6-2017

Exposing Problems Teaching Students Morphological Species Identification

Trevor Stamper
Purdue University, stampert@purdue.edu

Lauren Weidner
Purdue University

Gregory Nigoghosian
Purdue University

Ludmila D. Nunes
Purdue University

Recommended Citation

Stamper, T. I., Weidner, L., Nigoghosian, G., M., & Nunes, L. D. (2017, June). Exposing problems teaching students morphological species identification. Poster presented at the 2017 meeting of the Society for Wildlife Forensic Science, Edinburgh, Scotland.

Exposing Problems Teaching Students Morphological Species Identification

Trevor Stamper[1], Lauren Weidner[1], Gregory Nigoghosian[1] & Ludmila D. Nunes[2]

1—Department of Entomology, Purdue University, West Lafayette, IN 47907, USA
2—Center for Instructional Excellence, Purdue University, West Lafayette, IN 47907, USA
stampert@purdue.edu

ABSTRACT

When dealing with physical remains, morphological assessment for species is a traditional approach to entomological specimen identification. A dichotomous key guides the user through taxa determination for a specimen by providing a series of dual-choice nodes that center around morphological differences. Each nodal choice leads to either a new set of dichotomous choices or a taxa decision. We evaluated student's ability to utilize a dichotomous key down to species for a limited set of taxa, by reviewing their nodal decisions along with their confidence level using a Likert scale (1-5).

Along with individual decision recording, students conducted a post-decision group comparison, following a think-pair-share active learning model. If student answers were not the same, they re-evaluated their specimen until a mutual evidence-based decision was reached. We analysed student identification success as well as the correlation between confidence and accuracy. Students displayed high decision confidence but low accuracy. We observed a higher initial accuracy from students enrolled in STEAM majors when compared to non-STEAM majors and saw gender-based differences in accuracy improvement after a think-pair-share event. From these data we aim to improve student training in the use of dichotomous keys for species identification, with a continued approach that can be then used to provide guidelines for how forensic scientists should approach dichotomous key training.

BACKGROUND

In ENTM 22820: Forensic Analysis, students perform morphological examination of flies using a visual dichotomous key (figure 1). Species IDs are used for estimation of minimum postmortem interval (mPMI) using either a succession model (figure 2) or individual growth curve model (figure 3). Students record all nodal decisions in a standard form, which includes a likert confidence scale (figure 4).

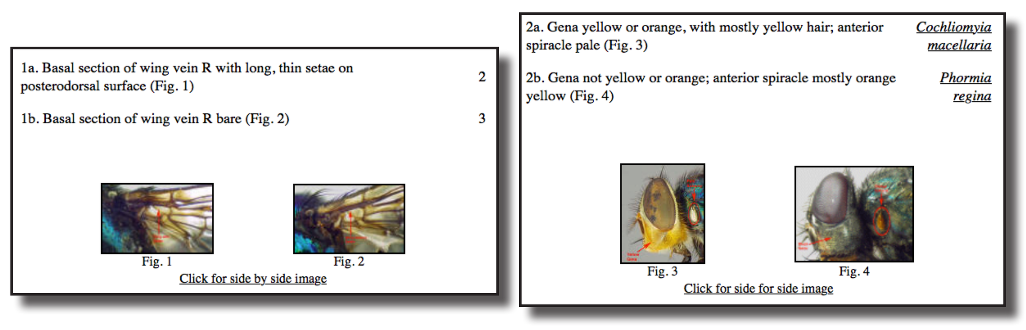


Figure 1: Example of the online visual dichotomous key used in this work (Cutter & Dahlem). Students are confronted with two choices, and their decision takes them to two more choices. Eventually the choices lead to a final species decision. In this key, nodal decision 1a takes the student to node 2, which leads to two final decisions, whereas nodal decision 1b takes the students to another group of decisions (not shown).

Stage	Egg	1st	2nd	3rd	Pupa
Species					
C. rufifacies	17.5	22.5 (40.0)	22.5 (62.5)	45.0 (107.5)	105.0 (212.5)
C. macellaria	17.5	25.0 (42.5)	31.3 (73.8)	50.0 (123.8)	106.3 (230.0)
C. vomitoria	10.0	12.5 (22.5)	22.5 (45.0)	35.0 (80)	122.5 (202.5)
L. coeruleivirdis	15.6	20.0 (22.5)	39.4 (75.0)	60.0 (135.0)	135.0 (270.0)
L. sericata	15.0	16.9 (31.9)	34.4 (66.3)	55.0 (121.3)	125.0 (246.3)
P. regina	12.5	15.6 (28.1)	30.0 (58.1)	60.0 (118.1)	150.0 (268.1)

Figure 2: Individual specimen maturation rate table that students use during lab 2 to determine Accumulated Degree Day (ADD) values for age estimation. These data are fabricted for these labs.

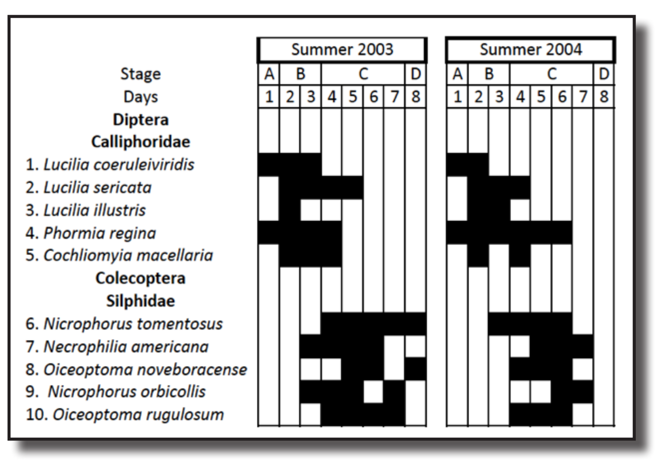


Figure 3: Succession table that students use during lab 1. These data are fabricted for these labs.

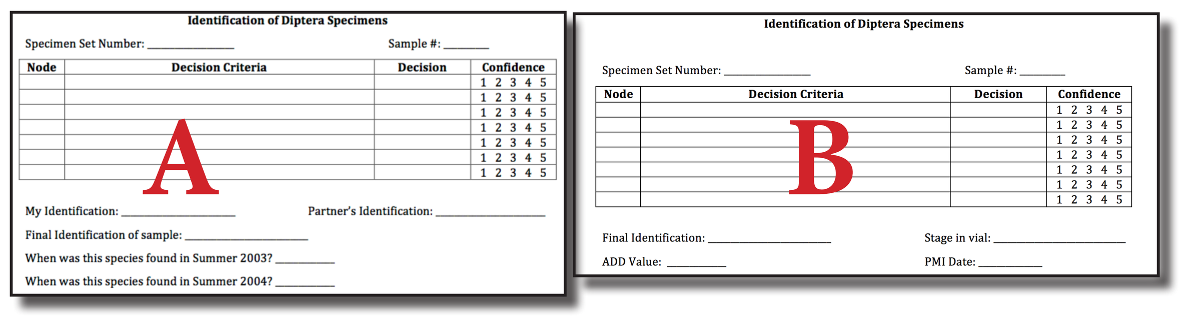


Figure 4: Comparison of nodal recording forms used (A) for succession (B) for individual specimen age estimation. Note the likert scale confidence scales are present for quick notation on student confidence at a given node.

RESULTS

We analyzed differences in student identification success (accuracy) for STEAM/Non-STEAM cohorts:

- Non-STEAM students show gains in initial accuracy between labs (figure 5; $F(1, 63) = 7.19$, $p = .009$, $\eta^2 p = 0.10$.)
- Within lab 1, only Non-STEAM students showed gains in final accuracy after the think-pair-share exercise (Figure 6), indicated by an interaction between accuracy and cohort, $F(1, 71) = 6.50$, $p = .013$, $\eta^2 p = 0.10$ and a lack of main effects.

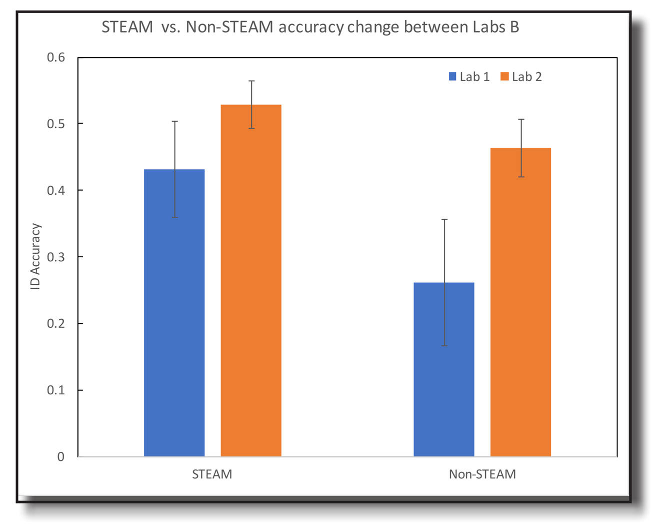


Figure 5: STEAM vs. Non-STEAM accuracy change in adult species identification using the visual key from lab 1 (blue) to lab 2 (orange). For lab 1 we used initial accuracy,

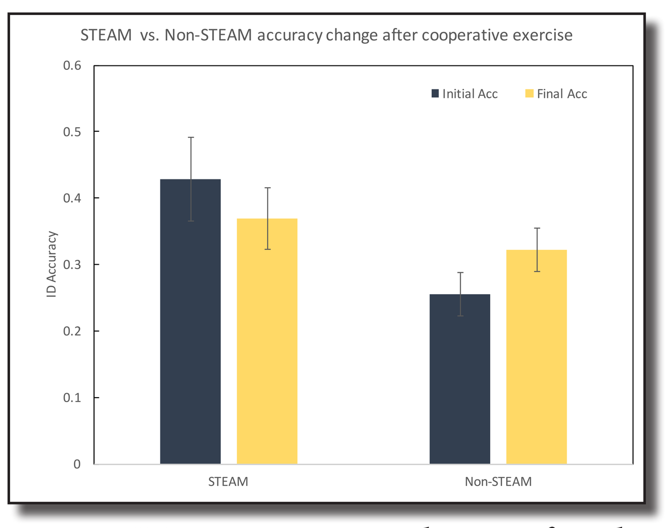


Figure 6: STEAM vs. Non-STEAM accuracy change after the think-pair-share exercise. No difference in STEAM, but significant difference in Non-STEAM.

We analyzed differences in student identification success (accuracy) for Male/Female cohorts:

- As we saw, overall, students make significant gains between labs 1 and 2, $F(1, 63) = 16.17$, $p < .001$, $\eta^2 p = 0.20$. However, this main effect is qualified by an interaction showing that the gains are larger for males relatively to females, $F(1, 63) = 4.84$, $p < .031$, $\eta^2 p = 0.07$, and as shown in figure 7.
- This larger gain for males than females is mirrored by higher gains in confidence for males on average (4.43) over females on average (4.02) during the identification of adults in lab 2.
- Within lab 1, there are overall gains in final accuracy after the think-pair-share exercise, indicated by a main effect of activity (initial vs. final), $F(1, 71) = 4.56$, $p = 0.036$, $\eta^2 p = 0.06$.
- However, this main effect is qualified by an interaction, $F(1, 71) = 7.95$, $p = .036$, $\eta^2 p = 0.06$. This interaction indicates that the gains after the think-pair-share exercise are larger for males than for females, as Figure 8 shows.

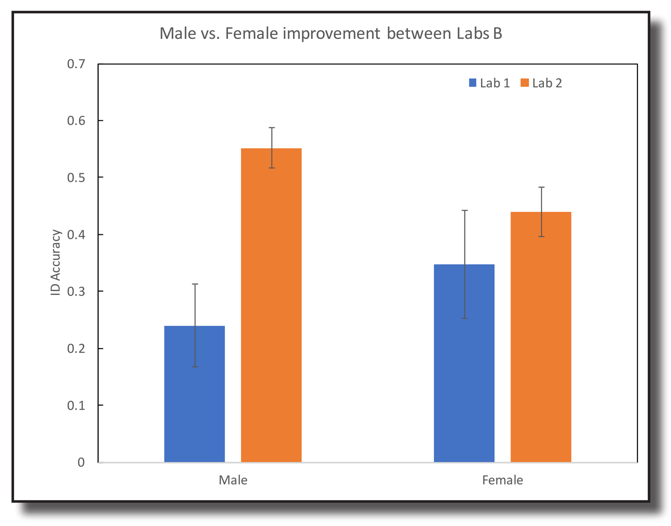


Figure 7: Male vs. Female improvement between lab 1 (blue) and lab 2 (orange).

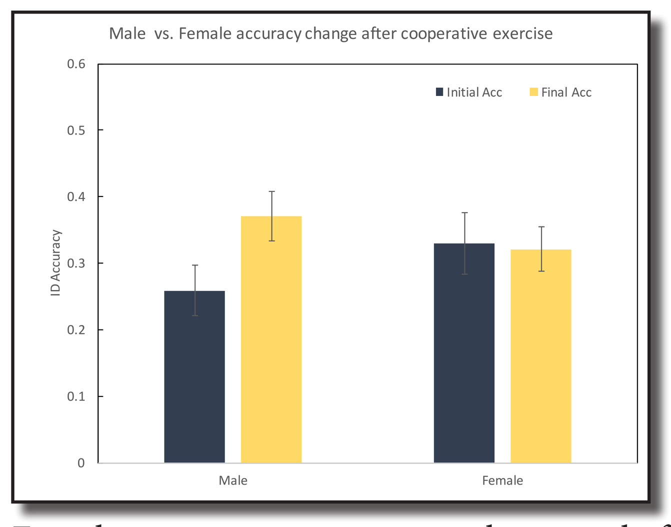


Figure 8: Male vs. Female accuracy improvement between before (blue) and after (yellow) the think-pair-share exercise.

DISCUSSION

We began this research to see how accurate students were when introduced to a dichotomous key for the first time. To our knowledge, no other effort has shown the accuracy rate of STEAM and Non-STEAM students when using a morphological dichotomous key.

We were also interested to see if repetition of the activity increased student accuracy and if student indicated confidence would correlate with accuracy.

Student accuracy starts low ($\mu = 0.30$) for the first event, but increases dramatically for the second exposure ($\mu = 0.464$), but there are interactions for both gender and STEAM/Non-STEAM (figures 6-8).

FUTURE WORK

We have just finished a replication of this work, and will be integrating those results in the near future. Beyond that, we see several possible manipulations to see how they impact our current findings:

- creation of an online tutorial covering fly anatomy and how to best view that anatomy
- fly anatomy homework assignment prior to lab 1
- revision of lab 2 to include the think-pair-share task
- re-ordering of labs with no modification

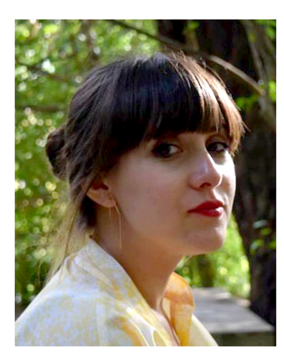
Work Cited

Cutter & Dahlem: http://www.nku.edu/~dahlem/ForensicFlyKey/species.htm

Trevor Stamper

Lauren Weidner

Gregory Nigoghosian



Ludmila Nunes

ACKNOWLEDGMENTS

Development of labs are almost never the work of a single individual, especially in ongoing courses with large student populations. The work presented on this poster could not be done without the dedicated attention of the many, many undergraduate student helpers who assisted in lab conceptualization, testing, and running. I also thank the hundreds of students who provided anonymous survey responses for these labs—all of those comments serve to improve the labs we build!

The contents of this poster were developed under grant # P116F140459 from the U.S. Department of Education. However, those contents do not necessarily represent the policy of the U.S. Department of Education, and you should not assume endorsement by the Federal Government.

PURDUE UNIVERSITY