Dichotomous Keys as Way of Seeing

Teaching Botany Out of Context and Other Ways of Questioning the *Artistic* in Artistic Research Strategies

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Dichotomous keys: A first encounter

Imagine this: You are an art student, a designer, an artistic-scientific researcher perhaps, and you are invited to a workshop at a school for art and design. You are here to try your hand at teaching and learning a variety of different artistic strategies, but when you enter the workshop room, you are instead outfitted with an unnamed plant, a jeweler's magnifying glass, and a large book containing rows upon rows of text couplets listing plant characteristics. *The plan for today is to identify the plant before us*, the instructor starts, *using a staple method in the natural sciences: species identification using a dichotomous key.*

Introduction

The instructor in question would be me, a PhD student well into their second year of an artistic-scientific graduate program at the FHNW Academy of Art and Design, and the workshop a 60-minute speculative teaching scenario on artistic strategies. Granted, to consider the strategy of plant IDing with a dichotomous key artistic would be a stretch in most circumstances; indeed, I myself was taught the method in a starkly

different context, namely the early semesters of an undergrad degree in biology. Still, I jumped at the opportunity to examine ID keying in this setting. It represented fitting grounds to test a theory that had slowly formed throughout my cross-education in media theory, art, and biology: that perhaps the word *artistic* could cautiously be dropped from *artistic-scientific research*, its strategies recognized as research methods in their own right. I used the invitation to experiment with short, 60-minute teaching workshops, not to try my hand at a specific teaching style or pedagogical method, but rather to ask a broader question: What if we not only taught *artistic* research strategies to would-be artistic researchers – but research strategies, point-blank?

Rothmaler's Exkursionsflora von Deutschland, page 56.

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Tabellen zum Bestimmen

Tabelle zum Bestimmen der Hauptgruppen

Beachte auch die Sondertabellen VII–IX zur Bestimmung von

a) Bäume u. Sträucher im nichtblühenden Zustand (vgl. S. 21) **Tab. VII** S. 78
b) Tauch- u. SchwimmPfl (vgl. S. 22) **Tab. VIII** S. 86
c) Pfl zur Blütezeit od. stets (scheinbar) ohne grüne Bl **Tab. IX** S. 91

Diese Pfl können jedoch auch mit den Tabellen I–VI bestimmt werden.

1 Pfl ohne B u. Sa. Vermehrung durch staubfeine Sporen. Stets Kräuter (vgl. Farne Abb. **99**, **104–119**: GanzrosettenPfl od. Bl einzeln an gestreckten Bodensprossen, selten WasserPfl, Abb. **104**; Bärlappe Abb. **94**, **96**; Schachtelhalme Abb. **101**; – SporenPfl). (Wasserlinsen werden wegen ihrer unauffälligen B auch hier verschlüsselt) **Tab. I** S. 56

1* Pfl mit Sa, die in B, Zapfen (Nadelhölzer) od. einzeln an Sprossachsen (*Taxus*, *Ginkgo*) erzeugt werden (SamenPfl). Kräuter od. HolzPfl **2**

2 SaAnlagen nicht in FrKn eingeschlossen („nackt"), oft auf der OSeite von Sa- od. Zapfenschuppen (Nadelhölzer), die zu Zapfen angeordnet sind, selten einzeln an Sprossachsen. Stets Bäume od. Sträucher, meist mit Harzgeruch. Bl nadel- od. schuppenförmig, nur bei *Ginkgo*, Abb. **120**/1, br u. 2lappig. Meist immergrün (Nacktsamige Pfl). **Tab. II** S. 59

2* SaAnlagen in FrKn eingeschlossen („bedeckt"). Kräuter od. Gehölze; wenn ZwergSträucher mit nadelförmigen Bl, dann ohne Zapfen (Bedecktsamige Pfl) **3**

3 Bl fast stets streifennervig, fast stets einfach u. ungeteilt, selten 3zählig. BHülle fast stets 3- od. 6zählig, nie 5zählig, od. B nackt u. von 1 od. 2 Spelzen eingehüllt (Gräser u. Sauergräser). StaubBl meist 6 od. 3, nie >18. Keimling stets mit 1 KeimBl. Primärwurzel kurzlebig, früh durch Büschel sprossbürtiger Wurzeln ersetzt. Nur Kräuter (Einkeimblättrige Pfl). **Tab. III** S. 60

3* Bl fieder- od. fingernervig, selten streifennervig. BHülle oft 4- od. 5zählig, wenn 3- od. 6zählig, dann Bl nicht streifennervig. StaubBl 1–∞, sehr selten 6 od. 3. Kräuter u. HolzPfl. Fast stets 2 gegenständige KeimBl. Primärwurzel oft bleibend (Zweikeimblättrige Pfl) **4**

4 BHülle fehlend od. gleichartig (Perigon), d. h. nicht in K u. Kr gegliedert (aber zuweilen aus 2 kelchartigen od. aus 2 kronartigen Quirlen bestehend) (Zweikeimblättrige Pfl mit gleichartiger od. fehlender BHülle). **Tab. IV** S. 63

4* BHülle ungleichartig, in K u. Kr gegliedert **5**

5 Kr freiblättrig, aus 2–∞ völlig voneinander getrennten Bl bestehend, die einzeln abzupfbar sind (Zweikeimblättrige Pfl mit freien KrBl). **Tab. V** S. 69

5* Sämtliche KrBl wenigstens an ihrem Grund miteinander verwachsen, beim Herauszupfen die Kr sich als Ganzes loslösend od. zerreißend (Zweikeimblättrige Pfl mit verwachsenen KrBl). **Tab. VI** S. 75

Tabelle I · Sporenpflanzen

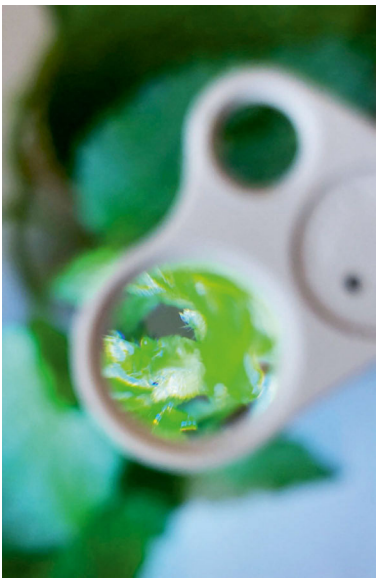
Zu den Sporenpflanzen gehören Algen, Moose u. Gefäß-Sporenpflanzen. Nur die zuletzt genannte Gruppe ist mit Hilfe der folgenden Tabelle zu bestimmen.

1 Stg gegliedert, quirlig verzweigt od. einfach. Bl quirlig, zu gezähnten, stängelumfassenden Scheiden verwachsen (Abb. **101**/3–7). **Schachtelhalm** – ***Equisetum*** S. 99

E.J. Jäger (Hrsg.), *Rothmaler - Exkursionsflora von Deutschland. Gefäßpflanzen: Grundband*, DOI 10.1007/978-3-662-49708-1_2

Courtesy of Vanessa Graf

Image of the plant seen through the microscope.



Photograph by Gabriela Aquije

Choosing a single research strategy for this purpose out of the wide variety of methods existent in the different sciences proved challenging, not least because the workshop scenario was limited in time and scope – and research strategies typically can take a lot longer than an hour to impart. I finally decided on plant identification through botanical ID keys, both as a matter of practicality (the basics of the method can easily be taught in a short amount of time) and personal preference (as a biology student, I had instantly taken to this systematic and often fascinating way of seeing our surroundings – and hoped my workshop participants, with their trained eyes as artists and designers, would feel the same).

Species identification is a cornerstone competence in many of the natural sciences, most notably biology and ecology, and dichotomous keys are central to the undertaking. They consist of long lists of couplets describing (plant) characteristics in highly standardized technical terms, inviting the researcher or student to make an informed choice to pass from one trait to the next until ending at the exact genus and species name of the organism under examination. The use of such a key requires a well-trained eye, grounded knowledge of technical vocabulary and (plant) biology, as well as the ability to accurately match the characteristics on the live organism to the traits described.

As I hoped to show through the embodied experience of identifying a plant in the detailed, specialized study of traits indiscernible to the untrained eye, the careful, applied practice of a scientific method can be reminiscent of employing artistic strategies – and vice versa. If an artist's work is carried out with the specific aim of research or knowledge production, why keep so strictly to teaching *artistic* methods only? By proposing a workshop that was not focused on a particular teaching method, but rather a different approach to teaching research strategies in art and design altogether, I was curious to see whether this impression would be shared by other artistic-scientific researchers.

This essay further reflects on this dissolution of expressly *artistic* into simply research strategies, starting with a short description of my workshop and teaching setting at the 2022 *Teaching Artistic Strategies* symposium. In the second part, the historical development, uncertainties, and dissonances of dichotomous keys and plant identification manuals are

briefly examined, contextualizing the felt assonances between plant ID keying and working as an artistic-scientific researcher beyond personal experience. Reflecting on case of dichotomous keys and the outcomes of the workshop, the essay concludes with a tentative verdict on the usefulness of a distinct category of *artistic* strategies (as opposed to other strategies in research) – and what this would mean for teaching them to the next generation of practice-based students and researchers.

The how of it all: Head in the Cloud, Hands in the Dirt

The series of workshops at the 2022 *Teaching Artistic Strategies* symposium was centered around teaching practices of artistic-scientific researchers: What could, what should teaching artistic strategies in and for research contexts look like? In short, 60-minute experimental teaching settings, participants took turns sharing their practices as teachers and stepping into the shoes of students. My workshop was entitled *Head in the Cloud, Hands in the Dirt* – a play on the combination of my own artistic-scientific research in media science (on metaphors such as the Cloud used as stand-ins for large-scale computer network infrastructures) with my formal training as a student of biology.

In preparing for the workshop, I had been going on walks through the neighborhood of the FHNW Academy of Art and Design in Basel to encounter local plant species. I was looking for one plant family in particular, *Lamiaceae* or the mint family, as it is called by its trivial name, so when I chanced upon an abundance of spotted dead-nettles (*Lamium maculatum* L.), I carefully picked up a few specimens to bring to the workshop. Participants were split into small groups of three to four people and presented with one of the specimens, as well as LED-equipped jeweler's loupes. A copy of the 21st edition of Rothmaler's field guide to botanical identification, *Grundband: Exkursionsflora von Deutschland*[1], was projected onto a wall, alongside translations into English. Wherever the textual descriptions were bordering on becoming too technical, complex, or simply unfamiliar to participants, illustrations taken from Schmeil-Fitschen[2] were provided as additional reference points.

Whereas usually beginners in botanical identification would go through the tedious, but often rewarding process of learning the highly technical vocabulary, abbreviations, and scarce illustrations used in the field guide, alongside being taught more profound plant physiology, the time constraints and specificities of the workshop setting called for more flexible methods. Participants were thus invited to engage in the identification of the plant before them in a collective and participatory manner, being guided through using the dichotomous key provided while simultaneously encouraged to discuss any unclarities in vocabulary, form, or plant physiology that might arise.

I had specifically chosen a member of *Lamiaceae* for the workshop, mainly because of its four key characteristics shared across the plant family: its four-sided stem, oppositely arranged leaves, dorsiventral blossoms, and a fruit that is split into four parts, more accurately called *eremocarp*. Each of these characteristics had the potential to reveal a different way of seeing to workshop participants not used to plant identification by dichotomous key or the careful examination of small and often overlooked plant traits, while at the same time being easy to spot once one knows what to look for. Through the practical experimenting with this systematic, technical, and highly standardized method of identifying different organisms, I hoped that participants would experience first-hand the link between ways of seeing and ways of knowing that is often highlighted as a central element of artistic-scientific practice, but far from unique to the field. It was the spark that had initially incited me to think about research strategies in the field of art and design being labeled expressly *artistic*, and I used the workshop as a testing ground to see whether my thoughts on the topic would resonate with my peers.

Before discussing the results of the workshop, however, it is worthwhile to take a moment to briefly examine the historical roots of dichotomous keys, which, at their onset, were heavily debated. The uncertainties and dissonances integral to the establishment of this particular method speak to a long, troubled process of conceiving a research strategy fitting its subject – labour that most artistic-scientific researchers of today will be more than familiar with.

Turbulent histories of well-established presents

Dichotomous keys have a firm and well-established hold on plant identification and, by extension, species ordering, on today's community of botanists and ecologists. Indeed, the importance of ID keys to the field and the framing of knowing how to use them as a key competence of any self-respecting biologist is often emphasized[3]. However, a short look at the historical roots of the method speak to the uncertainties, positionalities, and precarities inherent in this (as in any) scientific strategy, no matter how widespread and standardized it might appear decades later.

In her essay on identification keys, historian Sara T. Scharf traces the beginnings of botanical keying back to the first half of the 19th century and outlines the heated discussions around the development of the method[4]. At the height of colonial expansion, in what was termed the age of "discovery", a new need to communicate across larger distances and the ever-growing number of different plant species known to the Western scientific community led botanists at the time to search for a standardized approach to botanical identification. The best strategy for the task was far from clear, and soon, two factions emerged: Proponents of the so-called "natural method" argued that plants should be grouped by visual similarity and identified by their overall visual appearance, whereas defenders of the "artificial method" chose a more systematic strategy and ordered plants by traits in indexes, forgoing visual similarities entirely.

Only scarcely hidden underneath these debates was a deeper philosophical concern for the "correctness" or "truth" of the order of the plants. Many botanists at the time believed that a (Christian) God had intended a specific order of species on Earth[5], and that instead of meddling with this divine order, humans should instead only try to correctly discern and truthfully reproduce this order in their field guides and manuals. Finding the best-fitting manner to group and identify organisms was a quest for true, divine knowledge – how specimens were ordered, classified, and made identifiable in these first versions of plant ID manuals either made possible or obfuscated seeing the divinely intended order of things.

These developments not only represented a shift from a variety of ragtag, local, place- and context-based classifications and identifying schemes to a supposedly universal, divinely intended "truth", but also to a more global and standardized system of plant identification in general. The process included complex debates and numerous iterations of the layout and design of the new field guides, leading to the gradual and at times controversial development of many of the key components of modern-day ID manuals and keys. The way botanical information was presented on a page was thought to reflect the reality of a natural order of plants, and everything from the deliberate use of white space to guide the eye, standards of text indentation, and the visual arrangement of large descriptive blocks was up for discussion. The link between lived environment, text, and field guide layout was further reinforced through the "use of standardized terminology, the order in which features of specimens are presented, the order in which descriptions of species or of higher taxa are arranged, and, often, systems of cross-references" [6]. Another point of concern was the use of illustrations, or rather, the lack thereof: budget constraints and crude printing techniques led to the proliferation of text-based identification manuals instead of richly illustrated guidebooks.

Ultimately, the search for a fitting research strategy in the field of botanical classification and identification asked a simple question: How do we develop a method that best understands and captures the plants (the world) around us? Which practices grasp (divine) "truth", how is knowledge produced and translated to text and paper, and how do the strategies we use shape our views of what there is to be known? More than just a personal feeling of kinship between methods that I experienced in my training as both a biologist and artistic-scientific researcher, this brief look at the history of botanical identification reveals a more in-depth affinity between research strategies, whether they are labeled *artistic* or not. Why, then, are we so often invited to think of them, learn them, employ them, and eventually also teach them as separate?

Conclusion: Teaching ~~artistic~~ strategies

In the debriefing session after my workshop, many participants voiced a shared feeling of resonances between ID keying and their own practices, if not in the specificities of the method, then in the way that particular (and oftentimes skilled) attention is required for a specific type of seeing, a specific type of knowing. To me, it was encouraging feedback after having tried teaching a method from my training as a biologist with my peers in art and design for the very first time – and affirmation that even though they might come from vastly different fields, different types of research strategies do not necessarily need to be kept contained in their original contexts of origin.

It was equally fascinating to observe the nuanced differences between how artists and designers, unique in their practices but nevertheless all well-trained in visual understanding and perception, engage with botanical identification, as opposed to biology students. One example which might illustrate this point is which plant traits workshop participants were struggling to see clearly and, in contrast, which concepts came to them easily. Not used to having to look very closely at the sexual reproductive organs of plants, for example, it took quite a while for most participants to spot the four distinct capsules of the *eremocarp*-type fruiting body – an organ quite familiar even to beginner botanists. At the same time, being trained in art and design, the concept of a dorsiventral symmetry in the blossoms of our sample plant was immediately clear across the room. I had started out this workshop with the question of what would happen if we not only taught *artistic* methods, but simply research strategies to artists and designers, and by the end of it started to see a little bit of the answer: A fascinating cross-pollination of ideas, skills, and knowledges; a shared feeling of methodical affinities; and perhaps a growing understanding that in teaching strategies for research in art and design, it is not only the *how* that counts, but also the *what*.

If teaching botany (or any other research strategy) out of context is one side of this coin, then the other must no doubt be to take what has so far been labeled *artistic* strategies in research seriously as research strate-

gies, point-blank: to consider them as one of many, instead of methods in constant opposition, in the weird seclusion zone labeled artistic-scientific research. To extend this confidence in ~~artistic~~ strategies to teaching entails teaching them as, with, or alongside other research strategies, no special labelling required. My 60-minute slot at the *Teaching Artistic Strategies* was an experiment in how teaching for and in research in art and design could look like if this was the case – if, instead of teaching *artistic* strategies, we simply taught *research* strategies, whether that be painting, interviewing, writing, ID keying, statistical analysis, or else. The series of workshops at the symposium, taken in its entirety, was one larger-scale example, allowing for botanical identification to exist on the same theoretical and practical plane as critical debugging or associative image-story-telling, to name just two of the other ~~artistic~~ strategies experimented with during the teaching scenarios.

I like to believe that it is in a context and company as cross-disciplinary and openminded as this that experimental, ~~artistic~~ strategies can establish their full potential and provide a meaningful contribution to a wider scientific discussion on how knowledge is constituted, created, and established. In the same vein, I hold on to the idea that being taught and teaching research strategies that are not expressly *artistic* to researchers in art and design can only serve to better our research. In the end, *teaching ~~artistic~~ strategies* for research is about learning how to match (or, in many cases, create) the best-fitting strategy or method to a given research endeavour – and as curious researchers, why would we limit ourselves to what is considered *artistic* only?

Notes

1 Eckehart J. Jäger, ed.: *Rothmaler – Exkursionsflora von Deutschland. Gefäßpflanzen: Grundband*, 21st ed. (Berlin Heidelberg: Springer Spektrum, 2016).

2 Otto Schmeil et al.: *Die Flora Deutschlands und angrenzender Länder: Ein Buch zum Bestimmen aller wildwachsenden und häufig kultivierten Gefäßpflanzen*, 97th ed. (Wiebelsheim: Quelle & Meyer Verlag, 2019).

3 During a field trip in the second semester of my biology studies, for example, two of my professors not only highlighted the importance of correct species identification for any scholar in the natural sciences, but explicitly made note of the increased employability of anybody who can reliably ID a large number of organisms. For a discussion of the importance of identification keys that is more than anecdotal, see for example: Steve Tilling, "Keys to Biological Identification: Their Role and Construction," *Journal of Biological Education* 18, no. 4 (December 1984): 293–304, https://doi.org/10.1080/00219266.1984.9654660; Thomas Edison E. dela Cruz, Ma. Victoria B. Pangilinan, and Rodrigo A. Litao, "Printed Identification Key or Web-Based Identification Guide: An Effective Tool for Species Identification?," *Journal of Microbiology & Biology Education* 13, no. 2 (December 3, 2012): 180–82, https://doi.org/10.1128/jmbe.v13i2.426.

4 Scharf, Sara T.: "Identification Keys, the 'Natural Method,' and the Development of Plant Identification Manuals," *Journal of the History of Biology* 42, no. 1 (2009): pp. 73–117.

5 This discussion is not unique to dichotomous keys. For an interesting example on the conceptualization of life on Earth as a ladder or tree, reflecting anthropocentric hierarchies and ideals, see: Hejnol, Andreas. "LADDERS, TREES, COMPLEXITY, AND OTHER METAPHORS IN EVOLUTIONARY THINKING." In *Arts of Living on a Damaged Planet: Ghosts and Monsters of the Anthropocene*, edited by Anna Tsing, Heather Swanson, Elaine Gan, and Nils Bubandt, 87–102. University of Minnesota Press, 2017. http://www.jstor.org/stable/10.5749/j.ctt1qft070.9.

6 Scharf, Sara T.: "Identification Keys, the 'Natural Method,' and the Development of Plant Identification Manuals," p. 83.