The Swiss Robotic Camp: an innovative nationwide teacher training format in educational robotics

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The Robotic Camp is a teacher training on educational robotics (ER). The aim, besides instructing teachers on ER, was to create a community allowing the exchange of ideas between colleagues from all over Switzerland. In this work, the effectiveness of the camp was evaluated using the "Robotics Interest Questionnaire", an instrument for assessing ER knowledge and self-efficacy, interest, collaborative work and problem-solving. In addition to the questionnaire, interviews were conducted to explore the teachers' ideas, perceptions and evaluations of the camp experience. The results show a positive trend between pre- and post-test in all dimensions involved, and a statistically significant difference in the factors of self-efficacy and ER knowledge ($p<.001$) as well as teamwork ($p=0.050$).

1. Introduction

In recent years, many countries have incorporated educational robotics (ER) into classrooms, as evidenced by various studies and reports (Académie des Sciences, 2013; Bocconi et al., 2016; Bocconi et al., 2018; European Commission, 2016; Mangina et al., 2024; Royal Society, 2012; Thompson & Bell, 2013). Educational institutions worldwide are recognizing the potential of ER to engage students in STEM (Science, Technology, Engineering, and Mathematics) subjects (Chalmers, 2017; Park & Han, 2016; Sullivan & Bers, 2018) and to equip them with a diverse set of valuable competencies. These encompass problem-solving abilities, computational thinking, critical thinking, creativity, teamwork, and a better understanding of technology (Alonso-García et al., 2024; Calmet et al., 2016; Chalmers, 2017; Ching & Hsu, 2024; Hong, 2024; Sapounidis et al., 2023; Shute et al., 2017; Wang & Xie, 2024; Zhang et al., 2021).

These competencies are not only recognized globally but are also embedded in the school curricula of Switzerland. In the German-speaking (Lehrplan 21) and French-speaking (Plan d'Études Romand) regions, there are explicit recommendations for the inclusion of educational robotics activities, typically found under subjects like "Medien und Informatik" and "Éducation numérique" respectively. In the Italian-speaking part (Piano di studio della Scuola dell'obbligo ticinese), there is a suggestion that students should develop proficiency in programming technological devices integrated into other subjects, such as mathematics.

While there is ample evidence of the potential benefits of educational robotics in fostering these competencies, and ER is indeed included in Swiss compulsory school curricula, there remains a significant challenge to address the full integration of ER in Swiss schools. Educators require essential training and resources to effectively integrate this technology into their classrooms. Consequently, there is a compelling need to develop and implement teacher training programs that specifically focus on ER.

In recent years, efforts have been made to provide teachers with training in educational robotics, through initiatives such as the CAS in educational robotics (Negrini, 2019) in Canton Ticino, the Thymio MOOC of the EPFL (Ecole Polytechnique Fédérale de Lausanne, Switzerland) and INRIA (French National Institute for Research in Digital Science and Technology, formerly Institut National de Recherche Informatique et Automatique, France) or the RobertaRegioZentrum of the University of Teacher Training and the University of Applied Sciences of Luzern. While these are important in fostering teacher training in ER, several challenges persist. For instance, it has been reported that after the training, some teachers may find themselves isolated in their endeavors to integrate robotics into their teaching, or harbor concerns about their proficiency in computer science skills (Ertmer, 2005; Khanlari, 2016; Negrini, 2020), underscoring the critical need for the establishment of a supportive community of practice that can also help teachers after the initial training. As technology evolves rapidly, teachers must continuously update their knowledge and skills to keep pace with the dynamic developments in robotics; providing them with access to long-term support is crucial.

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Furthermore, the shortage of materials and ideas can act as a strong barrier to the widespread implementation of robotics programs in schools (Khanlari, 2016; Mubin et al., 2013). To surmount this challenge, it would be helpful to establish centralized repositories of educational resources, including lesson plans and activity guides, and ensure they are readily accessible to teachers.

Teacher training in ER should therefore also consider the long-term support of teachers, for example, by building professional networks between researchers, instructors and teachers to form a community of practice (CoP). The concept of "community," particularly within educational settings, is understood as a dynamic process of shared learning and collaboration that develops through common interests and sustained engagement. According to Kirschner and Lai (2007), a CoP forms not just as a group, but as a process where participants engage in social learning to solve shared problems, building collective knowledge and expertise. Duncan-Howell (2010) adds that online communities function as active learning environments, providing spaces for peer support and inquiry that establish relevance through authentic discussions.

The literature also suggests that there are four important dimensions for successfully teaching ER (Marras et al., 2024). The first dimension is self-efficacy and expertise in educational robotics (ER). Studies indicate that strong self-efficacy—defined as one's belief in their capability to organize and complete tasks (Bandura, 1994)—promotes teachers' psychological well-being, supports the adoption of effective teaching methods, and boosts student achievement (Zee & Koomen, 2016).

The second dimension relates to teachers' enthusiasm for ER and STEM subjects. When teachers feel unprepared to teach complex STEM topics, they may either avoid them or address them superficially (Bursal & Paznokas, 2006).

The third dimension emphasizes the importance of collaborative skills among teachers, crucial for achieving educational goals. Vangrieken et al. (2015) identify positive effects on communication, motivation, efficiency, and reduced feelings of isolation and workload when teachers collaborate. Collaborative teaching also raises overall competence and self-efficacy (Hattie, 2015; Puchner & Taylor, 2006).

The fourth dimension centers on problem-solving, which is crucial for both teaching and learning outcomes. ER provides a valuable setting for problem-solving since it involves heuristic thinking to develop robot behaviors for task completion, as advocated by Papert (1980). Problem-solving skills are essential for teachers in ER, as they play a key role in guiding students through these learning processes.

Based on these arguments, we have devised the Robotic Camp—an intensive educational robotics training program designed specifically for teachers in Switzerland. This initiative aims to empower teachers with the knowledge, skills, and resources required to effectively incorporate educational robotics into their classrooms, ultimately ensuring that students receive a well-rounded education enriched by the possibilities of robotics education.

Furthermore, the Robotic Camp is linked to the Roteco community (Robotic teacher community) that can offer long-term support to teachers and build a professional network of researchers and teachers from all over Switzerland.

In this article we present the experience with the Robotic camp and describe the impact of the camp on teachers' self-efficacy in proposing ER at school, interest in ER, problem-solving and collaboration skills. To measure the impact of the camp on these dimensions, we employed the robotic interest questionnaire (RIQ). Furthermore, interviews with teachers were also conducted to gain insight into how teachers valued the camp experience. The presented format can also be transferred to other domains and they training programs, offering instructors an innovative way to approach teacher training, in line with the dimensions of a good teacher training program, as cited by Schina et al. (2021).

2. The Robotic camp

The Robotic Camp is a three-day intensive teacher training on educational robotics. It was developed by five different institutions (SUPSI-DFA/ASP, SUPSI-DTI, PH GR, HEP/PH VS, and HES-SO VS) representing the various language regions of Switzerland. The aim of this training, besides instructing teachers on the use of different robots and programming languages and planning ER classroom activities for children, was to create a community of teachers in which ideas can be exchanged with colleagues from different linguistic regions of Switzerland, expanding their perspectives. This exchange would also be valuable to the camp instructors, providing an opportunity to explore activities and research conducted in other institutions nationwide.

The idea of organizing a camp also arose from the will to propose a different teacher training format than the traditional one, which consists of short courses arranged by schools or other educational institutions. A three-day intensive camp, where teachers also spend their leisure time together, allows for the building of stronger relationships and a sense of community. Effective professional development should offer teachers opportunities for sustained learning and address their specific needs, self-efficacy, and teaching beliefs (Duncan-Howell, 2010; Nørgård & Paaskesen, 2016; Papadakis et al., 2021). Nadelson et al. (2012), who organized a similar camp for STEM teachers, suggest that an effective camp should also present a wide variety of content and foster collegiality and informal discussions. Therefore, the camp was organized with various workshops based on the specific needs of teachers. Spending three days together also allowed for greater flexibility in the organization of content and time, giving more time for specific workshops or offering other (and individual) opportunities to revisit content. The considerably low ratio of three-four participants per instructor allowed for more individualized training, where teachers had the opportunity to bring their own issues and concerns and discuss them in detail with instructors.

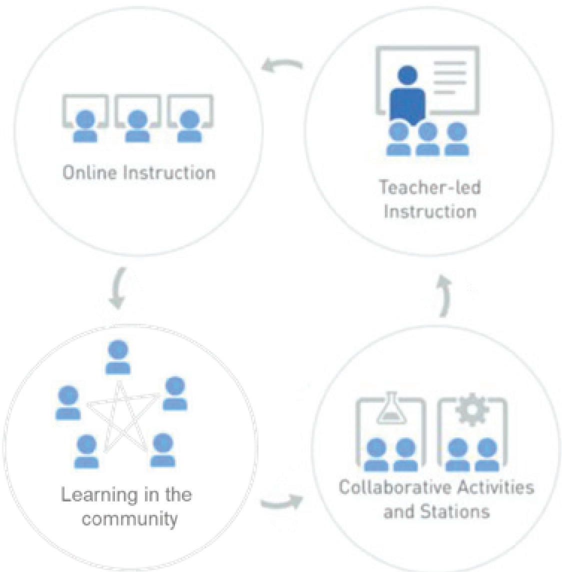
With the Robotic Camp, we aimed to build a community of teachers from different linguistic regions of Switzerland. One challenge was the diversity of languages that teachers speak. Offering training in three different languages (German, Italian, and French) is not straightforward, however this condition can also be considered a value-adding element. To address this issue, we decided to design a blended learning camp, where theoretical content was mainly provided to the participants in their languages through online materials, while hands-on activities were offered in mixed languages during in-person workshops.

The chosen format for the camp was inspired by blended learning models such as "station rotations" and "flipped classrooms" (Horn et al., 2014). The station rotation model requires participants to rotate between different modes of work, including at least one online. In our case, participants carried out online activities individually, while in the classroom, we proposed different types of activities, some workshop-based, some customized in small groups, and some frontal in large groups. The different "stations" used for the robotic camp were therefore the online activities, workshops in small groups, the frontal lesson and the customized activities such as individual consultations.

The flipped classroom model involves the reversal of the traditional learning phases of frontal classroom lecture and homework. In our case, the main theories of educational robotics were presented through videos, replacing the classic frontal format.

To these two models, we added the Roteco community and non-formal learning, making it possible to leave the traditional school setting and include experts and peers from outside the course, providing continuity for learning in the long term.

Figure 1:
Image adapted from the Blended Learning Universe (BLU_) (Clayton Christensen Institute, 2024)



The first Robotic camp was carried out in Airolo from May 27 to 29, 2023, and the second in Fiesch from 1 to 3 July, 2024. On both occasions, participants worked online on the virtual content in the two weeks before the camps. During the camp, participants took part in various workshops on the robots Thymio[1], LEGO Mindstorms or LEGO Spike[2], Makey Makey[3], as well as Micro:bit[4] and Calliope mini[5]. These workshops allowed participants to work with the robots in a learning-by-doing approach, aligning with the main idea at the basis of ER activities, namely that learning is considered as the active construction of knowledge in interaction with the world achieved through the manipulation of objects (Piaget, 1954 cited in Reyes Mury et al., 2022). In addition to the technical work on the functionality of the robots, there was also a didactical component where teachers learned to design educational activities using robots, guided by research-based frameworks such as the model for Creative Computational Problem Solving (Chevalier et al., 2020). Social activities were also incorporated to foster the sense of community and group cohesion . For example, a "robotic escape game night" has been organized, where teachers worked in small groups to solve different puzzles in two distinct escape games with the robot Thymio.

2.1 The Roteco platform

The participants at the Robotic camp first built a small community with the idea of maintaining contact during and after the camp, and sharing their ideas and experiences as part of a larger, nationwide network, known as Roteco. This is a community of educators, researchers, and practitioners in the field of educational robotics in Switzerland that was launched in 2018. It offers resources, events, and opportunities for collaboration, with a focus on engaging teachers and promoting ER in education (for a detailed description, see Reyes Mury et al., 2022). As of January 2024, around 2,000 members have shared approximately 1,000 activities spanning various school levels, including special needs education. These activities encompass tools, robotics, and unplugged activities, often integrating ER with other subjects. Detailed instructions, videos, links to websites, and images accompany these resources. Besides sharing activities, the platform covers news, interviews, research, events, contests, books, and training sessions related to ER and computer science education to offer teachers a lifelong learning experience.

3. Methods

The present work—based on the framework of the teacher training presented above and addressed to teachers of various school levels in the different linguistic regions of Switzerland—has the aim of assessing the impact of the experimental training with respect to different factors underlying the teaching of robotics at school. The research was guided by three questions with the aim of investigating dimensions that may seem unrelated.

First, the effectiveness of the implemented training was analyzed by investigating the participants' improvements in knowledge, sense of self-efficacy, interest in ER, and STEM in general. The second research question sought to understand whether immersive training had led to an increase in teachers' transversal skills, such as problem-solving and collaboration skills. The last question aimed to investigate differences in the dimensions examined with respect to the independent variables of expertise, gender, age, and school level of the teachers. The work was structured through a quasi-experimental research design involving two administrations of the same instrument at two times (T_0; T_1), before and after the two editions of the "Robotic Camp".

1 Thymio is an open-source educational robot designed by researchers from the EPFL, in collaboration with ECAL, and produced by Mobsya, a nonprofit association based in Renens, Switzerland.

2 LEGO Mindstorms and LEGO Spike are robots of the LEGO Group based in Billund, Denmark.

3 Makey Makey started out as a project initiated by Jay Silver and Eric Rosenbaum at MIT Media Lab based in Cambridge, Massachusetts, United States of America.

4 The Micro:bit is an open source hardware ARM-based embedded system designed by the British Broadcasting Corporation (BBC) based in London, England.

5 The Calliope mini is a single-board computer developed by the nonprofit Calliope gGmbH based in Berlin, Germany.

3.1 Participants

The questionnaire was administered electronically to a sample of 32 teachers. Sixteen participated in the 2023 edition, including 7 women (43.8%) and 9 men (56.2%), while another 16 took part in the 2024 edition, consisting of 11 women (68.8%) and 5 men (31.2%). In total, the sample includes 18 female (56.3%) and 14 male (43.8%) teachers. The questionnaire was completed anonymously. 56.3% of the teachers have a bachelor's degree, and the remainder have a master's degree (43.8%). The teachers work in all school levels: elementary (41.9%), secondary/middle (32.3%), upper secondary (16.1%) and university (3.2%). Two teachers (6.5%) teach in more than one school level. Half of the participants teach general education, 43.7% teach science subjects and only 6.3% teach arts. Half of the teachers come from the German-speaking area, 25% of the entire sample from the Italian-speaking area and the remaining 25% from the French-speaking area. The median age of the participants is 42 years. 37.5% of the teachers (age m=42.4 years; sd=8.18; length of service m=14.3 years; sd=11.6) stated that they had previous experience of ER in their school career, claiming expertise in the practice. 66.6% of the experienced teachers are male and only 33.3% female. Most of the experienced teachers come from the German (58.3%) and French linguistic territory (33.3%) and the other 8.3% from the Italian territory. 62.5% (of which 70% females and 30% males) do not consider themselves experts; on the contrary, they confirm that they have never had any experience of robotics. The largest number of non-experienced teachers comes from the German-speaking region (45%), 35% from the Italian-speaking region, and the remaining 20% from the French-speaking region. The average age of the inexperienced teachers is 42.1 years (sd=10.52) with an average of 14.7 years of professional experience (sd=11.4). Table 1 below shows the frequencies and percentages of the age and professional variables, according to the ER expertise of the teachers.

Table 1:
Descriptive statistics on demographic and professional data in relation to ER expertise

Variable		**Expertise**			
		Yes		**No**	
		F	**%**	**F**	**%**
Gender	*F*	4	12.5%	14	43.8%
	M	8	25%	6	18.8%
Age	*<42*	7	21.9%	11	34.4%
	>42	5	15.6%	9	28.1%
Linguistic region	*Swiss French*	4	12.5%	4	12.5%
	Swiss Italian	1	3.1%	7	21.9%
	Swiss German	7	21.9%	9	28.1%
Title of study	*Bachelor*	10	31.3%	8	25%
	Master	2	6.3%	12	37.5%
School grade	*Elementary*	5	16.1%	8	25.8%
	Middle	4	12.9%	6	19.4%
	Upper secondary	2	6.5%	3	9.7%
	University	1	3.2%	0	0%
	2 or more grades	0	0%	2	6.5%
Disciplinary field	*General education*	7	21.9%	9	28.1%
	Scientific	5	15.6%	9	28.1%
	Artistic	0	0%	2	6.3%

3.2 Data collection tools and procedure

Data were collected using a questionnaire in three languages aimed at detecting teachers' improvements in four different factors underlying the teaching of robotics. The instrument was structured in two sections: in the first, the participants' personal and professional data were collected, and in the second, coinciding with the "Robotics

Interest Questionnaire" (RIQ) validated in Italian language (Agus et al., 2023), the teachers' knowledge, sense of self-efficacy, interest, collaborative work and problem-solving with respect to ER were assessed. The RIQ assesses four dimensions by means of 27 items measured on a five-point Likert scale, from 1, indicating a high degree of disagreement, to 5, meaning strong agreement. The first dimension specifically assesses self-efficacy relating to knowledge of ER. The second assesses interest in ER and in STEM disciplines in general. The third assesses the attitude towards collaborative work. The fourth, and last, is a self-assessment with respect to problem-solving skills.

The RIQ is useful in the initial phase of training for assuming participants' levels in the dimensions investigated, both for guiding content choices and as a diagnostic tool of initial preparation. The RIQ is also beneficial in research designs involving dual administration (pre- and post-intervention). Experience in ER is a variable that exerts a measurable effect on the instrument, as reflected in the published normative data (Marras et al., 2024). In addition to the questionnaire at the end of the camp, individual interviews were conducted to explore teachers' ideas, perceptions and evaluations of the experience.

4. Results

The data were analyzed using descriptive and inferential statistics with Jamovi software (The Jamovi project, 2024). To analyze the data from both editions of the robotics camp collectively, a Wilcoxon Rank-Sum test was conducted on the RIQ factors (see Appendix) for the two independent samples participating in the camp at T_0 (supplementary table 1) and T_1 (supplementary table 2). The analyses show a positive trend between pre- and post-test (Table 2) in all dimensions involved. There is a statistically significant difference in the factor of self-efficacy and ER knowledge (p<.001) and in the transversal competence of teamwork (p=0.050). No significant differences are found in the STEM and ER interest factor and in problem-solving, although a positive trend emerges between the pre- and post-test means and medians.

Table 2:

Paired sample Wilcoxon test (N=32) on RIQ factors (T0 ; T1)

Factors	t	Mean	Median	SD	Wilcoxon	p
Self-confidence and knowledge in ER	T0	2.77	2.79	1.003	0.0	< .001
	T1	3.84	3.92	0.814		
STEM and ER interest	T0	4.25	4.43	0.559	101.5	0.102
	T1	4.37	4.43	0.457		
Teamwork	T0	4.44	4.50	0.516	90.0	0.050
	T1	4.60	4.75	0.448		
Problem-solving	T0	4.05	4.00	0.617	113.5	0.068
	T1	4.25	4.25	0.500		

Further analyses explored additional variables (Table 3), including teachers' initial expertise, gender, age (based on the median), and school level, focusing on elementary and middle schools as they were the most represented in the sample. It was found that both more experienced and less experienced teachers reported increased self-efficacy following the robotics camp. The gender variable indicates that both male and female teachers' self-efficacy and knowledge of ER increased significantly between the pre-test and post-test (Table 3). Concerning age and the factors of self-confidence and ER knowledge, a significant difference was observed between the two time points for both older and younger teachers. Among younger teachers, a significant difference also emerged in the teamwork factor (p=0.033) and a positive trend in interest in ER and STEM disciplines (p=0.056). Regarding the school level at which participants work, a significant increase in self-efficacy and knowledge in ER is evident for both elementary school teachers (p=0.002) and middle school teachers (p=0.006). Following the training, elementary school teachers demonstrate significant improvement in transversal skills, including teamwork (p=0.010) and problem-solving (p=0.010).

Table 3:

Paired samples Wilcoxon test on RIQ factors (T_0 ; T_1) in relation to the variables expertise, gender, age and school level.

Variable	Factors		N	t	Mean	Median	SD	Wilcoxon	p
Expertise	Self-conf. and knowledge in ER	yes	12	T0	3.62	3.71	0.649	0.00	0.002
				T1	4.24	4.46	0.625		
		no	20	T0	2.26	2.50	0.820	0.0	< .001
				T1	3.60	3.71	0.832		
	STEM and ER interest	yes	12	T0	4.36	4.36	0.420	17.50	0.331
				T1	4.51	4.57	0.387		
		no	20	T0	4.19	4.43	0.629	37.0	0.200
				T1	4.29	4.43	0.484		
	Teamwork	yes	12	T0	4.29	4.50	0.629	9.00	0.064
				T1	4.63	5.00	0.517		
		no	20	T0	4.53	4.50	0.428	45.0	0.401
				T1	4.59	4.75	0.416		
	Problem-solving	yes	12	T0	4.15	4.13	0.579	10.00	0.146
				T1	4.35	4.25	0.538		
		no	20	T0	3.99	4.00	0.646	53.0	0.157
				T1	4.19	4.25	0.479		
Gender	Self-conf. and knowledge in ER	f	18	T0	2.53	2.75	1.025	0.0	< .001
				T1	3.78	3.88	0.859		
		m	14	T0	3.08	3.00	0.920	0.0	0.001
				T1	3.90	3.96	0.778		
	STEM and ER interest	f	18	T0	4.31	4.43	0.597	44.0	0.377
				T1	4.39	4.43	0.487		
		m	14	T0	4.17	4.29	0.517	13.5	0.166
				T1	4.35	4.43	0.433		
	Teamwork	f	18	T0	4.44	4.50	0.489	42.0	0.182
				T1	4.60	4.63	0.385		
		m	14	T0	4.43	4.50	0.567	11.0	0.187
				T1	4.61	5.00	0.535		
	Problem-solving	f	18	T0	3.97	4.00	0.606	32.5	0.122
				T1	4.21	4.25	0.502		
		m	14	T0	4.14	4.13	0.641	28.0	0.399
				T1	4.30	4.25	0.511		
Age (years)	Self-conf. and knowledge in ER	<42	18	T0	2.86	2.75	0.919	0.0	< .001
				T1	4.12	4.33	0.663		
		>42	14	T0	2.65	2.92	1.127	0.0	0.001
				T1	3.47	3.54	0.866		
	STEM and ER interest	<42	18	T0	4.29	4.50	0.617	26.0	0.056
				T1	4.45	4.57	0.503		
		>42	14	T0	4.19	4.36	0.490	24.0	0.759
				T1	4.27	4.21	0.384		
	Teamwork	<42	18	T0	4.38	4.50	0.494	27.0	0.033
				T1	4.65	4.75	0.375		
		>42	14	T0	4.52	4.63	0.550	22.0	1.000
				T1	4.54	4.75	0.536		
	Problem-solving	<42	18	T0	4.06	4.13	0.645	41.0	0.166
				T1	4.28	4.25	0.521		
		>42	14	T0	4.04	4.00	0.603	20.0	0.260
				T1	4.21	4.25	0.489		

School level	Self-conf. and knowledge in ER	Elementary	13	T0	2.54	2.75	1.040	0.00	0.002
				T1	3.71	3.83	0.926		
		Middle	10	T0	2.80	2.71	1.077	0.0	0.006
				T1	3.94	4.00	0.734		
	STEM and ER interest	Elementary	13	T0	4.48	4.43	0.312	16.50	0.511
				T1	4.53	4.57	0.352		
		Middle	10	T0	4.44	4.50	0.384	23.0	1.000
				T1	4.41	4.50	0.372		
	Teamwork	Elementary	13	T0	4.37	4.50	0.496	9.00	0.010
				T1	4.73	4.75	0.297		
		Middle	10	T0	4.75	4.88	0.333	13.0	0.672
				T1	4.70	4.88	0.405		
	Problem-solving	Elementary	13	T0	3.83	4.00	0.688	2.00	0.010
				T1	4.29	4.25	0.477		
		Middle	10	T0	4.40	4.38	0.489	38.0	0.066
				T1	4.10	4.25	0.592		

In addition to the numerical data, qualitative information in the form of short interviews with participants and brief textual feedback were gathered. First, the audio data were transcribed, then the transcripts, together with the textual feedback, were analyzed following Mayring's qualitative content analysis (Mayring, 2014).

The qualitative analysis reveals how teachers positively valued the exchange with colleagues from different linguistic regions: *"c'était intéressant de discuter avec des profs qui avaient différents types de cultures, que ce soit aux primaires, aux secondaires, différentes langues"; "Un'altra cosa che mi ha fatto veramente molto piacere è lo scambio con gli altri colleghi, in modo che abbiamo visto come fare alcune lezioni, modificherò sicuramente il mio prossimo anno e vedo come farò delle lezioni perché mi hanno dato idee nuove, mi hanno dato materiali nuovi e questo ha tantissimo valore"; "Ich fand es wahnsinnig inspirierend, mich mit anderen Leuten auszutauschen. [...] Ich würde es wirklich jedem weiteren Lehrpersonen weiterempfehlen"; "Ich fand den Austausch zwischen den Kantonen und Sprachregionen sehr interessant, es hat gut getan ein bisschen über den Tellerrand zu schauen und zu erfahren, wie andere Lehrpersonen aus verschiedensten Stufen die Robotik in ihren Unterricht einfliessen lassen"; "Auch die Stimmung ist mega, denn es waren Menschen aus der ganzen Schweiz hier. Man fühlt sich viel mehr durchmischt als in unserem Schulhaus. Also ja, es ist der Hammer. Kann ich nur empfehlen"; "Et c'est vrai qu'être avec tout le monde, voir les différentes options, et puis avoir des gens qui les ont déjà utilisés en fait dans des cours ou qui ont envie aussi de tester ça, ça m'a donné beaucoup d'idées et de motivation".*

This exchange allowed them to gain new insights into planning and implementing ER in schools. Another valued aspect was the creation of a community to support participants in case of need, and stay in touch after the course: *"Et puis je repars avec plus de motivation, aller trouver des idées de séquences d'enseignement, d'avoir j'espère quelques personnes en réseau, même si elles sont peut-être un peu éloignées, pour créer d'autres séquences pédagogiques en lien avec la robotique"; "ho potuto conoscere tutte le persone di riferimento in questo campo, e questo è stato veramente per me di grandissimo valore, quindi grazie"*.

Regarding the acquisition of knowledge and competencies, participants highlighted how the robotic camp allowed them to explore different types of robots in a direct and practical way. This enabled them to learn how to program them and integrate them into their teaching activities: *"j'ai eu la chance de découvrir de nouveaux robots, on a pu vraiment explorer, on a été accompagnés tout au long du processus. Donc j'ai vraiment pu apprendre à programmer avec des blocs de programmation et j'ai eu plein d'idées d'activités que je pourrais amener dans mon établissement"; "devo dire che finalmente ho potuto vedere tanti robottini, averli qua in mano, pronti, e sperimentare, provare, però con l'aiuto dei tecnici, dei professori è stato veramente interessante"; "im Bereich Robotik Unterlagen zu generieren, ausprobieren können von den verschiedensten Robotern, dann auch die überfachlichen Kompetenzen dort anzuschauen. Wie kann ich das überall einbauen im Unterricht? Also die Möglichkeiten der Robotik die Augen zu öffnen, wo ich überall auch Robotik nutzen kann, ohne dass ich das nur im Kontext von Medien und Informatik nutze".*

In conclusion, the participants state that their expectations of the training were met: *"Mi sono iscritta a questo camp per diverse ragioni e sono contenta perché le motivazioni che mi hanno spinto ad iscrivermi a questo camp sono state ampiamente soddisfatte, anzi anche di più";"Ich habe mich hier eingeschrieben, weil mich erstens Robotik sehr interessiert und weil ich die Hoffnung hatte, dass ich ganz viele verschiedene Arten von Robotern und verschiedene*

Arten von Programmiersprachen lernen kennen. Und diese Erwartungen wurden voll und ganz erfüllt". They also now feel more comfortable about bringing ER into their classes although there are still a lot of aspects to be explored: *"Sono molto soddisfatta, ho imparato moltissimo. Vorrei poter ripetere l'esperienza per approfondire altri robot e avanzare ancora. Mi sento già molto più preparata per accompagnare gli insegnanti nell'introduzione della robotica in classe, ma c'è ancora un mondo da scoprire."*

5. Discussion and conclusion

The analyses, conducted using descriptive and inferential statistics, provide insights into the impact of the Robotic Camp on participating teachers. A positive trend is observed between the pre- and post-test in all dimensions assessed (Table 2). Notably, a statistically significant improvement is found in the factors of self-efficacy and knowledge in ER ($p<.001$) and the transversal competence of teamwork ($p=0.050$). While no significant differences are found in the STEM and ER interest and problem-solving factors, there is a positive trend evident in the means and medians between the pre- and post-tests.

The exploration of additional variables, including teachers' initial expertise, gender, age and school level, yielded nuanced findings.

The qualitative analysis, based on short interviews and textual feedback, provided additional depth to the findings. Teachers positively valued the exchange with colleagues from different linguistic regions, emphasizing the enriching experiences gained and the establishment of a supportive community.

The program's design incorporated a flipped classroom approach (Horn et al., 2014), providing participants with online preparatory material. This pre-camp preparation enabled participants to familiarize themselves with foundational concepts at their own pace and in their mother tongue. During the camp, a mix of modalities was employed to reinforce and apply this knowledge in hands-on, collaborative settings. While the pre-camp activities provided the necessary conceptual groundwork, the in-person, immersive experience was key to reinforcing and applying that knowledge in a collaborative and constructivist environment.

Preliminary observations, based on the interviews conducted with participants post-camp, suggest that the combination of pre-camp preparation and diverse in-camp learning modalities significantly enhanced collaborative practices, with participants reporting an increased ability to discuss, exchange and work effectively in teams, while approaching problems creatively. These findings provide actionable insights for the research community, highlighting the potential of immersive, structured training models to address the critical skills needed for ER implementation. However, future research should employ systematic pre- and post-camp assessments to quantify these impacts and evaluate the long-term transferability of these skills to classroom settings. By doing so, this training model can contribute meaningfully to the development of evidence-based guidelines for teacher support in ER.

Furthermore, this approach offers a promising model for teacher training in ER, because it combines flexibility, active learning, and intensive application. To further expand the impact on general practice, smaller, localized versions of these camps could be implemented, requiring less time commitment while retaining the key elements of pre-camp preparation and mixed learning modalities. Such localized programs could make ER training more accessible and scalable, empowering a broader range of teachers to integrate robotics into their classrooms.

While the results presented in this article are based on a small sample size of 32 participants from two editions of the camp and are therefore not generalizable, the camp's design featured two notable characteristics that contributed to its success: a high instructor-to-participant ratio and voluntary enrolment by teachers with interest in ER. These factors created an intensive learning environment highly conducive to engagement and skill development. However, such conditions may not be easily replicable in other contexts. To address these limitations in future editions, we suggest two follow-up strategies, which are not mutually exclusive and are both leveraging the teachers who have already completed the camp: on the one hand, the program could scale to accommodate larger groups by employing a peer-learning model where experienced participants mentor newcomers (Geeraerts et al., 2015). On the other hand, experienced participants could also take on the roles of organizers themselves for smaller, localized versions of the camp and act as initial person of reference for ER at their school. This could not only present more opportunities to foster community building, but also promote participation among a broader audience, including those with varying levels of prior interest in ER, which could help diversify the sample and enhance the generalizability of the findings.

Nevertheless, the general concept and training structure presented in this work may provide inspiration to those interested in transferring it not only to other geographical areas but also to other domains of knowledge and teacher training, offering trainers innovative ways to rethink and design teacher training.

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Keywords: Educational robotics; teacher training; community; RIQ questionnaire; blended learning

Das Robotic Camp: ein innovatives Format zur Ausbildung von Lehrpersonen im Bereich der Bildungsrobotik in der Schweiz

Zusammenfassung

Das Robotic Camp ist eine Fortbildung für Lehrpersonen zum Thema Bildungsrobotik (auf Englisch: Educational Robotics (ER)). Ein Ziel war es auch eine Gemeinschaft für den Austausch von Ideen mit Gleichgesinnten aus verschiedenen Regionen der Schweiz zu schaffen. Die Wirksamkeit des Camps wurde mit dem Robotics Interest Questionnaire evaluiert, einem Instrument zur Bewertung von ER-Wissen, Selbstwirksamkeitsgefühl, Interesse, Zusammenarbeit und Problemlösung. Ausserdem wurden Interviews mit den Lehrpersonen über die Camp-Erfahrung geführt. Die Ergebnisse zeigen einen positiven Trend zwischen dem Prä- und Posttest in allen betrachteten Dimensionen und einen statistisch signifikanten Unterschied bei den Faktoren Selbstwirksamkeit und ER-Wissen ($p<.001$) sowie bei der Zusammenarbeit ($p=0.050$).

Schlagworte: Bildungsrobotik; Fortbildung von Lehrpersonen; Gemeinschaft; RIQ-Fragebogen; integriertes Lernen

Le Robotic Camp : un format innovant pour la formation des enseignant-e-s en robotique éducative en Suisse

Résumé

Le Robotic Camp est une formation continue pour les enseignant·e·s au sujet de la robotique éducative (RE). L'objectif était également de créer une communauté avec des personnes provenant de différentes régions en Suisse. Une évaluation de l'efficacité du camp a été effectuée à l'aide du Robotics Interest Questionnaire, un instrument permettant d'évaluer les connaissances en matière de RE, le degré d'auto-efficacité, l'intérêt, la collaboration et la résolution de problèmes. En outre, des entretiens ont été menés avec les enseignant·e·s. Les résultats montrent une tendance positive entre le pré-test et le post-test dans toutes les dimensions considérées et une différence statistiquement significative pour les facteurs d'auto-efficacité et connaissance RE ($p<.001$) et de collaboration ($p=0.050$).

Mots-clés : Robotique éducative ; formation continue des enseignant-e-s ; communauté ; questionnaire RIQ ; apprentissage intégré

Robotic camp: un innovativo format di formazione per insegnanti nell'ambito della robotica educativa a livello svizzero

Riassunto

Il Robotic Camp è una formazione per insegnanti sulla robotica educativa (ER). L'obiettivo, oltre a una formazione sulla ER, era quello di creare una comunità per lo scambio di idee con pari provenienti da diverse regioni della Svizzera. L'efficacia del camp è stata valutata con il «Robotics Interest Questionnaire» (RIQ), uno strumento per valutare le conoscenze di ER, il senso di autoefficacia, l'interesse, il lavoro collaborativo e il problem solving. Sono state condotte anche delle interviste con i e le docenti sull'esperienza del camp. I risultati mostrano un trend positivo tra il pre e il post-test in tutte le dimensioni coinvolte e una differenza statisticamente significativa nel fattore di autoefficacia e conoscenza dell'ER ($p<.001$) e teamwork ($p=0.050$).

Parole chiave: Robotica educativa; formazione docenti; comunità; questionario RIQ; apprendimento integrato

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Appendix

Supplementary Table 1

Factors at T_0	Year	Mean	Median	SD	SE	U di Mann-Whitney	p (gdl=30)
Self-confidence and knowledge in ER	2023	2.77	2.83	0.999	0.2498	125	0.925
	2024	2.77	2.79	1.039	0.260		
STEM and ER interest	2023	4.32	4.36	0.396	0.0989	126	0.939
	2024	4.18	4.43	0.691	0.173		
Teamwork	2023	4.48	4.63	0.551	0.1378	110	0.501
	2024	4.39	4.50	0.491	0.123		
Problem-solving	2023	4.09	4.00	0.584	0.1459	124	0.879
	2024	4.00	4.25	0.665	0.166		

***TS1**: Wilcoxon-Rank sum test on RIQ factors (2023; 2024) in relation to the two independent samples participating in Robotic camp at* T_0

Supplementary Table 2

Factors at T_1	Year	Mean	Median	SD	SE	U di Mann-Whitney	p (gdl=30)
Self-confidence and knowledge in ER	2023	3.60	3.75	0.953	0.238	89.5	0.151
	2024	4.07	4.00	0.584	0.146		
STEM and ER interest	2023	4.46	4.57	0.434	0.108	102.0	0.333
	2024	4.29	4.43	0.478	0.120		
Teamwork	2023	4.69	4.88	0.443	0.111	99.5	0.268
	2024	4.52	4.50	0.452	0.113		
Problem-solving	2023	4.33	4.38	0.514	0.129	97.0	0.244
	2024	4.17	4.13	0.489	0.122		

***TS2**: Wilcoxon-Rank sum test on RIQ factors (2023; 2024) in relation to the two independent samples participating in Robotic camp at* T_1

Data set

ID	Robotic camp year	Gender	Linguistic Region	Age	Median Age (<42)	School level	Subject	Study	Length of service	Expertise	f1_T0*	f1_T1*	f2_T0*	f2_T1*	f3_T0*	f3_T1*	f4_T0*	f4_T1*
1	2023	M	Italian	53	>42	secondary	science	Master	4	No	2.92	3.33	4.43	4.43	5	5	4	4.5
2	2023	M	German	54	>42	secondary	general education	Bachelor	34	Yes	4.08	4.50	4.43	4.57	5	5	3.5	3
3	2023	F	Italian	49	>42	elementary	science	Bachelor	25	No	1.17	1.58	4.43	4.71	5	4.75	5	4.75
4	2023	F	Italian	45	>42	elementary	general education	Bachelor	22	Yes	3.08	3.58	4.43	3.86	4.75	4.5	4	4.25
5	2023	M	Italian	60	>42	more than on	arts	Master	40	No	2.00	2.33	3.43	4.00	5	5	4.25	4.5
6	2023	F	German	30	<42	elementary	general education	Bachelor	7	No	1.25	2.50	4.29	4.14	5	4.75	3	3.5
7	2023	M	Italian	54	>42	upper second	science	Master	25	No	2.67	3.33	4.29	4.57	4	4	3.25	4
8	2023	F	French	26	<42	elementary	general education	Bachelor	1	No	2.75	4.25	4.57	4.71	4	4.5	4	4.75
9	2023	F	German	33	<42	elementary	general education	Bachelor	8	Yes	4.00	4.42	4.57	4.86	4.5	5	4.5	4.5
10	2023	F	Italian	54	>42	elementary	science	Bachelor	33	No	1.00	2.92	5.00	5.00	4.5	5	4.25	4.25
11	2023	F	Italian	39	<42	more than on	science	Master	2	No	3.50	4.50	4.14	5.00	4.25	5	4	5
12	2023	M	German	42	<42	university	science	Bachelor	2	Yes	3.58	4.58	4.29	4.29	3.75	4.25	4	4.25
13	2023	M	German	45	>42	upper second	science	Bachelor	17	Yes	3.50	4.00	4.14	3.86	3.25	3.5	3.75	4.25
14	2023	M	Italian	40	<42	secondary	arts	Master	12	No	2.50	3.92	3.57	3.71	5	4.75	5	4.5
15	2023	M	French	35	<42	secondary	science	Master	6	Yes	2.50	2.92	4.29	4.57	4.75	5	4	4.25
16	2023	M	German	37	<42	secondary	general education	Bachelor	3	Yes	3.83	4.92	4.86	5.00	4	5	5	5
17	2024	F	French	54	>42	secondary	science	Master	24	No	1.0	2.9	4.7	4.1	5.0	4.8	4.8	4.3
18	2024	F	German	30	<42	elementary	general education	Bachelor	7	No	2.8	4.8	4.4	4.4	4.8	5.0	3.5	4.0
19	2024	F	German	37	<42	upper second	general education	Master	12	No	2.6	3.8	2.3	3.0	3.8	4.3	3.5	4.0
20	2024	F	German	35	<42	secondary	general education	Master	11	No	1.8	3.6	4.6	4.0	4.5	4.5	4.3	3.3
21	2024	M	German	30	<42	elementary	general education	Bachelor	6	Yes	4.3	4.6	4.7	5.0	4.5	5.0	4.3	4.8
22	2024	F	German	40	<42	elementary	general education	Bachelor	16	Yes	2.8	3.9	4.9	4.7	3.3	4.3	4.5	4.8
23	2024	F	French	42	<42	elementary	general education	Bachelor	7	No	1.5	4.7	3.7	4.4	4.0	4.5	3.3	4.8
24	2024	F	German	27	<42	elementary	general education	Bachelor	2	No	2.5	3.5	4.6	4.6	4.5	5.0	2.8	3.5
25	2024	F	French	42	<42	secondary	science	Bachelor	17	Yes	4.2	4.8	4.1	4.7	4.8	4.0	4.3	4.0
26	2024	F	German	44	>42		science	Master	20	No	3.4	4.1	3.9	4.1	4.5	3.8	3.8	4.5
27	2024	M	French	49	>42	upper second	science	Master	5	Yes	4.6	5.0	3.3	4.4	5.0	5.0	5.0	5.0
28	2024	F	German	40	<42	secondary	general education	Master	15	No	3.4	4.5	4.6	4.4	5.0	5.0	4.5	4.0
29	2024	M	French	57	>42	elementary	general education	Bachelor	36	Yes	3.1	3.7	4.3	4.3	4.0	5.0	3.0	4.3
30	2024	F	German	47	>42	elementary	science	Master	25	No	2.9	3.8	4.4	4.1	4.0	4.3	3.8	3.8
31	2024	M	French	29	<42	secondary	science	Master	1	No	1.8	4.1	4.9	4.6	4.5	4.0	4.8	4.3
32	2024	M	German	53	>42	upper second	general education	Bachelor	21	No	1.8	3.5	3.6	3.6	4.3	4.0	4.3	3.8

*f1= factor 1 "Self confidence and knowledge in ER" / f2 = factor 2 "STEM and ER interest" / f3 = factor 3 "Teamwork" / f4 = factor 4 "Problem solving"