Developing interactive dichotomous taxonomic keys available for smart phones in the field

Project team: Dr Stephen Scott, Emmanuel Delaborde, Sophie Fern

Snapshot

Smart phones are common place and therefore could be used as a teaching tool for students. A web based Key-Builder was developed to provide a key to identify species on the sea shore for a class field trip. Students who had a capable device found the digital key helped their learning of taxonomy. However, not all students had smart phones and so the provision of smart devices for class work is still required. The use of digital keys has huge potential to support the learning and application of taxonomy in the biological sciences.

Introduction

As students are using smart phones in their everyday life we thought they could use their smart phones to identify animals in the field (taxonomy). Being able to identify species is important in biological studies but is difficult as it requires a high level of specific knowledge. Students don't have this knowledge, but still need to identify animals. Traditionally, paper-based dichotomous keys are used to identify unknown animals. However to use these paper-based keys students need a good knowledge of zoological terms (e.g. operculum, dorsal, etc.). Students struggle with this method of identifying species as they do not have the zoological vocabulary; they make incorrect choices and end up with incorrect identification. When pictures are provided for students to use to confirm their identification they tend to skip using the key and guess the species identification based on the picture alone. This is an issue as many species look similar.
Also, staff that possess the specific taxonomic knowledge may not have the computer expertise to create a digital taxonomic tool and so this digital opportunity is lost.
Therefore the aim of this project is to develop a web based tool that can be used by taxonomic experts to create interactive dichotomous taxonomic keys for smart phones, that are targeted to the end user and can be used with or without internet access.

Methods

A dichotomous taxonomic key is very much like a tree with bifurcating branches and a single leaf on the tip of the end branch. The Key-Builder and the Keys were developed using HTML 5 by Emmanuel Delaborde to ensure cross platform compatibility. The Key-Builder was designed to be web based and easy to use with buttons for building and editing the key. Drawings and photos can be added at multiple places to aid the user. A glossary can also be created, with pictures, that automatically links to the technical words in the key. Shortcuts are also incorporated so once a level of taxonomic knowledge is developed students can jump to the phylum or class of animals before working to the species level. Once a key is created it can be; Viewed, as seen by the user; Cloned, to duplicate the key so a new version can be created or Published so it is available for users. The key can also be de-assembled and rebuild using the detached branches and leaves.

A key was built to identify the intertidal animals on the Portobello shore by Sophie Fern with assistance from Sally Carson of the New Zealand Marine Studies Centre who allowed the use of information and photos from their database.

Ethics approval was obtained (D14/018) and the key was tested with students on the field trip to Portobello in 2014 and 2015. After the field trips the students were invited to participate in a

survey (only 2014 available) of their phone use, and their option of the digital-based key and a paper-based key. Students were also invited to a focus group about their phone use and the use of the digital key.

Key Findings, outputs and outcomes

The Key-Builder has been developed and keys published. See http://keys.otago.ac.nz/ and click on the View button to down load the Portobello 2015 key.

Of the 53 students who took part in the 2014 survey; 81% owned a mobile device, other than a laptop. Of those students that could downloaded the digital key; 73% tried and of those who tried 70% were successful. In 2015, 55 students (39%) had successfully loaded the key onto their phone for the field trip. In the focus group only 16 of the 22 students had a smart phone. Therefore not all students had access to a smart phone and even if they did the phone was "not very smart". This meant not all students had access to the digital key via their personal phone so a class set of iPads was provided to ensure enough devices were available to the students on the field trip.

Based on the 2014 survey, for those 35 students who had answered questions on both the paper and digital key a paired t-test on the mean Likert scores indicated no preference for either type of key. However, overall more students were positive about the digital key (81%) than the paper key (68%), with many positive comments such as "*It was definitely easier to use than the printed key. I felt a lot more confident in correctly identifying the animal and it was a lot faster and more efficient and accessib*le" but students also noted "*I find these gadgets hard to use and very frustrating*" and "*was quite slow*". Analysis of individual questions indicated that the digital key was easier, gave a clearer species identification, and helped students learn zoological terms and taxonomic features. The focus group also commented that they liked the digital key, but were wary of taking electrical equipment onto the rocky sea shore and that the sun and the device's small size made the screen difficult to see. Students also commented they wanted a real application, not a series of web pages.

Discussion and implications

Taxonomy is an area of biological science that is important but difficult to learn. Having a taxonomic key that the students work through in a systemic way and that has a inbuilt glossary, diagrams and a picture and description to confirm an identification has helped with this task. This reflects the increased level of resources available to support a student learning zoological terms and species identification with a digital key relative to a paper based key. However care needs to be taken that all students have access to such a digital resource if it is required for course work. Students also have high standards for digital media and so clearly describing the key as a down-loadable set of web resources is important for setting the expectations of the students.

The capacity to build keys in a simple manner with the web based Key-Builder tool has huge potential to support the learning of taxonomy in a wide audience. There are biological sciences courses in multiple learning institutes that face the same challenge of teaching taxonomy and obtaining accurate species identification. Taxonomic keys can be developed for a target audience, a specific purpose or in different languages (e.g. Te Reo). Experts could also develop specific keys for their specialty research areas to help with more complex identification challenges. Therefore, there is wide applicability for this development.