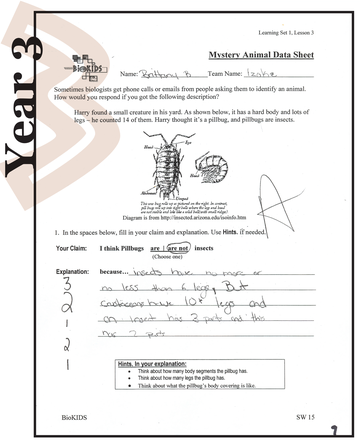
Using claims, evidence, and reasoning to back up assertions about scientific phenomena have been an important part of the *BioKIDS* curriculum since its inception. Scaffolds have been used in an effort to assist students in constructing complex these explanations. While the claims students were asked to make between the 3rd and 4th enactment of the *BioKIDS* curriculum remained consistent, the scaffolding changed significantly in response to input from teachers. Scaffolding received minor changes between the 4th and 5th enactment. Results from a comparison of student ability to construct the required scientific explanations between year 3, 4, and 5 was used to inform the design of both the scientific questions and the scaffolds for year 6.

Research Question

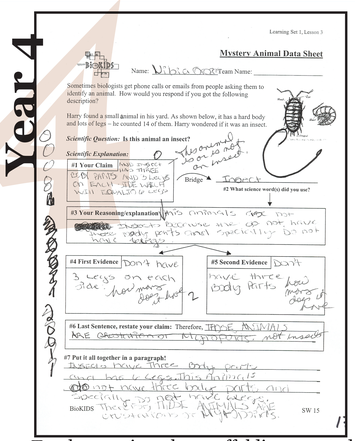
How have the changes in scaffolding affected student ability to construct accurate scientific explanations in the *BioKIDS* curriculum?

Evolution of Scaffolds and Student Work

Year 3

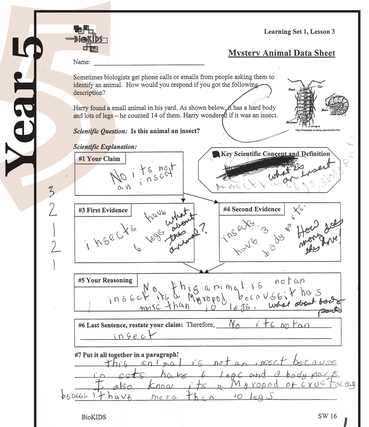


Year 4



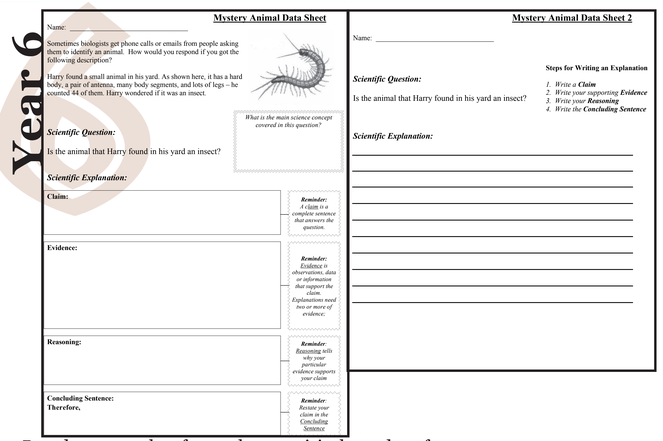
Teachers using the scaffolding wanted something similar to what students were using in other grades to make writing explanations more straightforward.

Year 5



Due to collaboration with teachers during our annual summer institute, the decision was made to move the reasoning scaffold after the evidence. This was deemed as a more natural way to write.

Year 6



Based on results from the empirical study of explanation scaffolds and insight from working with the scaffolds for several years, changes were made to make the scaffolds more accessible to students.

Research Methods

We selected fifty (50) student notebooks at random from the same teacher for each of the three consecutive years. Students were assessed on the accuracy of their scientific explanations of various ecological phenomena in four scientific aspects of their explanation: content knowledge, claims, evidence, and reasoning. Using ordinal logistic regression and controlling for student backgrounds, we examined how the log-odds of constructing an accurate scientific explanation changed as a function of the new scaffolding constructs.

Results

Content

Question	Year 3	Year 5
2	+	-
3	+	+
4		+
5	-	
6	+	+
7	+	-
8	-	+
9	-	-

Claim

Question	Year 3	Year 5
2	+	-
3	+	+
4		+
5	+	
6	+	+
7	+	+
8	-	+
9	+	+

Evidence

Question	Year 3	Year 5
2	-	+
3	+	+
4		-
5	+	
6	+	-
7	-	-
8	+	+
9	+	+

Reasoning

Question	Year 3	Year 5
2	-	-
3	+	+
4		+
5	-	
6	+	-
7	-	-
8	-	-
9	-	-

"+" indicates a trend toward *increased* log odds for constructing an accurate scientific explanation compared to year 4
"-" indicates a trend toward *decreased* log odds for constructing an accurate scientific explanation compared to year 4

Conclusions

Improvements in wording scientific questions

Students make claims based on their response to a scientific question. The process of developing a coding rubric for analysis led to a better understanding of how the wording of a scientific question can influence the challenge a student may face when writing a scientific explanation. Questions that asked students to make selections and used terms such as "which" deemed easier than questions that asked students "why". Questions in which the expected response was unclear were rewritten.

Why do you not see (your animal) in your schoolyard? → Rewritten as → Even though there is (your animal)'s food in your schoolyard, why is the animal NOT living there?

Changes to scaffolds for scientific explanations

Based on observations made during the rubric development process and discussions with teachers using the scaffolding, a decision was made to eliminate any influence the scaffolding may have on the amount of evidence needed in order to construct an accurate scientific explanation. In some cases, students were arbitrarily forced to use two pieces of evidence when one would suffice. Generic hints were also included to remind students what type of information to include in each box.

Increased need for teacher professional development

As is clear from the empirical results, students' performance during year 4 tended to be lower than both that of year 3 and year 5. The drastic scaffolding changes made during year 4 occurred immediately preceding the year 4 enactment, leaving little to no time for teacher professional development concerning this new form of scaffolding scientific explanations. We believe scores improved during year 5 after teachers had an opportunity to work with the new method of scaffolding.

BioKIDS
Kids' Inquiry of Diverse Species

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biokids.umich.edu