The botanical content in the South African curriculum: A barren desert or a thriving forest?

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Botanists who are interested in education have often expressed their dismay at how plant sciences are neglected in Biology curricula, despite the important roles that plants play. While botanists in several overseas countries have studied the ways in which plant sciences are represented in curricula, no research has been done on how botany is neglected in the South African curriculum. Currently, the South African curriculum is known as the Curriculum and Assessment Policy Statements (CAPS) for Grades R–12. In this study, a comparison was made among the content that is generally taught in introductory plant sciences courses, the American Society of Plant Biologists' principles for plant biology education and the relevant CAPS documents. The time spent on plant, animal or human-focused content was established and compared at both phase and grade level. It was found that while the curriculum addresses all the major concepts in the plant sciences, very little time was being allocated to exclusively plant-focused content as compared to animal and human-focused content. This neglect was particularly prevalent in the Foundation Phase. The way in which the content is structured and presented in the curriculum may in all likelihood not be sufficient to provide a strong knowledge and skills foundation in the plant sciences, nor will it encourage the development of positive values towards plants. While consensus regarding the content of a curriculum will be difficult to achieve, awareness of potential gaps in the curriculum should be brought to the attention of the botanical and educational communities.

Introduction

Wilkens[1] called plants the 'most important, least understood and most taken-for-granted of all living things' and botanists interested in education have been concerned about the neglect of plants in Biology curricula for a long time.[2] Indeed, Wandersee and Schussler[3,4] went so far as to develop the term 'plant blindness' to describe the lack of awareness of plants and neglect of plants in education. It should be noted too that there seems to be a disconnect between plant neglect in schools and the general population's interest in plants.[5] According to the US Census Bureau,[6] 68% of US households either bought plant and gardening-related products or engaged in gardening related activities in 2010 and according to a Harris poll[7], 7% of US adults list gardening as a favourite leisure activity.

In the United States of America, botany experienced a 'golden age' in the early 1900s, but declined in popularity as disagreements about course content and pedagogy, as well as irrelevant content and a lack of qualified teachers caused a shift towards a single Biology subject.[2] Le Grange's[8] description of the history of Biology in South Africa confirms that similarly, at least in the Transvaal, Botany was the dominant subject in the life sciences and was only replaced by Biology as a school subject in 1935. Even though a strong emphasis on Botany remained for a considerable period, over time topics such as animal and human physiology and molecular biology were included in the subject, with less and less focus on plant sciences.

In South Africa, curriculum changes post-1994 included a move towards outcomes-based curricula.[8,9] In the process, Biology was renamed and became the Life Sciences. The most recent change has been the introduction of the Curriculum and Assessment Policy Statements (CAPS).[10-13] CAPS represents, once again, a performance-based syllabus type curriculum.[14] In this study, only the Life Sciences related CAPS documents were analysed.

These changes, coupled with the worldwide trend towards neglecting the plant sciences in Biology curricula, prompted this investigation into the consequences of the curriculum changes for the botanical sciences; specifically whether the plant sciences component of the curriculum has been weakened, or whether the study of plants has benefitted from the changes. An attempt was made to find a way in which to answer the question posed by Uno[5]: 'What and how should students learn about plants?' Subsequently, the plant-focused content in the relevant CAPS documents (Grades R–12) was assessed and compared with the prevalence of zoological and human-focused content.

Literature

Why should students learn about plants?

It has been shown in many studies that learners dislike plant sciences as a subject.[2,4,5,15] However, this does not mean that the plant sciences should be neglected in school curricula as we should teach what it is important for learners to know, not what they prefer to know.[16] Plants provide not only aesthetic pleasure, but many products that humans have exploited for millennia, such as food, clothing, construction materials, fuel, paper, industrial chemicals, alcohol, essential oils and medicines. These uses of plants should be enough reason to study plant sciences. In addition, many of the biggest challenges facing 21st century society are botanically based. These include deforestation, global warming, food security, the anthropocentric extinction of species, erosion, the influence of invasive species and the discovery of new plant-derived pharmaceuticals that may help in the fight against disease. Furthermore, plants are extensively used in biotechnology and are also often used to study fundamental life processes. Without a basic understanding of the structure, functioning, diversity and ecology of plants, many of these benefits would be difficult to maintain. The US-based National Research Council[17] has encapsulated these views in a strong statement:

> *Modern civilization rests on the successful and sustained cultivation of plants and on the wise use of the biologic and physical resource base on which their cultivation depends. Our knowledge about the world around us is incomplete if we do not include plants in our discoveries, and it is distorted if we do not place sufficient emphasis on plant life.*

Recontextualisation of the parent discipline to form the curriculum

Bernstein[18] described the flow of information from the knowledge that is produced in the academic discipline in which it originated, to the form that the knowledge takes in the educational arena, including the school curriculum, and the classroom where the knowledge is reproduced as a process of recontextualisation. Although school science can be expected to differ from the original scientific discipline, it is reasonable to expect a strong resemblance with the parent discipline, even if it is, at best, a simplification. The knowledge that is incorporated in the school curriculum is described by Taber[19] as a curricular model of the science itself. The development of curricular models is an endeavour to find the optimum level of simplification – a level at which the content is simple enough for learners to understand and that also provides an adequate reflection of the scientific understanding of the parent discipline on which it is based. This refers not only to the depth of the content, but also to the choice of what should be included in and excluded from the curriculum.

Bernstein[20] classified those individuals who are involved in curriculum construction as belonging to the 'official recontextualising field' and he included those who recontextualise the curriculum to train teachers, write textbooks or conduct research on the curriculum in the 'pedagogic reconceptualising field'. It should be remembered that the construction of a curriculum is a selective process performed by those in the 'official recontextualising field' and as such, will be influenced and moulded by these individuals who have their own backgrounds, agendas and biases, even when the curriculum reflects the parent discipline to a reasonable degree. Kind and Taber[21] describe school science as politically constructed and assert that it cannot be a neutral reflection of professional science. Additionally, those who play a part in the 'pedagogical recontextualising field' will bring a further recontextualisation to the subject that is now encapsulated in the curriculum, further changing the content that will eventually reach the classroom. In this study, only the recontextualisation that occurs between the parent subject and the curriculum was considered.

The recontextualised curriculum must, furthermore, show curricular coherence if the logical structure of the parent discipline is to be made visible to students.[22] Curricular coherence implies that the subject matter is articulated over time as a sequence of topics and performances that reflect the logical and hierarchical nature of the subject. The content must show progression, in terms of depth and rigour, with connections and coordination between topics made apparent. No literature could be found that explores the curricular coherence in the current Life Sciences curriculum and whether there is a coherent structure to the content related to plants.

What should students learn about plants?

One of the primary questions faced by those attempting to study the recontextualisation of the Life Sciences into a comprehensive, yet simplified curriculum concerns the content. It is not easy to decide what learners should know about plants and this is one of the challenges that curriculum designers face. Uno[5] suggested that new and existing knowledge should be structured around the major concepts and principles of the discipline and cautioned that it would be difficult to agree on a consensus list of facts or terms that students would have to know. As a result, he did not provide clarity on what these major concepts and principles might be. The American Society of Plant Biologists (ASPB)[23] developed a list of basic plant biology principles for science education at the K–12 level (see Table 1). This list of concepts essentially refers to content for science education that can be integrated with biology at different educational levels.

Khodor, Halme and Walker[24] developed a biology concept framework as one possible way to organise the large number of concepts that are covered by a typical undergraduate Biology curriculum. This framework 'is hierarchical, places details in context, nests related concepts, and articulates concepts that are inherently obvious to experts, but often difficult for novices to grasp'. Unfortunately, no similar concept framework has been developed for the plant sciences. One factor that complicates the development of such a framework is the inevitable overlap between the concepts that are essential for the understanding of the plant sciences and the concepts that are common to other biological sciences, especially the zoological sciences and human physiology.

As it was not the purpose of this study to develop a complete concept framework for the plant sciences, similar to the biology concept framework, another strategy had to be followed. It was decided to follow the example of UMALUSI[14] and develop a list of concepts or topics that reflects typical botanical content from tertiary level textbooks that are specifically written by botanists to be used in undergraduate plant sciences courses. While this is not a comprehensive, definitive list of concepts, it provides a useful tool with which to analyse the plant sciences content in the CAPS curriculum.

Method

Four undergraduate textbooks were used to develop a list of common topics that could be described as representative of a typical undergraduate plant sciences course. These textbooks are generally available from publishing houses in South Africa and all have been previously prescribed for plant sciences related modules by the author. The textbooks all originate from the United States of America and are general texts that are used in undergraduate plant sciences courses. The number and variety of unique plant-related course offerings in different South African universities does not allow the author to draw conclusions about the extent to which each book is currently prescribed in South Africa. The latest editions that are available were used. Most of the information was gained from the index pages, although in some cases, some clarification had to be sought from the text where the headings were not sufficiently descriptive. Textbooks by the following authors were used: Mauseth[25], Evert and Eichhorn[26], Stern et al.[27] and Uno et al.[28] The ASPBs[23] list of principles of plant biology was mapped against this topic list.

The study used document analysis to determine what botanical content is included in those CAPS subjects that either include science content or life sciences in particular. All content related to plants or plant sciences was identified, including content relevant to other living organisms. In order to find out whether the topics represented the main botanical ideas, they were compared with the list of common plant science topics and the ASPB list. It should be noted that the main focus in this article is on the *intended* curriculum as it is encapsulated in the various curriculum documents and not on the *enacted* curriculum. The following Curriculum and Assessment Policy Statements (CAPS documents) were included:

CAPS Life Skills Foundation Phase Grades R–3[10]

CAPS Natural Sciences and Technology Intermediate Phase Grades 4–6[11]

CAPS Natural Sciences Senior Phase Grades 7–9[12]

CAPS Life Sciences Further Education and Training Phase Grades 10–12[13]

The CAPS documents were examined to compare the amount of plant-focused content with the animal- or human-focused content. The number of hours that the curriculum specifies should be dedicated to each topic was classified either as being generally applicable to all or most living organisms, as being applicable to plant-focused content

Table 1: The principles of plant biology developed by the American Society of Plant Biologists.[23]

1	Plants contain the same biological processes and biochemistry as microbes and animals. However, plants are unique in that they have the ability to use energy from sunlight along with other chemical elements for growth. This process of photosynthesis provides the world's supply of food and energy.
2	Plants require certain inorganic elements for growth and play an essential role in the circulation of these nutrients within the biosphere.
3	Land plants evolved from ocean-dwelling, algae-like ancestors, and plants have played a role in the evolution of life, including the addition of oxygen and ozone to the atmosphere.
4	Reproduction in flowering plants takes place sexually, resulting in the production of a seed. Reproduction can also occur via asexual propagation.
5	Plants, like animals and many microbes, respire and utilise energy to grow and reproduce.
6	Cell walls provide structural support for the plant and also provide fibres and building materials for humans, insects, birds and many other organisms.
7	Plants exhibit diversity in size and shape ranging from single cells to gigantic trees.
8	Plants are a primary source of fibre, medicines, and countless other important products in everyday use.
9	Plants, like animals, are subject to injury and death due to infectious diseases caused by microorganisms. Plants have unique ways to defend themselves against pests and diseases.
10	Water is the major molecule present in plant cells and organs. In addition to an essential role in plant structure, development, and growth, water can be important for the internal circulation of organic molecules and salts.
11	Plant growth and development are under the control of hormones and can be affected by external signals such as light, gravity, touch, or environmental stresses.
12	Plants live and adapt to a wide variety of environments. Plants provide diverse habitats for birds, beneficial insects, and other wildlife in ecosystems.

exclusively, as being applicable to animal-focused content exclusively, or as being applicable to human-focused content (and thus often applicable to animals too). Analysis along these lines was conducted for the four phases of schooling and for the individual grades.

Results

The list of topics and concepts that the four botany textbooks had in common is shown in the first column of Table 2. The textbooks were very similar in their approaches to the plant sciences and contrary to Uno's[5] prediction that it would be difficult to agree on a consensus list of topics, it would appear that there is broad consensus about the content that should be covered in a typical undergraduate plant sciences course. The amount of detail and the depth to which each topic is covered varies between the textbooks, but the major concepts that students are required to study are clearly identifiable. The content in these textbooks is considerably more advanced than would be taught at school level, but still provides an indication of the breadth and content of the subject. A comparison between the textbook topic list and the ASPB[23] list of principles of plant biology can be drawn from the first and the second columns of Table 2. It is clear that the ASPB list of principles is not as extensive as the textbook topic list, but it still covers all the major ideas in the plant sciences. The grades in which these topics are included are shown in the third column of Table 2.

A comparison between the general, animal, human and plant-focused content showed that exclusively plant-focused topics were the least prominent in the South African curriculum.

Foundation Phase Life Sciences – the early years

The Curriculum and Assessment Policy Statement for Life Skills - Foundation Phase[10] sets the zoocentric tone for the school curriculum. In the Foundation Phase, the strand 'Beginning knowledge and Personal and Social Well-being' that forms part of the life skills subject includes topics that introduce learners to content that will form the foundation for natural sciences topics in Grades 4–9 and life sciences topics in Grades 10–12. This part of the curriculum is understandably dominated by human-focused topics (e.g. 'my body' and 'the senses'), that are of course also valid for many animals, especially mammals. The curriculum includes very little plant-focused content, while animal-focused content is much more prevalent. The few references to plants are mostly associated with how plants provide humans (and animals) with food, shade or shelter. Plants are not shown as interesting organisms in their own right. The time spent on plant-related content in Grades R–3 is approximately 11 h. It is not possible to provide a precise number for the hours required to teach plant-focused content, as this content is frequently integrated into more general topics such as 'the seasons'. Furthermore, some of the curriculum content may or may not include plant-focused content, depending on the teachers' interpretation of the content. In contrast, animal-related topics feature regularly in the life skills curriculum and occupy approximately 57 h of teaching and learning time.

The only exclusively plant-focused topic in Grade 1, the 'basic structure of plants and what they need to grow, is covered in 4 h. In Grade 2, learners again study the effects of the seasons on organisms, this time with reference to the sowing, growing and harvesting of plants. No exclusively plant-focused content is included in Grade 3, unless the sections on healthy eating and the processing of products that we get from plants are regarded as plant focused. In contrast, 15 h are devoted to insects and animal life cycles, more than all the plant-focused content for Grades R–3 combined.

In the Foundation Phase, routine, free play or structured activities are recognised. Only one of the free play activities, gardening, is plant focused. Plants do not feature in the resource list for life skills[10(p. 13–14)], but recommended resources do include a selection of fruit and vegetables (p. 20) and a suggestion for a nature corner/discovery table with plants or pictures of plants for the Grade 1 topic of plants and seeds (p. 33).

To appreciate the contrast between the plant and animal sciences, a comparison shows that Grade R learners spend 2 h each on birds, reptiles, dinosaurs, wild animals in general and finding out about one wild animal in particular, while the teacher may or may not include plants in topics on how nature is affected by the seasons. The only additional topic in Grade R that is plant related is the section on fruit and vegetables,

Table 2: List of the topics in the Curriculum and Assessment Policy Statements (CAPS) curricula for Grades R–12[10-13] that are included in botany textbooks, including those by Mauseth[25], Evert and Eichhorn[26], Stern et al.[27] and Uno et al.[28] The American Society of Plant Biologists (ASPB)[23] principles listed in Table 1 that correspond to these topics are shown in the second column. It should be noted that not all the ASPB topics are covered in detail.

Topics generally covered in plant sciences textbooks	ASPB principle number	Grade/s in which the content is included in the CAPS curriculum
Introduction		
Introduction to plants		1, 4
The Nature of Science*		10
Plant-human interactions	6, 7	1, 2, 6, 12
Life at the molecular and cellular level		
Chemistry of life*	1	10
Cell structure*	6	9, 10
Cell division, mitosis*		10
Genetics and heredity		
Chemistry of heredity, DNA*	1	12
Genetics and patterns of inheritance*		12
Recombinant DNA technology and biotechnology*	8	10, 12
Meiosis*		12
Plant structure		
Plant tissues and organs	6	R, 1, 4, 9, 10
Growth and development	7	4, 5
Life processes in plants		
Reproduction: flowers, fruit and seeds	4	R, 1, 7, 11
Mineral nutrition and soil	2	1, 2, 10
Water relations and transport of nutrients	2, 10	10
Energy metabolism: Photosynthesis and respiration	1, 5	5, 6, 8, 11
Hormones – responding to the environment	11	12
Classification and biodiversity		
Classification and systematics*		7, 10
Biodiversity*		7 , 10
Viruses*		8, 11
Prokaryotes: Bacteria and archaea*		7, 8, 11
Fungi*		8, 11
Algae*	7	11
Non-vascular plants: mosses	7	11
Vascular, seedless plants: ferns	7	7, 11
Vascular seed plants: Gymnosperms and angiosperms	7	7, 11
Ecology – life at the population, community and ecosystem level		
Introduction to ecology*		8
Ecosystems and environmental interactions*	2, 12	R, 1, 4, 5, 6, 8, 10, 11
Food chains and food webs*		5, 6, 8, 10
Population ecology*		11
Biomes	12	10
Biosphere*	12	7, 10
Conservation*		8
Human impact on the environment*		11
Evolution		
Evolutionary concepts*		7,
History of ideas about origins*		12
History of life on earth*	3	10
Fossils*		10, 12

** Note that not all the topics in these textbooks are exclusively focused on plant sciences. These topics are applicable to other organisms too.*

where the focus is placed on types, tastes, textures, colours and shapes, with a single reference to where fruit and vegetables come from.

Intermediate Phase: Grades 4–6

In the Intermediate Phase, science topics are addressed in the subject Natural Sciences and Technology which requires 3.5 h of instructional time per week. The subject is divided into four knowledge strands, namely Life and Living, Matter and Materials, Energy and Change, and Planet Earth and Beyond.[11(p.10)] Life sciences are limited to the Life and Living strand which is taught only in the first term of each year (January to the end of March) – a total of 45 h each year.

Although the difference between exclusively plant-focused topics and animal-focused topics is smaller than in the Foundation Phase, there is still a preponderance of animal content in the Intermediate Phase. Many of the topics refer to plants and animals equally or at least do not exclude plants, for example: 'living and non-living things', 'food chains' and 'ecosystems and food webs'. These general topics require approximately 26,25 h of class time. It is left to the discretion of the teacher – and possibly to the writers of textbooks – how much of this content will be focused on animals instead of plants. Human Nutrition is taught for nearly 20 h. Exclusively animal-focused content (e.g. 'habitats of animals', 'structures for animal shelters' and 'animal skeletons') requires 33,75 h of teaching time. Exclusively plant-focused content (e.g. 'what plants need to grow' and 'photosynthesis'), occupies approximately 24,25 h.

The plant-focused content in this phase is somewhat repetitive and limited to dry, basic facts. The reference to photosynthesis in Grade 5 leads to the role of plants as producers (food) and in Grade 6, the same topic again leads to a discussion of food and oxygen and, although there is some progression, the content can easily be interpreted as repetitive. Plants are presented as mere providers of food and oxygen to be used by other organisms.

Senior Phase: Grades 7–9

In the Senior Phase, the life sciences form part of the subject Natural Sciences. This subject includes the same four knowledge strands that are used in the Intermediate Phase[12(p. 9)]. The Grade 7, 8 and 9 Life and Living content is taught for 3 h per week during the first nine weeks of the school year only. Many of the topics, including biosphere, biodiversity, sexual reproduction, variation (Grade 7) and interactions and interdependence within the environment (Grade 8) appear to be focused on both plants and animals (including humans). The curriculum does not provide insight into the extent to which teachers will use this content to include plants and not only animals. A re-introduction to photosynthesis and respiration, as well as to micro-organisms, appears in Grade 8. The introduction to cells in Grade 9 requires 6 h of teaching time, with the remaining 21 h devoted to systems of the human body. In this phase, only 11,25 of the 81 h of teaching time is devoted to content that is specifically plant science focused.

The Grade 7 curriculum provides one example of the repetition of some of the plant-focused activities. Learners are required to grow plants such as beans or maize to determine the requirements for growth. This is the third time that learners have to perform this activity in school, having done so in Grade 1 (beans or lentils) and Grade 4 (bean seeds).

Further Education and Training: Grades 10–12

In this final phase of schooling, Life Sciences is taught as a subject on its own and is divided into the following strands: Life at the Molecular, Cellular and Tissue level; Life Processes in Plants and Animals; Environmental Studies and Diversity, Change and Continuity.[1] A significant number of the topics can not be separated as either human, animal or plant focused, but are relevant to living organisms in general. Examples of such content include: how science works, the chemistry of life, DNA, cells, cell division, genetics and inheritance, biosphere to ecosystems, biodiversity and classification, history of life on earth, respiration, gaseous exchange, population ecology, human impact on the environment and evolution by natural selection (not listed in sequence). These topics require 187 h of class time. The extent to which plants will be used as examples when these topics are taught in the enacted curriculum is not known, but previous research has shown that teachers prefer to use animal examples.[3,4,16] Exclusively human-focused topics (e.g. support and transport systems, human gas exchange, excretion, human endocrine system, and homeostasis in humans) are specified for approximately 76 h of teaching time. Animal-focused and plant-focused topics require approximately 52 h and 46 h respectively.[13]

Discussion

It can be argued that the frequent changes in the policy and content of the curriculum have not provided sufficient opportunity for academic analysis of each reiteration. It is encouraging to see that the 4 CAPS documents that include the scientific content of the school curriculum give some attention to all the topics that are usually covered in plant sciences courses (see Table 2). Uno[5] suggests that new and existing knowledge should be structured around the major concepts and principles of the discipline for understanding to develop. However, during the analysis, it became clear that many of the topics received only cursory attention, whereas other topics, such as photosynthesis and ecosystems and environment interactions, were included in several grades and were covered in more depth, thus showing progression. The logic behind the sequencing of topics could not be discerned and connections and coordination between topics were not made apparent, thus failing to achieve curricular coherence as defined by Schmidt et al.[22]

Zoocentrism, anthropocentrism and plant blindness could be clearly identified from the data. The curriculum analysis provides an overview of the extent to which plant-focused content is overlooked in favour of animal and human-focused content in the life sciences related South African curriculum documents. Although the time that is currently devoted to the plant sciences is clearly more limited, it will be difficult, if not impossible to develop consensus in both the official recontextualising field and the pedagogic recontextualising field about the amount of time that should be devoted to different topics in the life sciences. However, the current lack of debate around the lack of representation of the plant sciences does not do justice to the potential consequences of such neglect.

The neglect is especially noticeable in the Foundation Phase where very little attention is given to plants in Grades R–2, with no exclusively plant-focused content in Grade 3. Children build their understanding of the biological world through their interactions with both the natural world and through exposure to school content and activities. Tunniciffe and Ueckert[29] recognise that very little is known about the development of botanical concepts and skills in the early years of schooling, as most of the research in biology education focuses on secondary school biology. The infrequent focus on plants and the way that content is distributed in the Foundation, Intermediate and Senior Phases will, in all likelihood, not be sufficient to provide a strong knowledge or skills foundation in the plant sciences. In a recent study, Foundation Phase learners in Gauteng even indicated that they do not think that plants are alive, but they do think that water is alive (Naudé F 2015, oral communication, July 21). According to Uno[5], understanding is hampered when learners are exposed to disconnected facts, breadth rather than depth of coverage and a requirement for recall of facts. The long gap between one year and the start of the next year when learners will once more study the life sciences may not encourage continuity in the development of a coherent understanding of the knowledge and skills associated with the subject in general and plant sciences specifically.

The lack of plant science content will probably hamper the development of positive values towards plants, but there is very little research concerning the development of such values in the early years. The development of a relationship with the environment, including positive values and attitudes, is included in the explanation of the Foundation Phase Life Skills[10(p. 9–10)] subject, but it is difficult to see how the limited opportunities that learners have to learn to appreciate plants will encourage the development of this relationship. It is important that learners are shown the relevance of the content that they learn in order to stimulate their interest in the subject.[5] This means that learners should be shown, not only how useful plants are to humans, but also that it is important to appreciate plants as the interesting organisms they are. It is even possible, given the status quo, that learners will develop the idea that plants are not worthy of being studied.

Several authors have offered suggestions on how learners' plant blindness may be averted. De Beer and Van Wyk[30] suggested that teachers can stimulate learners' interest in plants and encourage learners to consider a career in the plant sciences by introducing ethnobotany into the classroom. They provide several examples of the judicious use of South African ethnobotanical content that will not only contribute to the inclusion of indigenous knowledge into the curriculum, but that will increase the relevance of plants to learners while avoiding repetitive, dry factual content. Both Hershey[16] and Strgar[31] note that appreciation of plants may benefit from the guidance and enthusiasm of a teacher or mentor. Tunniciffe and Ueckert[29] suggest that children must be assisted to look with meaning and accuracy, in contrast with merely seeing. In the case of plants, this is especially important, as research has shown that 'children may not see the trees'[32] and, unlike animals that draw attention to themselves, 'plants need to have attention drawn to them'.[15] Balas and Momsen[33] demonstrated that there is a real difference in the way that plants and animals are perceived and that plant blindness is, in part, a physiological phenomenon. However, as the plant sciences content in curricula, including CAPS, has decreased over time, the lack of plant-related content, coupled with decreasing appreciation of plants, may have become a self-perpetuating phenomenon leading to teachers who themselves lack the appropriate values to encourage appreciation in learners.

It is not known whether the use of the suggested activities, equipment and resources that complement the teaching of the CAPS curricula is interpreted as a compulsory part of the intended curriculum, or whether teachers are allowed flexibility to choose different activities. Several of the suggested activities may be beneficial to the development of a love of plants. Furthermore, if they are conducted in a structured and systematic way, knowledge, skills and understanding of plants can be enhanced while the development of misconceptions can be minimised. Pedagogical approaches to learning and teaching that emphasise critical thinking and process skills, combined with an understanding of concepts, will contribute to the development of botanically literate students and citizens.[5] It is essential that teachers understand that seemingly simple activities, such as observing plants, learning the names of a few plants, labelling, describing and comparing the parts of different plants, or germinating seeds, may counteract some of the gaps in basic botanical knowledge.[29] These activities may lead to the development of knowledge and skills that promote inquiry in more complex topics, such as the community structure and may also allow the development of a closer bond between the learner and nature.[34,35] Whether the activities described in the CAPS documents are indeed sufficient to allow learners to develop knowledge, skills and a positive view of plants remains to be investigated in the South African context.

Conclusion

This purpose of this paper was not to argue for a specific 'ideal' curriculum, but to explore the existing curriculum in terms of the botanical content contained in the CAPS documents. In the CAPS for both Foundation and Intermediate Phases, very little attention is given to plants. In the Senior and FET Phases, the situation is not much better. The ASPB[23] cautions that childhood is the time when persistent inaccurate ideas about plants can be established and they warn that a basic understanding of how plants live and grow is essential for the understanding of the many environmental challenges that humanity faces in the 21st century.

An extensive search of the South African literature did not provide any articles that highlighted the plight of the plant sciences in school curricula, although a growing literature base concerning this phenomenon is developing in Europe and the USA. The lack of plant-focused content, especially in the early years of schooling should be of great concern, not only to educators, but to botanists who are concerned with the way that plants are viewed in the community, and even to parents who may recognise that a biased curriculum will not provide their children with a balanced understanding of the life sciences.

In some countries such as the United States of America, the United Kingdom and Sweden, there has been some interest in the way that botany is portrayed in curricula. The concerns regarding the lack of botanical instruction raised by the ASPB[23] and other authors referred to above seems not to have reached the botanical community in South Africa. As far as could be determined in an extensive literature survey, there has been no comment from the botanical community in South Africa regarding the lack of focus on the plant sciences in the curriculum documents. As Hoekstra[36] suggests, 'botanists work very hard to make their science second-rate in the eyes of the public' – a sentiment shared by Hershey[16] who declared: 'Plant blindness: "We have met the enemy and He is Us"'.

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