Students' interest in useful plants: A potential key to counteract plant blindness

Peter Pany
University of Vienna
Austrian Educational Competence Centre for Biology (AECCbio)
Porzellangasse 4
1090 Vienna, Austria

DOI: 10.3732/psb.1300006
Submitted 1 September 2013.
Accepted 13 January 2014.

Acknowledgments: The author thanks N. Milasowszky for help with statistical data analysis as well as Ch. Heidinger, M. Kiehn, M. Scheuch, and two anonymous reviewers for their constructive comments on this paper.

Abstract

"Plant blindness" is a term for the observation that people tend to overlook plants in everyday life, resulting in a constrained view on nature. The present study addresses how botany educators could counteract this phenomenon by looking at students' interest in useful plants. Therefore, a questionnaire was developed that tests students' interest in five subscales (medicinal plants, stimulant herbal drugs, spice plants, edible plants, and ornamental plants). Students (n = 1299) between 10 and 19 years of age were investigated in order to detect patterns of interest in useful plants. Results show that stimulant herbal drugs are of above-average interest for all grades, and medicinal plants are interesting for grade 12 as well as for grade 5, although less interesting for grade 8, whereas edible plants and ornamental plants trigger only low interest. Hence, medicinal plants and stimulant herbal drugs seem to be especially suitable for counteracting plant blindness in education.

Key words: plant blindness; questionnaire; students' interest; useful plants

"Teaching botany is a hard thing to do" is a sigh heard from many biology teachers and botany lecturers. Since the 1950s, teaching botany in school and at the university level has been considered difficult (Greenfield, 1955). One of the most apparent reasons for these problems is a phenomenon called "plant blindness" (Wandersee & Schussler, 2001), which means that students tend to overlook plants and herbal products in everyday life (Hershey, 1996). Therefore, students not only ignore the important role of plants in nearly every ecosystem, but also in their personal lives. Hence, processes essential for life on our planet (e.g., photosynthesis) do not find a way into students' consciousness.

A major part of biomass on earth seems to remain unperceived by most people of all age classes.

Many reasons are given for this problem, with some attributing it to the way biology is taught in school. Even at university level, botanists sometimes do not emphasize sufficiently the important role of plants as producers, food, habitats, etc. (Hoekstra, 2000). Instead, the phenomenon of so-called "zoochauvinism" (Bozniak, 1994) is predominant in teaching biology; teachers use animals as examples to explain general biological principles (e.g., natural selection and evolution) much more frequently than they do with plants (Hershey, 1996; Link-Pérez et al., 2010). In addition to these teaching-based reasons, the perception of plants by people is different compared to that of animals. Plants are rarely perceived as individuals but rather as a kind of "green mass" with leaves and stems blurring into an indistinguishable pattern of green shades (Wandersee & Schussler, 2001; Schussler & Olzak, 2008).

The phenomenon of plant blindness has serious consequences for the attitude of students (and, by extension, of people in our societies) toward the environment and their way of perceiving nature. Recent research has pointed out the following manifestations of plant blindness:

- Plants are completely overlooked in students' everyday lives (Balick & Cox, 1997).
- Students do not perceive plants as creatures but consider them only as a kind of "scenery" for animals (Wandersee & Schussler, 1999).
- Students do not know the needs of plants; that means they are not aware of what substances

plants need to survive (e.g., water, nitrogen, phosphorous, etc.) (Wandersee & Schussler, 1999; Schussler et al., 2010).

- There is a lack of personal contact with plants and plant growth. Even frequent plant species cannot be differentiated or named (Wandersee & Schussler, 1999; Bebbington, 2005).
- Students do not have a basic knowledge of plant life cycles, their reproduction, or their roles in different ecosystems (Wandersee & Schussler, 1999; Schussler & Winslow, 2007).
- The role of plants in one of the most important cycles in ecosystems—the carbon cycle—is completely ignored (Wandersee & Schussler, 1999).
- The diversity of the plant kingdom, the co-evolution of plants with many animals, the manifold evolutionary adaptations, and the versatile colors, smells, and flavors are not perceived (Wandersee & Schussler, 1999).
- Even if plants are seen as creatures, they are seen as inferior compared to animals (Flannery, 2002).
- When working with plants, students usually become aware only of visually perceptible structures (e.g., colorful blossoms or patterned stems) but do not go into further understanding of the role plants play in an ecosystem or the contribution of plants to their personal lives (Tunnicliffe, 2001).
- In educational settings (e.g., in botanical gardens) students tend to move their attention immediately from the plants to any animal appearing on the scene (Tunnicliffe, 2001).

Nonetheless, plant blindness can be counteracted. Hershey (1992, 2002, 2005) proposes specific "plant-mentoring-programmes" in schools: for example, planting seedlings and watching them grow to procure practical experience with plants and make their life processes more apparent to students. Moreover, special programs in museums and botanical gardens should be implemented, communicating the important role of plants in everyday life. Strgar (2007) indicates that the knowledge of teaching experts and their enthusiasm may also make it easier for students to realize the importance of plant life. Lindemann-Matthies (2005) also examined the preferences of students for animals compared to plants and investigated programs to enhance students' interest in plants (e.g., creating a "plant gallery" with pictures of plants students encounter growing on their way to school).

In spite of all these efforts, there are few evidence-based considerations about which specific plant groups should be used to efficiently counteract plant blindness. According to the self-determination theory of motivation, considering an object "interesting" is an important condition to make cognitive learning efforts possible and to develop intrinsic motivation (Deci & Ryan, 1993). Moreover, present research has pointed out that pre-existing interests are an important key for connecting new information to existing knowledge (Hidi & Baird, 1986; Hidi, 1990; Krapp, 1999). Nevertheless, scientific studies investigating which plants students perceive as interesting have hardly been performed.

Only few data are available concerning the interest in plants (Schreiner & Sjøberg, 2004), and they only provide information on a quite general level (e.g., interest in "plants in my environment"). However, results of Krüger & Burmester (2005) and Lindemann-Matthies (2005) show that useful plants may be considered interesting by students because usability is one of the most important criterion students apply when arranging plants into groups. In addition, Hammann (2011) pointed out that medicinal plants are interesting for students. What remains unknown is whether students find useful plants interesting on the whole or only selected subgroups of useful plants. Furthermore, there are no findings regarding how far students' interest in useful plants depends on gender and/or age, which may have special relevance in light of the studies by Kattmann (2000) and Löwe (1987), which describe students' decreasing interest in biological topics with increasing age.

Therefore, the aim of the present study is to explore the structure of interest with regard to useful plants. This objective seems all the more important since a look into currently used biology text books (e.g., Campbell & Reece, 2011; Cholewa et al., 2010) shows that botanical content already is often introduced by means of a subgroup of useful plants, namely ornamental plants. Is this plant group then an appropriate gateway entering botany? In order to answer this question, the study presented here seeks to find out whether there are any differences in interest within the target group (high school students) regarding different subgroups of useful plants. Which subgroups of useful plants are actually interesting for students? Since students' interests cannot be assumed as stable and are known to change in high degrees during adolescence, for example, to fulfil gender roles (Krapp, 2000), the present study also explores how students' interest in useful plants differs with regard to various grades and genders in order to assist teachers (or any other botany educator) to impart botanical contents on the basis of plants that are seen as interesting by their particular students. For this purpose, a questionnaire (Fragebogen zur Erhebung des Interesses an Nutzpflanzen, or FEIN) was designed that measures the interest in useful plants, based on a pre-study (Sales-Reichartzeder et al., 2011) and induced by findings from recent research that has shown that questionnaires are appropriate tools for examining students' interests (e.g., Urhahne et al. 2004).

MATERIALS AND METHODS

The FEIN questionnaire

The definition of the term "useful plants" underlying the questionnaire is based on the fundamental work "Nutzpflanzenkunde" (meaning "botany of useful plants") by Lieberei et al. (2007). Hence, "useful plants" are defined as all plant species used by humans. They are divided into various groups according to their specific purpose (e.g., spice plants, edible plants, etc.). In our pre-studies (Sales-Reichartzeder et al., 2011), the questionnaire contained six subscales. In addition to the subscales "edible plants," "spice plants," "medicinal plants," "stimulant herbal drugs," and "ornamental plants," a subscale based on biological theory named "technically used plants" was introduced that represented plants used for gaining energy, producing textiles or dyes, or building materials. This subscale could not be maintained with reliability analysis (Cronbach's Alpha = 0.53). These findings do not astonish with regard to the high variability of application fields of technically used plants, their most important common feature being that they do not belong to any of the other subscales. Because of these reasons, the subscale "technically used plants" was excluded from the questionnaire.

The final version of the FEIN questionnaire tests five subscales that measure the interest in edible plants (mean of items 1, 6, & 11), spice plants (mean of items 4, 9, & 14), stimulant herbal drugs (mean of items 2, 7, & 12), medicinal plants (mean of items 3, 8, & 13), and ornamental plants (mean of items 5, 10, & 15). Each plant group is represented by three items, with the whole questionnaire containing 15 items (see Appendix A). The design of the items follows the ROSE Questionnaire (Relevance of Science Education), an instrument used in one of the largest international comparative studies investigating students' view on science and science education in 41 countries (Schreiner & Sjøberg, 2004). The items are formulated as headlines describing the object of interest, such as "plants to improve my room" or "plants curing a sore throat." Similar to ROSE, the questionnaire uses a four-stage Likert-scale (1-Not interested, 2-Rather not interested, 3-Rather interested, and 4-Very interested). Additionally, the following demographic data were collected in the questionnaire: sex, age, grade, school. Without any time pressure, filling in the questionnaires took approximately 10 to 15 minutes.

Survey Participants

In a preparation phase (December 2009) before performing the study on a large scale, the questionnaire was handed out to 95 students from one secondary school in Vienna. Afterwards, ten students from different grades were asked for detailed feedback about the questionnaire to ensure that each statement was well understood by the students. According to the first test-run and the preliminary statistical analysis (n = 95), minor changes were made in wording and layout to improve the questionnaire for the large-scale survey.

Subsequently (from March to May 2010), 15 secondary schools voluntarily participated in the main phase of the present study. Each of these was located in a different Viennese district and two were outside Vienna, providing a representative cross-section of secondary schools in and around Vienna. The questionnaires were filled in voluntarily during the students' biology lessons. A total of 1,417 students answered the questionnaire; 118 of them were excluded due to missing, double, or obvious hoax answers (e.g., zigzag patterns), which resulted in a final number of 1,299 participating students. These 1,299 usable questionnaires were filled in by 51% male and 49% female secondary school students; 21% of the students attended the 5th grade, 14% the 6th grade, 13% the 7th grade, 17% the 8th grade, 10% the 9th grade, 16% the 10th grade, 4% each the 11th grade and the 12th grade (exact numbers are given in Table 1).

Table 1. Descriptive statistics of the sample (n = 1,299).

	5th Grade	6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	Total
Male students	133	97	87	122	63	117	30	14	663
Female students	144	85	80	103	69	95	26	34	636
Mean of age (a)	10.75	11.87	12.89	13.76	14.95	16.00	16.93	18.06	14.40

Statistics

In order to investigate the structure of students' interest in useful plants, original data were subjected to principal components analysis (PCA) using the correlation matrix. Only principal components that accounted for variances greater than 1 (Kaiser-Guttman criterion) were used to represent the data. A "varimax" rotation was applied to the retained components to redistribute the variance among factors to obtain PC scores (James & McCulloch, 1990; Jolliffe, 2005; Norusis, 1990). Multivariate analysis of variance (MANOVA) with subsequent post-hoc tests (Scheffé tests) was used to find out whether the students exhibited any differences concerning interest in useful plants. Univariate analysis of variance (ANOVA) with subsequent post-hoc tests (Scheffé tests) then was used to find out whether there were differences in students' interest in different groups of useful plants as such and to analyze differences with regard to the degree of interest students have in different grades for the five groups of useful plants, respectively. *T*-tests were used to test differences in interest between the five subscales and to test gender differences between the five subscales. Cronbach's Alpha was used to measure the reliability of the subscales. All statistical analyses were performed using SPSS™ for Windows, Version 16.0.

Results

Components of interest in useful plants

The PCA of our data led to five principal components complying with the Kaiser-Guttman criterion (see Appendix B). They together explained 51.9% of the total variance. This structure of interest in useful plants found in the investigated population corresponded with the five subscales derived from biological theory. Cronbach's Alpha gave values between 0.66 and 0.76 for the five subscales (see Table 2).

Differences between the five subscales relating to the whole sample

In order to investigate whether there are differences in interest between the five subscales, a univariate ANOVA was calculated. The results of this analysis show that there are significant differences in interest between the five subscales ($F_{4,\ 6490} = 202.5$, $P < 0.001$). Furthermore, it seemed to be important to gather information whether a plant group is interesting for students or not. Hence, the mean of interest of a certain subscale was tested on whether it exceeds or falls below the value of 2.5, which represents medium interest on the Likert scale from 1 to 4. The results of the analysis for the whole sample show that medicinal plants are the most interesting plant group (mean of interest = 3.09, $t = 28.25$, df = 1298, $P < 0.001$), followed by stimulant herbal drugs (mean of interest = 2.90, $t = 16.31$, df = 1298, $P < 0.001$) and spice plants (mean of interest = 2.56, $t = 2.91$, df = 1298, $P = 0.004$). These three plant groups attract above average interest and can therefore be termed as interesting. Edible plants(mean of interest = 2.43, $t = -3.33$, df = 1298, $P = 0.001$) and ornamental plants (mean of interest = 2.32, $t = -7.20$, df = 1298, $P < 0.001$) turn out to be the plant groups arousing below average interest. An overview of the means of interest with standard deviations in the five subscales calculated for the whole sample is given in Table 3.

Differences between grades

The results of the MANOVA show that there are noticeable differences in how far students

Table 2. Reliability of the five subscales of the FEIN questionnaire.

	Medicinal plants	Stimulant herbal drugs	Spice plants	Edible plants	Ornamental plants
Cronbach's Alpha	0.718	0.739	0.660	0.661	0.760

Table 3. Means (M) and standard-deviation (SD) of interest in different plant groups measured with the FEIN questionnaire. Means above 2.5 indicate above-average interest.

Plant group	M	SD
Medicinal plants	3.09	0.75
Stimulant herbal drugs	2.90	0.88
Spice plants	2.56	0.78
Edible plants	2.43	0.78
Ornamental plants	2.32	0.89

from different grades are interested in the five plant groups (*Wilks's* Λ = 0.907, $F_{35, 5416}$ = 3.628, $P < 0.001$), although the order of the subscales is similar in most grades (see Table 4). The results of the calculated ANOVAs enabled us to detect three types of patterns; interest means of the five subscales for all grades with *F*-statistics are given in Table 4.

1. The interest in edible plants, spice plants, and ornamental plants in low grades (5 and 6) is significantly higher than in higher grades (7 to 12) (see Figure 1A–C).

2. The interest in medicinal plants in grades 5, 6, and 12 is significantly higher than in the other grades, so the very young and older students are very interested (see Figure 2).

3. The interest in the plant group of stimulant herbal drugs does not change at all; there are no significant differences between the eight grades (see Figure 3).

As the results show, the interest in different groups of useful plants is definitely not the same at all grades and also strongly depends on the useful plant subscale.

GENDER DIFFERENCES

In general, there are few significant gender differences with regard to the interest in useful plants. Ornamental plants are the only subscale in which significant gender differences could

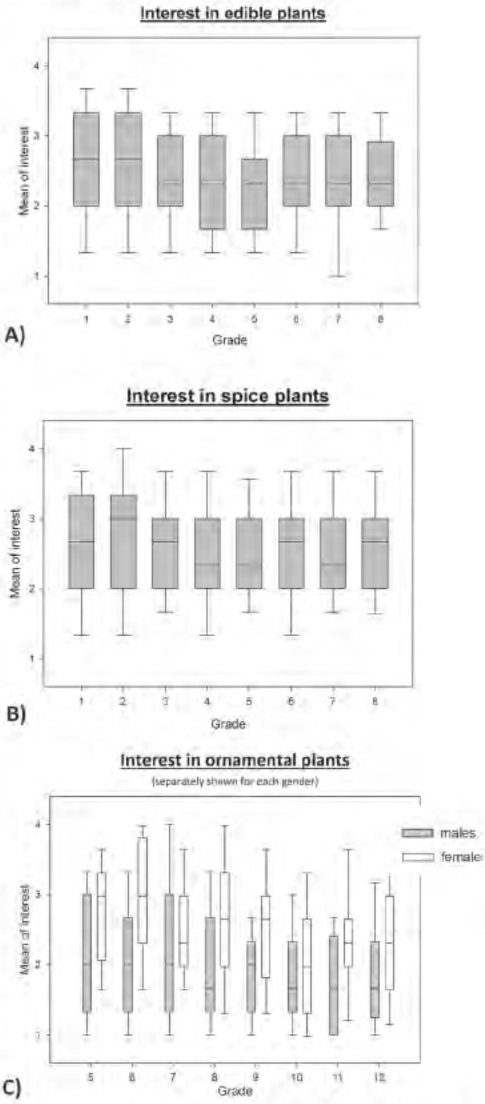

Figure 1. Means of interest of the subscales "edible plants," "spice plants," and "ornamental plants" for all grades; for ornamental plants, male and female students are indicated separately.

Table 4. Means (M), Standard deviations (SD), and univariate F-Statistics of interest in the subscales of the FEIN-questionnaire for different grades.

Subscale	5th Grade		6th Grade		7th Grade		8th Grade		9th Grade		10th Grade		11th Grade		12th Grade		F	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
Medicinal plants	3.16	0.74	3.22	0.75	3.05	0.71	2.91	0.77	2.87	0.86	3.11	0.69	3.11	0.67	3.39	0.59	7.524	**
Stimulant herbal drugs	2.85	0.88	2.87	0.90	2.97	0.81	2.94	0.91	2.86	0.96	2.92	0.87	2.84	0.81	3.00	0.84	0.748	
Spice plants	2.81	0.80	2.75	0.86	2.57	0.75	2.48	0.81	2.51	0.70	2.49	0.75	2.48	0.67	2.60	0.79	2.484	*
Edible plants	2.81	0.77	2.58	0.81	2.42	0.71	2.30	0.81	2.27	0.76	2.39	0.73	2.33	0.71	2.45	0.63	5.719	**
Ornamental plants	2.56	0.89	2.54	0.95	2.42	0.90	2.29	0.92	2.19	0.84	2.04	0.79	2.04	0.77	2.25	0.83	8.012	**

Note: *P < 0.05, ** P < 0.001.

be detected in all grades. This plant group is significantly more interesting for female students of all ages than for males ($t = -11.72$, df = 1298, $P < 0.001$) (see Figure 1C), although in itself it is a less interesting subscale for both genders.

DISCUSSION

In order to efficiently counteract plant blindness (Hershey, 2002), educators should introduce botanical content using exemplary plants considered interesting by students (Hidi & Baird, 1986). Such interesting teaching objects may be found in the group of useful plants (Krüger & Burmester, 2005). Regarding the structure of students' interest in useful plants, the following important findings are to be pointed out: Students do differentiate the group of useful plants in subgroups (Appendix B), and some groups of useful plants (medicinal plants, stimulant herbal drugs, and spice plants) are significantly more interesting for students than others (edible plants and ornamental plants) (see Table 3). Furthermore, there are significant differences between students of different grades with regard to the interest in all groups of useful plants with the exception of stimulant herbal drugs (see Table 4 and Figures 1–3). Significant gender differences could only be detected concerning interest in ornamental plants (see Figure 1).

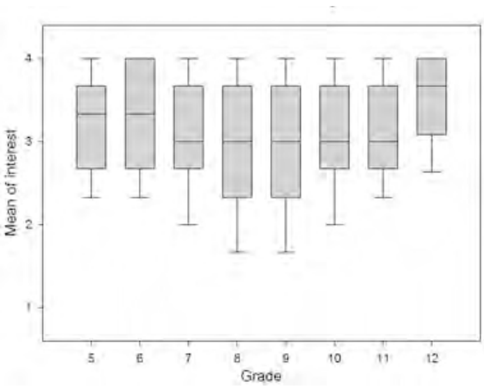

Figure 2. Means of interest of the subscale "medicinal plants" for all grades.

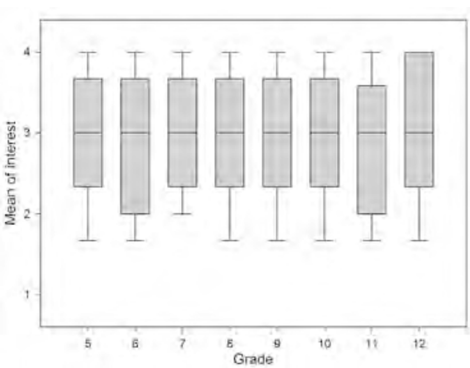

Figure 3. Means of interest of the subscale "stimulant herbal drugs" for all grades.

These findings can be very helpful to structure botany units focusing on plants that are perceived as interesting by students. This is important for learning settings such as botanical gardens as well as museums, where working with students is limited to a short time. During the few hours available in such settings, no time should be wasted on plants considered as uninteresting by the recipients. The results might also be useful for programs enhancing the role of plant science in school, such as "PlantingScience" (www.plantingscience.org) or "Biological Sciences Curriculum Study – BSCS" (www.bcsc.org). Furthermore, it is especially important for developing botany teaching units in school—the institution that is usually the basis of general education.

At present, botanical content tends to be imparted mainly by means of ornamental plants. Even in university textbooks (e.g., Campbell & Reece, 2011), ornamental plants (e.g., lilies) can often be found as examples. Plants such as *Amaryllis*, devil's backbone, or cut flowers sometimes are recommended as advantageous examples for school (e.g., Hershey, 1992, 2005) because they can be purchased easily and be grown inside a classroom without problems. Even if individual teachers decide to do otherwise, a view into currently used Austrian biology textbooks confirms this trend. In all these books, information about the general structure of plants or the structure of flowers is implemented using daffodils or tulips as examples (Rogl & Bergmann, 2003; Cholewa et al., 2010; Schirl & Möslinger, 2011).

Quite on the contrary, the investigated interest ranking of different plant groups suggests using medicinal plants and/or stimulant herbal drugs as key plants to proceed into botanical matters. Medicinal plants should be used as flagships because they are very interesting for students of all grades, and stimulant herbal drugs present themselves as a link to botany because they are also ranked with above-average interest and do not show any differences between grades and genders. Moreover, both plant groups do not show the typical decrease of students' interest with increasing age (Kattmann, 2000) as do other plant groups (e.g., ornamental plants, edible plants).

Although ornamental plants certainly have some practical advantages for teaching botany in school, as mentioned previously, it should be taken into account that they trigger only below-average interest. Besides, ornamental plants do show strong gender differences leading to a high risk of losing the attention of male students altogether; moreover, even female students consider other plant groups more interesting. In light of the findings of the present study, ornamental plants can be only restrictedly recommended as examples to enter botany. Consequently, even the general structure of plants or flowers should be imparted using medicinal plants and/or stimulant herbal drugs as exemplars.

This study throws a first light on the structure of interest in useful plants. In order to sustainably implement botanical content in education, plants like sage (*Salvia officinalis*), tobacco (*Nicotiana tabacum*), or belladonna (*Atropa belladonna*) should be preferentially used as impressive examples. In order to extend these findings, the FEIN questionnaire should be translated and validated in other languages as well. What still remain unexplored and a field open for prospective studies are, for example, beneficial learning settings that keep students' interest focused on plants.

In summary, dealing only with plants that meet students' interests can open a window of opportunity to prevent them from perceiving plants only as scenery for animal life and to enable students to develop a more realistic view of nature, without disregarding a vast majority of the organisms building the foundation of life on earth.

Literature Cited

BALICK, M. J., & COX, P. A. (1997). Plants, People, Culture (1st ed.). W.H. Freeman & Company.

BEBBINGTON, A. (2005). The ability of A-level students to name plants. *Journal of Biological Education,* 39(2), 63–67.

BOZNIAK, E. C. (1994). Challenges facing plant biology teaching programs. *Plant Science Bulletin,* 40, 42–26.

CAMPBELL, N. A., & REECE, J. B. (2011). *Biology.* San Francisco: Pearson.

CHOLEWA, G., DRIZA, M., EINHORN, S., & FELLING, J. (2010). Vom Leben (Vol. 1). Wien: Ed. Hölzel.

DECI, E. L., & RYAN, R. M. (1993). Die Selbstbestimmungstheorie der Motivation und ihre Bedeutung für die Pädagogik. Zeitschrift für Pädagogik, 39(2), 223–238.

FLANNERY, M. C. (2002). Do plants have to be intelligent? *The American Biology Teacher,* 64(8), 628–633.

GREENFIELD, S. S. (1955). The challenge to botanists. CHALLENGE, 1(1). Retrieved from https://secure.botany.org/plantsciencebulletin/psb-1955-01-1.php.

HAMMANN, M. (2011). Wie groß ist das Interesse von Schülern an Heilpflanzen? Zeitschrift für Phytotherapie, 32(01), 15–19.

HERSHEY, D. R. (1992). Making plant biology curricula relevant. *BioScience*, 42(3), 188–191.

HERSHEY, D. R. (1996). A historical perspective on problems in botany teaching. *The American Biology Teache*r, 58(6), 340–347.

HERSHEY, D. R. (2002). Plant blindness: "We have met the enemy and he is us." *Plant Science Bulletin*, 48(3), 78–84.

HERSHEY, D. R. (2005). Plant content in the national science education standards. Retrieved from http://www.actionbioscience.org/education/hershey2.html.

HIDI, S. (1990). Interest and its contribution as a mental resource for learning. *Review of Educational Researc*h, 60(4), 549–571.

HIDI, S., & BAIRD, W. (1986). Interestingness: a neglected variable in discourse processing. Cognitive Science, 10(2), 179–194.

HOEKSTRA, B. (2000). Plant blindness: the ultimate challenge to botanists. *The American Biology Teacher*, 62(2), 82–83.

JAMES, F. C., & MCCULLOCH, C. E. (1990). Multivariate analysis in ecology and systematics: panacea or Pandora's box? *Annual Review of Ecology and Systematics*, 21, 129–166.

JOLLIFFE, I. T. (2002). Principal component analysis. New York: Springer.

KATTMANN, U. (2000). Lernmotivation und Interesse im Biologieunterricht. Lehren und Lernen im Biologieunterricht, 13–31.

KRAPP, A. (1999). Interest, motivation and learning: An educational-psychological perspective. *European Journal of Psychology of Education*, 14(1), 23–40.

KRAPP, A. (2000). Interest and Human Development During Adolescence: An Educational-Psychological Approach. In Motivational psychology of human development: Developing motivation and motivating development (p. 109). The Netherlands: North Holland.

KRÜGER, D., & BURMESTER, A. (2005). Wie Schüler Pflanzen ordnen. Zeitschrift für Didaktik der Naturwissenschaften, Jg. 11, 85–102.

LIEBEREI, R., REISDORFF, C., & FRANKE, W. (2007). Nutzpflanzenkunde: Nutzbare Gewächse der gemässigten Breiten, Subtropen und Tropen. Georg Thieme Verlag.

LINDEMANN-MATTHIES, P. (2005). “Loveable” mammals and “lifeless” plants: how children’s interest in common local organisms can be enhanced through observation of nature. International Journal of Science Education, 27(6), 655–677.

LINK-PÉREZ, M. A., DOLLO, V. H., WEBER, K. M., & SCHUSSLER, E. E. (2010). What’s in a name: Differential labelling of plant and animal photographs in two nationally syndicated elementary science textbook series. *International Journal of Science Education*, 32(9), 1227–1242.

LÖWE, B. (1987). Interessenverfall im Biologieunterricht. Unterricht Biologie, 124, 62–65.

NORUŠIS, J. M. (1990). SPSS PC and statistics 4.0. New Jersey: Prentice Hall.

ROGL, H., & BERGMANN, L. (2003). biologie aktiv (Vol. 1). Graz: Leykam.

SALES-REICHARTZEDER, J., PANY, P., & KIEHN, M. (2011). Opening the window on “plant-blindness.” Botanic Gardens *Conservation International Education Review*, 8(2), 23–26.

SCHIRL, K., & MÖSLINGER, E. (2011). Expedition Biologie (Vol. 1). Wien: Dorner.

SCHREINER, C., & SJØBERG, S. (2004). Sowing the seeds of ROSE. Background, Rationale, Questionnaire Development and Data Collection for ROSE (The Relevance of Science Education): A comparative study of students’ views of science and science education (pdf) (Acta Didactica 4/2004). Oslo: Department of Teacher Education and School Development, University of Oslo.

SCHUSSLER, E., LINK-PÉREZ, M. A., WEBER, K. M., & DOLLO, V. H. (2010). Exploring plant and animal content in elementary science textbooks. *Journal of Biological Education,* 44(3), 123–128.

SCHUSSLER, E., & OLZAK, L. A. (2008). It’s not easy being green: student recall of plant and animal images. *Journal of Biological Education,* 42(3), 112–119.

SCHUSSLER, E. & WINSLOW, J. (2007). Drawing on students’ knowledge. *Science and Children,* 44(5), 40–44.

STRGAR, J. (2007). Increasing the interest of students in plants. *Journal of Biological Education*, 42(1), 19–23.

TUNNICLIFFE, S. D. (2001). Talking about plants–comments of primary school groups looking at plant exhibits in a botanical garden (ITS). *Journal of Biological Education*, 36(1), 27–34.

URHAHNE, D., JESCHKE, J., KROMBASS, A., & HARMS, U. (2004). Die Validierung von Fragebogenerhebungen zum Interesse an Tieren und Pflanzen durch computergestützte Messdaten. Zeitschrift für Pädagogische Psychologie, 18(3), 213–219.

WANDERSEE, J. H., & SCHUSSLER, E. E. (1999). Preventing plant blindness. *The American Biology Teacher*, 61(2), 82–86.

WANDERSEE, J. H., & SCHUSSLER, E. E. (2001). Toward a theory of plant blindness. *Plant Science Bulletin,* 47(1), 2–9.

Appendix A. Items of the questionnaire to investigate the interest in useful plants

(Der Fragebogen zur Erhebung des Interesses an Nutzpflanzen, or FEIN)

English translation of the FEIN questionnaire

(This translation should only give an impression of the items used in the original German questionnaire, shown in the next column. The English items are not linguistically validated.)

How interested are you in learning about the following?

1. In which countries vegetables (e.g. tomatoes) grow naturally
2. Plants used to produce narcotics
3. Plants used to cure inflammations (e.g. a sore throat)
4. Parts of plants used to produce oregano, chili or caraway
5. Plants for decorating my room
6. Organic agriculture
7. Plants which can cause hallucinations
8. Plants which enhance the healing process of wounds
9. Spice plants
10. Taking care for house plants
11. Horticulture without pesticides
12. Producing opium and heroin from opium poppy
13. Plants which can be used to produce a soothing infusion (e.g. against cough)
14. Substances that make spices taste hot
15. Balcony flowers

German version (original language)

Wie interessiert bist Du an folgenden Bereichen?

1. In welchen Ländern verschiedene Gemüsepflanzen (z.B. Tomate) in der freien Natur wachsen
2. Pflanzen, aus denen Rauschmittel erzeugt werden können
3. Pflanzen, die gegen Entzündungen (z.B. Halsschmerzen) helfen
4. Pflanzenteile zur Herstellung von z.B. Oregano, Chili oder Kümmel
5. Pflanzen zur Verschönerung meines Zimmers
6. Biologische Landwirtschaft
7. Pflanzen, die Halluzinationen erzeugen können
8. Pflanzen, welche die Heilung von Wunden unterstützen
9. Gewürzpflanzen
10. Die Pflege von Zimmerpflanzen
11. Gartenbau ohne Spritzmittel
12. Die Gewinnung von Opium und Heroin aus dem Schlafmohn
13. Pflanzen, aus denen man einen heilenden Tee (z.B. gegen Husten) machen kann
14. Inhaltsstoffe, die Gewürze scharf schmecken lassen
15. Blumen an Fensterbänken

Appendix B. Principal components of the FEIN questionnaire (values < 0.3 not indicated)

Principal component PC1 (11.6% of variance) was equivalent to subscale "ornamental plants," PC2 (10.7% of variance) was equivalent to subscale "stimulant herbal drugs," PC3 (10.2% of variance) was equivalent to subscale "edible plants," PC4 (9.9% of variance) was equivalent to subscale "medicinal plants," and PC5 (9.5% of variance) was equivalent to subscale "spice plants."

Principal component →	PC1	PC2	PC3	PC4	PC5
Item 5 (Ornamental plants 1)	0.772				
Item 10 (Ornamental plants 2)	0.759				
Item 15 (Ornamental plants 3)	0.746				
Item 2 (Stimulant herbal drugs 1)		0.761			
Item 7 (Stimulant herbal drugs 2)		0.745			
Item 12 (Stimulant herbal drugs 3)		0.717			
Item 1 (Edible plants 1)			0.722		
Item 6 (Edible plants 2)			0.643		
Item 11 (Edible plants 3)			0.639		
Item 3 (Medicinal plants 1)				0.754	
Item 8 (Medicinal plants 2)				0.719	
Item 13 (Medicinal plants 3)				0.715	
Item 4 (Spice plants 1)					0.725
Item 9 (Spice plants 2)					0.687
Item 14 (Spice plants 3)					0.665