

From Wooden Blocks to Whimsical Robots: The “Programmieren spielend entdecken” Series to Nurture our Future Innovators

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Abstract. This poster presents the educational initiative of the extracurricular learning centre Smartfeld in St. Gallen, Switzerland. It focuses on the Programmieren spielend entdecken (Discovering Programming through Play) series, which is designed to provide a motivating introduction to programming for students of all ability levels in primary and secondary schools in the canton of St. Gallen. It consists of four different workshops tailored to different school levels. The PSE workshops aim to improve IT skills and various competencies, including social skills, while providing grade-specific programming experiences. Smartfeld, a unique interdisciplinary venture, brings together regional higher education institutions and the start-up environment. Located in the vibrant Swiss Innovation Park Ost, Smartfeld's mission is to foster creativity and future skills, promote STEAM education, and prepare students and educators for the digital age in an inspiring learning environment.

This poster does not have empirical results, but teacher feedback and workshop attendance data support its success, particularly among primary school educators. The workshops use a visual programming language to facilitate understanding and focus on core programming concepts. The inclusion of robots and microcontrollers increases engagement and motivation levels remain consistently high. The Smartfeld initiative has delivered over 400 workshops to over 7000 students. The use of visual programming languages has proved effective in facilitating problem solving and stimulating interest in programming, highlighting the importance of hands-on, experiential learning in the digital age.

Keywords: robot, programming, introduction, primary education, secondary education, creativity, playful, microcontroller, extracurricular, learning lab

1 Extracurricular learning venue “Smartfeld”

This poster describes an example of practice in the offer of the education laboratory “Smartfeld” in St. Gallen, Switzerland. It presents the series “Programmieren spielend entdecken” PSE (engl.: discover programming through play), an offer for all levels of primary and secondary school. The overall objective is to provide motivating programming introductions for pupils with diverse performance levels across schools within the canton of St. Gallen. These workshops aim to bolster IT proficiency and a range of competencies, including social skills. Classes are invited to partake in workshops tailored to their grade level, hosted at the extracurricular learning center, Smartfeld.

Smartfeld is an interdisciplinary initiative that stand as a unique entity in Switzerland, consisting of key stakeholders such as the Switzerland Innovation Park Ost, Swiss Federal Laboratories for Materials Science and Technology (EMPA), the St. Gallen Centre of Vocational Education and Training (GBS), the University of Applied Sciences of Eastern Switzerland (OST), the University of Teacher Education St. Gallen (PHSG) and the University of St. Gallen (UniSG). The overarching mission revolves around nurturing creativity and future skills while preparing pupils and educators for the demands of the digital era. Nestled within the dynamic Switzerland Innovation-park Ost, replete with burgeoning start-ups, Smartfeld combines technology and creativity, thereby fostering a deliberate emphasis on STEAM subjects and the creation of inspirational learning and experimental ecosystems.

This poster presents a practical demonstration of an innovative and playful approach to programming introduction within the school environment. All findings and conclusions presented herein are grounded in teacher feedback, practical classroom experiences, and an overall analysis of workshop participation data since the inception of the program.

Feedback analysis underscores the high acclaim received by active educators. It serves as a captivating and motivating initiation into the world of programming for pupils while instilling confidence in teachers' abilities to integrate programming into their curricula. There exists a substantial demand for such programs, particularly among primary-level educators. The intensive format of the workshops expedites efficient grade-appropriate introductions, fostering a compelling start and enabling swift progression. By introducing vital concepts within this learning ramp, pupils gain a foundation that can be further reinforced within their schools. Consequently, more complex educational goals can be pursued with a foundation already established. Moreover, the authentic context of the start-up hub co-located within the Smartfeld facility fosters direct and credible implementation, emphasizing the relevance and applicability of these skills in the professional world. This localized experience provides pupils with an understanding that such opportunities are not limited to Silicon Valley but are also manifest in their region.

2 Programmieren spielend entdecken – Workshops

The PSE series represents a structured introduction to programming designed for schools within the region. Comprising four half-day workshops tailored to various grade levels, ranging from the first primary school class to the final secondary school class, this initiative seeks to nurture pupils' programming skills over the course of their educational journey. Each workshop integrates age-appropriate robots or micro-controllers, fostering a hands-on, progressively challenging learning experience.

1st & 2nd primary class: Cubetto

Commencing with the utilization of the non-computer-based learning robot "Cubetto," this introductory stage engages pupils in the fundamental concepts of programming. Wooden blocks are employed to construct simple sequences in playful tasks.

3rd & 4th primary class: Thymio

This phase bridges the gap between robots and computers, initiating pupils into the world of visual programming languages. Individual sequences are constructed using various programming blocks, empowering pupils to execute tasks like illuminating an LED upon button press. Early sensor integration, such as the ultrasonic sensor show the combination of input and output through different pre-programmed modules.

5th & 6th primary class: mBot

Advancing to more sophisticated programming paradigms, pupils delve into concepts like loops and iterations to program self-guided robots. The visual programming language evolves with the incorporation of more intricate blocks, stimulating cognitive growth and problem-solving skills to program an obstacle-dodging robot.

1st - 3rd secondary class: micro:bit

The apex of the PSE series integrates microcontrollers, enabling pupils to interface with multiple sensors and actuators concurrently. This workshop promotes a deeper understanding of device control and encourages creative problem-solving.

The overarching objective is to provide pupils with a tangible programming experience, fostering an immediate connection between their actions and technical devices. This approach enhances pupils' engagement, curiosity, and persistence in pursuing diverse programming objectives.

Throughout these workshops, a visual programming language is exclusively employed. This pedagogical choice underscores the efficacy of block-based programming, as it simplifies program comprehension and enables a clear focus on core programming concepts. By minimizing text-based errors, pupils can more effectively engage with the structural aspects of programming, thus facilitating a more comprehensive understanding of programming principles.

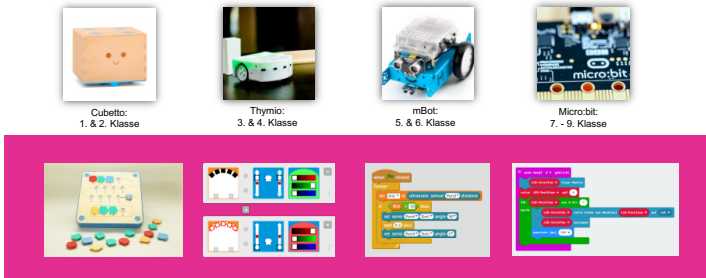


Fig. 1. An overview of the four different workshops of the “Programmieren spielend entdecken” series with their corresponding robots or micro-controller and their programming language.

3 Conclusion

The Smartfeld has already conducted around 400 workshops engaging over 7000 pupils as part of the PSE series. The PSE series underscores the favourable reception of the four workshops within the PSE series, as evidenced by sustained interest from regional educators visiting the Smartfeld regularly. Emphasis on visual programming languages has yielded positive outcomes, guiding pupils effectively toward problem-solving.

The decision to focus primarily on visual programming languages has proven to be the right one, as we have seen that it leads the pupils to the solution of the problems. With the block-based programming language, it is easier to focus on the concepts and not have to deal with the common errors of text-based programming languages.

The incorporation of robots and microcontrollers proves to be successful as it enhances the pupil’s enjoyment for programming and facilitating their initiation into the field. Consistently high motivation levels among participants stem from direct feedback afforded by interactions with robots and microcontrollers. Notably, these conclusions are based on initial feedback and insights garnered during workshop implementations, necessitating further investigation into motivation as a function of block-based languages or haptic device usage.

The figures show that the Smartfeld is being actively used. It is particularly well used by teachers at the primary level. It is posited that this preference may be attributed to the generalist training of primary school teachers as opposed to their specialized secondary-level counterparts. Within the primary level, workshops tailored for 5th and 6th-grade classes witness the highest attendance rates, partially attributable to the integration of "media and computer science" into standard curriculum at this educational tier.