

# Teaching Methods

## FloraGator: A Novel, Interactive, and Online Multiple-entry Key for Identifying Plant Families

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**SUMMARY.** An interactive plant key was developed as an online tool with the specific goal of improving student learning of botanical vocabulary, plant morphology, and plant families. The online tool provides two options for using the multiple-entry key: identification of plant families based on historic botanical illustrations or live plant samples. The database consists of 196 angiosperm families, each with up to 220 botanical characters, and includes all of the plant families found in Florida. The tool uses a ternary system to record the diversity within each plant family such that upon entering identification information, families are eliminated that do not contain specific characters, which narrows the list of possible correct families. The remaining families are ranked according to total score, so families in which the features are common will appear first. This versatile online tool can be used nationwide to supplement in-person laboratory courses or distance education classes in horticulture, botany, systematics, and biology. To date, the newly launched site has been accessed by 1148 unique visitors from 15 countries.

Plant families are the highest taxonomic rank used in horticulture, consisting of one or more related genera. In most plant identification courses, students are expected

to learn 150+ plant species by family, genus, specific epithet, and sometimes cultivar. With the onset of distance education technologies, new approaches can be used to help identify plants by family. These online innovations not only serve to reinforce important subject knowledge but help meet a critical need when shifting from traditional, entirely synchronous laboratories (hands-on live learning) to a hybrid approach with asynchronous components. With nearly one-quarter of faculty reportedly teaching online (Seaman, 2009), a number of studies have shown distance education to be comparable (Anderson and Walker, 2003; Henss et al., 2006; Miller and Pilcher, 2001; Spooner et al.,

1999) or even superior to traditional classroom teaching (Means et al., 2010). Keeping students engaged, motivated, and challenged while teaching online still remains a challenge (Aragon, 2003; Beaudoin, 1990). Although learning outcomes can be equivalent among traditional in-class versus hybrid distance education courses, greater student satisfaction is still often correlated with live instruction (Hoch and Dougher, 2011; Rieger et al., 2011). Effective online formats use a variety of instructional strategies to enhance interactive learning, ensure critical thinking, and provide immediate feedback (Campbell et al., 2011; Schroeder-Moreno, 2010; Tignor et al., 2007; Wilson and Thetford, 2003).

To address the need for improved online learning tools, we developed an innovative method for classifying plants using an open sourced, asynchronous database. The online key (Fig. 1) was inspired by an existing flowering plant family identification site that used an algorithm for the botanical characters of a given plant (Phillips, 2005). The code was rewritten specific to the 196 families of monocotyledonous and dicotyledonous plants of Florida, many of which are found in other parts of the world. The taxonomic classifications follow the system proposed by the Angiosperm Phylogeny Group (APGIII, 2009). The database uses a ternary system to record the diversity within each plant family. For each of the 220 features listed in the key, the database records either a 0 for “absent,” a 1 for “rare,” or a 2 for “common.” As a user fills out the form, the key eliminates any family in which the feature never appears. The remaining families are ranked according to total score, so those in which the features are common will appear first. The site (coined FloraGator) was programmed using JavaScript (Netscape Communications, Dulles, VA) and branded with an alligator/flower icon professionally designed (Thoman, 2012).

As an alternative to keying out an unknown plant sample online, users can also select from a menu of highly detailed, full-color botanical illustrations obtained from an online library (Stüber, 2008) of an historical flower biology book (Thomé, 1885). Each illustration shows the parts of a plant in remarkable detail, and many include

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Fig. 1. Screen capture of the FloraGator multiple-entry key (University of Florida, 2012) showing (from left to right) option buttons, a botanical illustration, a close-up view, the illustration caption, and a list of matching families the key produced based on the selections.

both longitudinal section and cross section through the flower's ovary to illustrate the locules, ovules, and placentation (Fig. 1). For greater detail, a tool was added that allows users to zoom in on a given plant section. The plates were slightly modified in Photoshop (Adobe Systems, San Jose, CA) to remove each plant's scientific name and family name, but they are otherwise the same as the originals. The captions were translated from the original German and have, in a few minor cases, been edited for clarity.

In summary, through the use of historical botanical illustrations and/or live plant material, the multiple-entry process of FloraGator has created a powerful online learning tool for anyone studying botany, plant identification, and plant systematics. By selecting from a database of 220 features specific to the habit, leaves,

flowers, perianth, androecium, gynoecium, and fruit of an unknown species, users can practice their botanical knowledge virtually anywhere and at any time. To broaden its use, an application is currently being developed for smaller sized notepads or smart phones.

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