



## INTERACTIVE EXPERIMENTAL GARDEN – A PLATFORM FOR LIFELONG LEARNING AND RESEARCH IN INNOVATIVE PLANTING DESIGN

Dagmar Hillová\*, Viera Šajbidorová, Ladislav Bakay

Slovak University of Agriculture in Nitra, Slovak Republic

The Interactive Experimental Garden is an educational platform for experiential education, lifelong learning, and self-education in the perennial herbaceous planting design at the Horticulture and Landscape Engineering Faculty of the Slovak University of Agriculture in Nitra. Garden is a “living textbook”, which presents the collection of perennials, bulbous plants, annual and biennial plants and their combinations. The garden serves as the platform for investigating an innovative way of acquiring knowledge and experience by carrying out construction and maintenance activities in the garden, as well as research activities in the field of innovative planting design (evaluating of low-cost planting design, flowering phenology monitoring, pollinator species and spontaneously spreading weeds monitoring). The Interactive Experimental Garden is also the platform for discussion in the field of herbaceous planting design for students, experts and the public, and what is more, it increases awareness of innovative planting design.

**Keywords:** perennial, planting design, pollinators, phenology, lifelong learning

### 1 Introduction

Rapid urbanization is destroying natural ecosystems and damaging the environmental quality of towns (Alberti and Marzluff, 2004). Climate change, biodiversity loss, environmental degradation and the desire to intensify cohabitation with the nature have all enhanced our interest in the ecological trend of the planting design. The interest of landscape architects focuses on the innovative planting design with:

- the possibility of cost reduction in planning, establishment and maintenance,
- enhancing habitat and food for fauna within extended flowering,
- providing multiple ecosystem services.

The low-cost planting design, for example pictorial meadow or prairie planting requires only annual mowing once established, with no fertilizers or fungicides, and few if any herbicides (Diboll, 2004). The extended flowering meadow and prairie grasses and flowers create high-quality habitats for birds, butterflies, and other wildlife. The self-sustaining plant communities of planting meadow and prairie provide landscape beauty for decades to come and participate in ecological services: temperature reduction, erosion

control on slopes and disturbed ground, stream and riverbank stabilization, excess nutrient absorption in wetlands, soil phytoremediation of contaminated soil, or provides food and/or habitat for wildlife (Iuliana, et al., 2011; Seiter, 2016). The deep-rooted forb plants encourage infiltration of rainwater into the soil, thus reducing stormwater runoff and flooding, and can also serve as buffer strips between maintained turf and wetland areas, such as ponds, waterways, and marshes (Diboll, 2004).

The research experience and expertise of innovative planting design must be continuously transformed into lifelong learning and determination for new research. The Interactive Experimental Garden at the Horticulture and Landscape Engineering Faculty of the Slovak University of Agriculture in Nitra has become an educational and research platform for experiential education, lifelong learning, and self-education within the innovative planting design.

The aim of this article is to present the importance of the Interactive Experimental Garden and their website as an opportunity platform for:

- comparison of approaches in the innovative low-cost planting design;



Dagmar Hillová, [Slovak University of Agriculture in Nitra](https://www.uniag.sk), Faculty of Horticulture and Landscape Engineering, Department of Planting Design and Maintenance, Tulipánová 7, Nitra, Slovak Republic  
e-mail: [dagmar.hillova@uniag.sk](mailto:dagmar.hillova@uniag.sk); [viera.sajbidorova@uniag.sk](mailto:viera.sajbidorova@uniag.sk); [ladislav.bakay@uniag.sk](mailto:ladislav.bakay@uniag.sk)

- determination of value of spontaneously spreading weeds for innovative planting design;
- setting revitalization principles (changes in planting plans) in the garden according to phenology and pollinators monitoring.

## 2 Material and methods

### Interactive Experimental Garden – study area

The Interactive Experimental Garden (also garden will be used later in the text) aims to be a “living textbook”, which presents the collection of perennials, bulbous plants, annual and biennial plants and their compositions (Šajbidorová and Hillová, 2018). The garden was established within the Cultural and Educational Grant Agency of Ministry of Education,

Science, Research and Sport of the Slovak Republic (project registration number 035SPU-4/2016). The aim of the project was to create an area for practical education in the study programs the Landscape and Garden Architecture and Biotechnics of parks and Landscape Arrangements (see Figure 1–3).

Students from various study programmes took part in the project under the professional tutorship of teachers from the Department of Planting Design and Maintenance of the Horticulture and Landscape Engineering Faculty. In the practical courses Landscape Floriculture, Designing in Landscape Floriculture, Production of perennials and bulbous plants, Planting design and maintenance and Budgeting of landscape design and architecture, students got involved in all work duties of a landscape architect, i.e. from drafting



■ **Figure 1:** Site plan of the Interactive Experimental Garden showing the sections of the garden and the connection to the surroundings. IEG 1 – IEG 10 means Interactive Experimental Garden



■ **Figure 2:** Aerial image showing the geometric layout of the garden; June 2019

the project proposal until proper completion and design of the garden covering the total area of 750 m<sup>2</sup> including:

- terrain works,
- installation of an original irrigation system,
- construction of flower bed borders from terraced panels,
- construction of gravel footways (40 m<sup>3</sup> of macadam),
- placing of soil into flower beds (170 m<sup>3</sup> of compost soil),
- planting of 7 solitaire trees, 260 pieces of shrubs, 1,330 pieces of perennials and 6,650 pieces of bulbous plants.

The garden was completed between September 2016 and June 2018. Designing the garden served as experimental education for students since its very beginning. Regarding all the experience and abilities they were able to acquire, the whole process was a great contribution to their future profession. After completion, the garden has become an educational platform for various subjects in the study program at the Horticulture and Landscape Engineering Faculty thus ensuring its long-term sustainability.

The Interactive Experimental Garden promotes creative thinking of both students and teachers. It provides the experimental environment for semestrial projects and theses of students dealing with composition principles of the landscape design, production of new plant species and varieties or evaluation of differentiated approaches to planting design and many others. From the pedagogical point of view, the garden enables to apply new forms of creative and experimental education of students in the study programmes of the Horticulture and Landscape Engineering Faculty. The garden is an effective tool for simulating working conditions in an office of a landscape architect.

The Interactive Experimental Garden provides professional background for teachers in the Department of Planting Design and Maintenance. The cooperation between the university, experts and the public through the garden activities has a brand-new dimension now. Official Garden Debates, three times a year, bring possibility to present students, teachers and faculty activities, and provide place for meeting and co-working.



■ **Figure 3:** Aerial image showing the garden segments and the surroundings; November 2018

### 3 Results and discussion

#### Research opportunity of the Interactive Experimental Garden

The garden is the platform for investigating an innovative way of acquiring knowledge and experience by carrying out research activities in the field of innovative planting design. The garden creates space for solutions in actual research topics: low-cost planting design, phenology monitoring, pollinators monitoring, and monitoring of spontaneously spreading weeds.

##### ■ Low-cost planting design

One of the experimental approaches in the garden is to determine maintenance requirements in different planting compositions of the garden (IEG 1: Stylized nature: woodland and woodland edge with elements of monocultural drifts, IEG 2: Stylized tallgrass and forb plant communities with monoculture drifts, IEG 3 and 4: Non-formal planting in the style of a pictorial

meadow – blue and yellow, IEG 5: Stylized pictorial meadow – white and green, IEG 6, 7 and 8: Stylized pictorial meadow – red and purple and IEG 9 and 10: Traditional herbaceous border planting in blocks with random dispersion). Additional information about the herbaceous planting composition in the Interactive Experimental Garden is available on website [www.interaktivnazahrada.sk/en](http://www.interaktivnazahrada.sk/en).

The second goal is an adjustment of the above planting composition to the low-cost planting design, considering also principles for herbaceous planting in dry conditions (Hillová, 2016; Hillová et al., 2016; Šajbidorová et al., 2019). This determination serves to state the “ecological value” of each planting composition in the garden, that means how it significantly impacts the environment – amount and frequency of irrigation, mulching, fertilization and other maintenance interventions as well as hiding and feeding opportunity for insects, reptiles, amphibians and small mammals.

### Spontaneously spreading weeds monitoring

Experiences with spontaneously spreading weeds in planned planting and their potential further ornamental use is often perceived as a treat of planted design by experts and laymen. Despite the fact, some of spontaneously spreading weeds exhibit a kind of beauty which is 'authentic' and can remind residents of the memory or history in a site and demonstrate the changing dynamic for the naturally proceeding succession (Dunnett, 2004; Kuhn, 2006). Planning the multi-layer planting (Rainer and West, 2015) is a design approach by which we can control weeds with dense planting of the functional ground cover layer. Weeds that cover the soil early in the spring, do not restrict deliberately planted plants in growth, and do not interfere in higher design layers may be accepted as potential settlers.

Specifying and monitoring features of spontaneous spreading weeds with potential further ornamental use in ecological approach of multi-layered planting design is one of the research goals in the Interactive Experimental Garden. Selected taxa of spontaneously spreading weeds, which belong to three groups:

1. fill gaps before engaging space with later sprouting, but purposely planted perennials,
2. are later dormant or do not tend to climb or grow over purposely planted perennials in height,
3. reduce the occurrence of weeds growing in/ over design layers, were monitored.

The spontaneous vegetation can enhance biodiversity and establish oases for habitats, wildlife, and people. Inventory and survey of existing vegetation of a site is the first step of designing innovative low maintenance communities. Essentially, there are four ways of dealing with existing (spontaneous) vegetation:

- maintaining the current state (status quo) through appropriate measures (for example, maintaining a meadow by mowing);
- allowing succession to proceed naturally (no intervention takes place: a new kind of wilderness will be created);
- effecting changes in succession through interventions (for example, creating an open grove-like effect by removing branches and shrubs in a mature stand);
- improving of the aesthetic value by changing the species composition (Kühn, 2006).

The spontaneously spreading weeds in the Interactive Experimental Garden without threatening impact on the surrounding planting were *Prunella vulgaris*

L., *Ficaria verna* Huds., *Fragaria vesca* L. and partially *Glechoma hederacea* L.

### ■ Phenology monitoring – timing and abundance of flowering

Knowledge about the onset of aesthetically significant phenophases as well as knowledge of the local succession of usual vegetation cycles in larger groups of plants is increasingly important for the use of plants in landscaping (Bulíř, 2011). Flowering of perennials is the most important aspect when talking about the herbaceous planting design. The aim of this part of research is to evaluate the phenology of perennials – timing and abundance. The beginning of flowering was determined by the opening of the first flower in monitored specimens. Full flowering of a plant is when 50% or more of the flowers in a plant open. The end of flowering is when less than 50% of the flowers are flowering and the majority of flowers show signs of decay. In our study we used the methodology of Leverenz (2006). The most important data is the total sum of days of full flowering.

Phenology monitoring in the garden starts on 15<sup>th</sup> February with the first flowering plant, *Galanthus elwesii*. The monitoring has been done three times a week during the whole season and it has still not been over (in October). During phenology monitoring changes in the beginning of flowering in the same taxa at different light condition in the garden were observed (the beginning of flowering of *Rudbeckia fulgida* in the IEG 9 starts on 3<sup>th</sup> June compared to the same taxa in IEG 10 with more shade starts on 12<sup>th</sup> June).

The focus on high seasonal dynamics of plants composition and wide offer for insect, when designing herbaceous composition, is necessary.

### ■ Pollinators monitoring

Monitoring of pollinators is carried out with the main focus on species from the families *Apidae* and *Syrphidae*. Species composition and feeding preference of pollinators in the Interactive Experimental Garden were evaluated. Wild bees are well known pollinators and there is plenty of information about their distribution and feeding preferences. Hoverflies (Diptera: *Syrphidae*) are among the most important pollinators, although they attract less attention than bees. They are usually thought to be rather opportunistic flower visitors, although previous studies demonstrated that they show colour preferences and their nectar feeding is affected by morphological constraints related to flower morphology. Despite the growing appreciation

of hoverflies and other non-bee insects as pollinators, there is a lack of community-wide studies of flower visitation by syrphids (Klecka et al., 2018).

Appearance of wide range of pollinators with different feeding preferences is possible to increase by high diversity of plants composition.

The selection of research topics and research solutions is an integral part of education at the Horticulture and Landscape Engineering Faculty of the Slovak University of Agriculture in Nitra.

### **Experiential education opportunity of the Interactive Experimental Garden**

The Interactive Experimental Garden provides the experimental environment in the field of the herbaceous planting design at the Horticulture and Landscape Engineering Faculty, applying new forms of creative and experiential education.

Experiential learning can be defined as studying by experience or by performing an activity (learning by doing) (Lewis and Williams, 1994). The first theories about experiential learning date back to the 19<sup>th</sup> century when the main goal was to enrich conventional learning methods. This learning method is based upon the principle of interdisciplinary and constructive education. A constructive principle means that the outcomes of the educational processes are variable and often unpredictable, and students are in the role of critics of their own learning processes. The way one student can solve a problem differs from another one. The experience or knowledge from experiential education may vary considerably within one group of students (Wurdinger, 2005). Thanks to experiential learning (e.g. a practical educational project), participants create their own knowledge through active learning in the framework of interactions with their teachers and classmates or teammates (Frank et al., 2003). A teacher plays the role of a students' tutor and teaches them how to study. A teacher does not play the role of "a provider of knowledge or facts", he/she is rather a mentor, a facilitator, an assistant or an intermediary in education. From the students' viewpoint, experiential education brings various advantages such as: gaining presentation skills, improved reasoning, better learning abilities, increased motivation, self-confidence and student's independence (Orevi and Danon, 1999). In the course of experiential education, students acquire in-depth comprehension of content and processes, adopt new team-working skills or learn to work with people with different backgrounds, attitudes and qualifications

in order to solve problems jointly and mutually (sharing opinions for the purpose of finding answers to questions).

Student's participation in the project of the Interactive Experimental Garden had a positive impact on acquiring new skills and abilities. The Interactive Experimental Garden has become an original educational tool. Real participation of students in projecting and performing the complete landscape works has turned a traditional approach to education into an experiential and interactive form, bringing new competences of a student and a teacher. A web questionnaire was used to collect the opinions of students with the aim to confirm positive impacts on their acquiring of new skills and abilities. The respondents were sent the questionnaire online. They had to answer 10 open and multiple-choice questions. In total, 82 students were included from the bachelor's study program Landscape and Garden Architecture and of the engineer's study program Landscape and Garden Architecture and Biotechnics of Parks and Landscape Arrangements at the Horticulture and Landscape Engineering Faculty at the Slovak University of Agriculture in Nitra. The feedback provided by the online questionnaire was 27%, i.e. 22 students from 82 in total. However, the informative value of the research sufficed. The average feedback of the answers is 33% compared to paper-based questionnaires with the feedback rate of appr. 56% (Nulty, 2008). The outcomes of the questionnaire survey have proved practical contributions of experiential education to the study and the profession of a landscape architect.

The respondents who built the garden appreciated having acquired practical skills and experience motivating them in the work or in further studies at the faculty. Other benefits regarded by the students were development of managerial skills, team-working abilities, sharing joint experience between teachers and students and new viewpoints of the relationship between them. Students' views indicate positive acceptance of the Interactive Experimental Garden in the university educational process.

After completion, the garden has become an educational platform for various subjects in the study program at the Horticulture and Landscape Engineering Faculty, thus ensuring its long-term sustainability. As for the subject of Landscape floriculture, students may apply the knowledge as a textbook of morphological, habitual, growing, ecological and aesthetic features of plants. Observing and evaluations of plant combinations, perceiving seasonal dynamicity of plants as well as assessing maintenance management

and the process of planting reconstruction is the core of the subject of Designing in Landscape floriculture. In the subject of Landscape design and maintenance, students may acquire skills in maintenance of woody plants, construction of irrigation systems or methods of flower bed mulching. At the same time the garden will provide an opportunity for allocating proper deadlines and financial costs of completion and maintenance of flower beds in the subject of Budgeting of landscape design.

### Social and cultural opportunities of the Interactive Experimental Garden

The Interactive Experimental Garden is the platform for discussions in the field of herbaceous planting design for the public and experts and has an impact on awareness increasing of planting design and on the faculty ranking between experts and public.

Thematic trainings and events in the garden aim at:

- showing attractive faculty education area to the public and foreign visits to the faculty,
- offering workshops and courses to the public,
- being professional partner to experts.
- The students of the course Design in Landscape Floriculture participated in guided tours in the garden and thematic lectures during
- spring debates on bulbs,
- the 11<sup>th</sup> edition of the Open Park and Garden Weekend Event in summer, with debates on Perennials Seasonal Dynamics,
- autumn debates on designing flower beds.

## 4 Conclusion

The Interactive Experimental Garden set up an innovative experiential learning approach in bachelor and master study programs Landscape and Garden Architecture and Biotechnics of Park and Landscape arrangements. The students participating on several practical courses gain:

- working experience within installation and subsequent maintenance of the garden;
- creative mindset due to participating in looking for and selection of solutions to problems or research topics (evaluations of low-cost planting designs, monitoring flowering phenology, pollinator species and spontaneously spreading weeds);
- communication skills within organizational and professional support of thematic trainings and events in the garden.

The garden has created the brainstorming and communication platform allowing exchange of skills, knowledge and ideas between different professions, generations, experts and the public since its inception.

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