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Application of inquiry-based learning for visitors of botanical garden

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Abstract: Contemporary view of the education emphasizes transformation and development of primary knowledge by active learning. To the concept of active learning fits well the model of research cycle for science teaching. This approach is based on a controlled dialogue and its development into debate on the question, to which the answer can be obtained by examining and searching for evidence. Acquisition of scientific approach as formulating a testable question, planning and implementation of procedure for obtaining a response, evaluation of evidence leading to the conclusions and sharing of the results are steps, where the learner is actively entering the cognitive process. This paper reports a specific example of application an inquiry activity for visitors of botanical garden, which can be implemented during routine visit.

Keywords: education, inquiry, botanical garden, science

Introduction

People visit botanical gardens for various reasons. Mostly, they expect relaxation and exploring. Educational programs at botanical gardens are offered to wide range of people from preschool age to the third age. Botanical gardens are excellent surroundings for learning outside and this is appreciated by teachers and pupils in primary and secondary schools. Many household gardeners accumulate considerable knowledge of plant biology through a range of informal learning sources. Teaching in the natural environment allows getting more comprehensive knowledge and stronger relationship with nature, which helps to be inclined to sustainable consumption.

Contemporary view of effective science learning

Man creates new knowledge and its understanding on the basis of what he already knows and what he believes. This is called primary knowledge, it is learned especially during childhood and it is very stable. If the primary knowledge is not taken into consideration, learning may fail. However, primary knowledge is often not consistent with scientific information. Learners need to see situations where their ideas do not work and how is manifested the fact that negates them, so they can replace primary knowledge with correct information.

The only really effective way is active learning. Each of us controls his own learning process. Despite this, it often happens that we offer only the possibility of passively received information in school, but also in other educational institutions. Learning effect without active involvement is short-term and primary knowledge is activated after some time.

The basis of science learning is science. We obtain concept about work of scientists only if we get the opportunity to be involved in the research process. Only then we will understand that scientific knowledge is based on evidence confirmation answers to our questions. It teaches us to select information based on analysis and do not take uncritical and superficial arguments as facts.

There are several models of inquiry cycle in school. Pedagogues see the inquiry process most often as cycle of six steps. As an example, we present Six-phase inquiry cycle by LLEWELLYN (2002):

- Inquisition. Staying a question to be investigated.
- Acquisition. Brainstorming possible solutions.
- Supposition. Selecting a statement to test.
- Implementation. Designing and carrying out a plan.
- Summation. Collecting evidence and drawing conclusions.
- Exhibition. Sharing and communicating results.

Inquiry cycle presents number of opportunities to search and form an opinion based on learning about real world and through reflection of knowledge and experience. There does not have to be implemented whole inquiry cycle within one activity. It is possible to focus more on one phase according what skill we plan to develop.

Instruction which encourage searching for answers to relevant and interesting questions, will improve motivation and learning intensity. Mentioned effect will be achieved also with those tasks, which require actively do only one step after proper introduction. For example, assumption and argument: What happens if ... ? Why do you think that? Let's try that.

Teachers in school often link inquiry with practical activity. However, planning and implementation of inquiry is the fourth step of the inquiry cycle. There should be good handling with questions before practical activity. Man is looking for answers to his own questions. Skilled lecturer handles discussion in a way to evoke questions within the topic, which can be answered by inquiry. Inquiry in the broader sense does not have to be difficult or time consuming part of the educational process. Inquiry-based learning stands on the problem, which is

interesting. If the topic is presented by demonstration of the phenomenon relevant to the question, second step in the form of discussion about possible solutions will naturally follow.

If the question is attractive enough, it can be asked by the lecturer. Participants will acquire the question and awake their own motivation to seek answers. The second option is to wait until they ask the question by themselves after introduction of the problem or demonstration.

GARDNER et al. (2001) point out that few things in life are as enjoyable as when we concentrate on a difficult task, using all our skills, knowing what has to be done.

Discussion about possible solutions should lead to the realization, that broad and too generally formulated question can not be answered precisely. Participants have to realize what means testable statement, assumption and hypothesis. Inexperienced „researchers“ need help with formulating a hypothesis. At first, it is easier to formulate assumption: Which of the proposed solutions will work? Why do you think so?

If we have testable statement, learners are generally able to individually propose observation, research or experiment in order to find evidence of its validity.

Partial orientation by the lecturer is needed if learners have little experience with the topic, they do not know which tools can be used or they are unable to follow the plan in detail. They can individually inquire after clarification of the necessary details.

Interpretation of the collected data and facts is difficult part of the inquiry. The advantage of learning compared to scientific work is the discovery of already known facts and opportunity to verify scientific conclusions. It is important to share our results and conclusions and to take into consideration more points of view and opinions. This reduces the likelihood of our findings being misinterpreted. The results are presented verbally, in writing, or in combination depending on the circumstances, so others have the opportunity to react. It is necessary to carefully to listen arguments of other researchers and correct our conclusions, if it is needed. It often happens that new problem arises during this discussion and inquiry cycle is repeated.

Example of the inquiry activity during visit of the botanical garden

Having the drive (or ‘oomph’) to be self-educative, autodidactic, engage in self-directed inquiry learning, allows learners significant input into the selection of topic or focus of the activity, engages them more deeply with the learning task and generates a greater intensity of learning (WATTS 2015).

Visitors of botanical garden like the opportunity to individually examine some plants and experience discovery. We will focus their attention on one question. Together we will briefly discuss possible solutions and assumptions. We will allow them to spend more time with plants they need to examine during the tour.

Nowadays it is a very popular activity to demonstrate cooking different dishes. We use recipe for a dessert called “Baked bananas on ginger”

(http://www.zazvor.info/banany-na-zazvoru.php) in our inquiry activity. Discussion about the plants, from which our ingredients originated, represents motivational phase to attract the attention of visitors. We will tell our participants to carefully read the recipe and to list all the plants, from which our ingredients originated. We will use these 5 plants in our example: banana tree, orange tree, ginger, grapevine and vanilla.

An important role is played by questions of lecturer.

Initial interview will look like this:

- Do you know the plants from which our ingredients came?
- Which parts of plants were used for the preparation of this delicacy?
- What do we know about these plants?

Guide will ensure that participants are fully concentrated on the content, method and approach to document observations with following dialog:

- What do banana tree, ginger and vanilla have in common?
- Could they be related?
- Which characters of these plants are important for getting the answer to our question?

More questions within the discussion will encourage participants to voice and justify their assumptions:

- What do you need to explore this?
- How do you do it?
- How do you capture the result?
- What do you need to do it?

If the response to any of these questions leads to spontaneous discussion, it is necessary to encourage and support it with additive questions:

- Who else does have the same opinion?
- Why do you think that it is/ is not this way?
- Can we implement this idea right here, in the botanical garden?
- What other method could be used?

For example, there could arise proposal to compare leaves of our five plants. This idea could be immediately implemented during the tour. Guide will simply follow standard plan of the tour, but he will also bring visitors to plants from which our ingredients originated. He will give them enough time to get photos of needed leaves or he will tear off one leaf from each needed plant and he will give it to visitors for examination and description. Guide will accept the plan proposed by visitors. He will tell them about the plant, its origin, using, cultivation, etc. during the observation of leaf.

Participants will then discuss findings about observation of shape and structure of leaves. They will sort leaves by similarities of shape and venation. They will form their own conclusion and assess the validity of their assumption. After that they will listen scientific explanation:

Banana tree and ginger are really close to each other. They belong to common order Zingiberales. But vanilla is from family Orchidaceae and belongs

to order Asparagales. However, vanilla belongs to monocotyledons with parallel venation like other two mentioned species. Its flowers are similar to the flowers of orchids that we like to grow at home. At first sight, leaf of the orange tree is similar to the leaves of first three plants. But when we look closer and more carefully, we will see pinnate branched venation, which is characteristic for dicotyledons. Grapevine is such a dicotyledonous plant as orange tree. Its characteristic carved palmate leaves do not have any other similarities to leaves of orange tree except branched venation.

Visitors of the botanical garden had the opportunity to learn the following information during the tour:

Banana tree, ginger, vanilla and orchid belong to monocotyledons with parallel venation. Orange tree and grapevine are dicotyledonous plants and their leaves have branched venation. Visitors individually concluded that banana tree and ginger are related plants and lecturer confirmed this information. They have learned some interesting facts about the origin and using these plants.

Steps of inquiry cycle were applied in our example like this:

- presentation of the problem and research question presented by lecturer
- guided discussion about the research question
- forming own testable assumption
- planning and implementation of inquiry to verify assumption
- interpretation of conclusions
- discussion of conclusions and their verification from another source (the source was lecturer's knowledge in this case)

Participants had the opportunity to actively inquire in each stage of exploration and verify the correctness of their own conclusions.

Conclusion

The inquiry cycle can be inserted into learning during tour in botanical garden without requesting any large material resources. It is much more important to have well-thought relevant problem, which will get people's attention. Inquiry-oriented approach demands guide in botanical garden with very good communication skills. He often does not manage routine tour or inquiry with prepared questions, because he has to quickly response on current interest and ideas of visitors. Visitors of botanical garden will remember all the information about plants, which they got by inquiring, probably for a long time. They had been motivated for another future visit of garden. This is the reason, why it is good to have ideas for inquiry and to alternate them cyclically or seasonally.

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