Improvement of student's plant species knowledge by different identification methods

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Theoretical background

Knowledge of species is an important detail and learning goal in biology lessons, as a good knowledge of species is essential for understanding biological context (especially for the topics of ecology and evolution). Furthermore, a good knowledge of species can contribute to a better understanding of nature conservation, which can promote environmental action (Berck & Klee, 2013). Unfortunately, animals receive more public attention than plants, which is described by the phenomenon of "plant blindness" (Pany, 2014; Wandersee & Schussler, 1999). With the ongoing loss of biodiversity and desired Sustainable Development Goal 15 (United Nations, 2015) the relevance of plant species knowledge is reinforced. An analysis of curriculums in Germany shows that the method of identification with books, apps and outdoor-excursions are recommended activities, in addition to making observations, herbarium and creating species profiles (Lindemann-Matthies & Remmele, 2021). For this reason, three identification methods for increasing the knowledge of plant species were tested, in order to investigate the influence of the method on improving species knowledge in the medium term. A theory of concept learning describes that intensive engagement promotes the memory of knowledge (Mietzel, 2007). Under many other conditions, attention and meaning are also relevant for recognition (Rugg, 1998). Therefore, it can be assumed that methods with a focus on the importance of plants, such as the presentation by the teacher, increase species knowledge. As well it can be assumed that in-depth examination of the plant via nature guide promotes the knowledge of species. In contrast, the use of an ID-App to identify the species (by just taking a photo) is not considered to be very beneficial.

Research design and methodology

Three groups á ten biology students received two species of local plants weekly for nine weeks for identification. The eighteen species in total were presented in their habitat, potted or at least as a part comprising stem, leaves and flowers. If not shown in its habitat, information on the natural occurrence and overall habitus of the plant species were provided. As a pre-test, previous knowledge was assessed by writing the presumed name of the species and/or plant family on a note anonymously. Thereafter, the students of the different groups identified the plant species either by using an ID-App (flora incognita), an identification book (nature guide) or by a short teacher presentation (5-Minutes-Biology). The method of 5-Minutes-Biology according to Beiler (1965) is a recurring action led by teachers, in which knowledge of

morphology can be promoted, occasional finds can be discussed and basic biological terms can be saved - without reference to actual lesson. This procedure of those three methods was repeated weekly while rotating the method of identification between groups (Figure 1). In this way, each student identified six plant species by using the ID-App, nature guide and 5-Minutes-Biology. By weekly rotating the methods between the groups the influence of intergroup heterogeneity and different teachers were minimized.

		Group 1	Group 2	Group 3
Week 1	Species 1 & 2	5'-Minutes-Biology	Nature guide	ID-App
Week 2	Species 3 & 4	ID-App	5'-Minutes-Biology	Nature guide
Week 3	Species 5 & 6	Nature guide	ID-App	5'-Minutes-Biology
Week 4	Species 7 & 8	5'-Minutes-Biology	Nature guide	ID-App
Week 5	Species 9 & 10	ID-App	5'-Minutes-Biology	Nature guide
Week 6	Species 11 & 12	Nature guide	ID-App	5'-Minutes-Biology
...	...	...	...	...

Figure 1: Rotating design with three groups á ten students

The post-test was carried out at the end of the semester, by an online query with images of the plants. The actual plants could no longer be presented due to the temporary vegetation period and context effects could thus be prevented (Myers & Wahl, 2008).

Findings

Figure 2 shows the results of the pre-test. The blue colored columns represent the proportion of species that the students precisely named by species. The orange colored columns represent the proportion of correctly identified plant families. Accordingly, the students recognized only a few plants exactly (*Achilla millefolium* 79.31 %, *Galium odoratum* 34.48 %, *Echium vulgare* 29.63 %), although they are part of the local fauna in Germany. The most common plants, which were correctly named after plant families, are *Jacobaea vulgaris, Geranium molle* and *Echium vulgare* (13 % - 18 % correct answers).

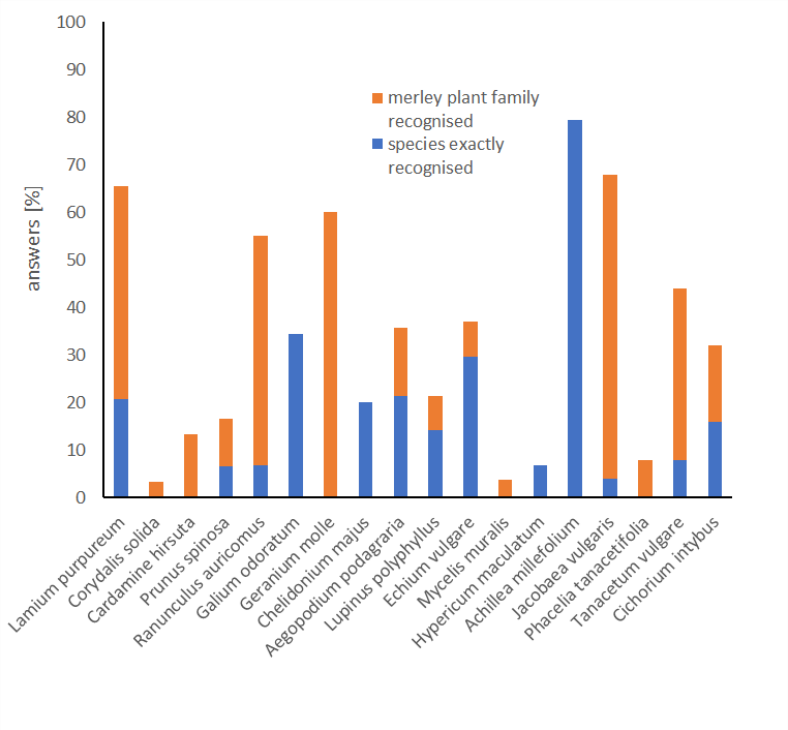

Figure 2: Species recognition of selected plant species by students (pretest, N = 30).

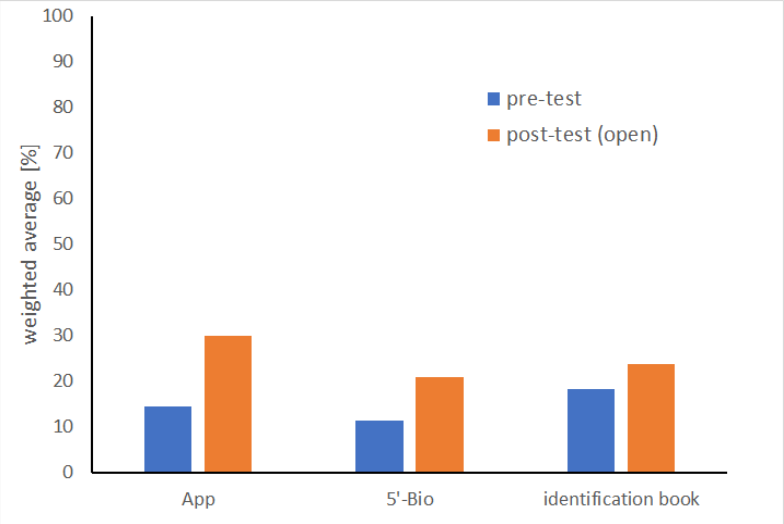

Figure 3: Species knowledge by students before (pre-test) and after using methods of identification (N = 462).

Figure 3 shows the weighted average of the exact naming of plant species after using the three methods (ID-App, 5'-Minutes-Biology and Identification book/Nature guide). In a total of 331 cases (of N = 462) species were not recognized by students in pre- and post-test. In 55 cases, species were not recognized in the pretest but recognized in the post-test. A significant improvement species knowledge, after McNemar-Test (related samples), occurred for the methods ID-App ($p = 0.000$) and 5-Minutes-Biology ($p = 0.003$). However, no significant changes were shown for the nature guide method ($p = 0.118$).

Conclusion

Contrary to our assumptions, promotion of plant species knowledge was superior using the method ID-App compared to the methods using the nature guide book or the 5-Minutes-Biology. After using the ID-App, results show better species knowledge scores than the 5-minute biology. The question arises, whether these results can also be replicated with pupils. At school, the choice of the identification method depends on the teacher (Lindemann-Matthies & Remmele, 2021). Based on these results the ID-App can be recommended for school practice, ahead of conventional methods like nature guide or 5-Minutes-Biology.

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