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How to support teachers to carry out educational robotics activities in school? The case of Roteco, the Swiss robotic teacher community

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The development of 21st-century transversal competences such as communication, cooperation, and creativity as well as computational thinking and programming may be aided through educational robotics (ER). Different countries have inserted ER in their school curricula, however, to date ER activities are not carried out systematically in all schools and are more an initiative from single pioneer teachers. In Switzerland, to support all teachers to carry out ER activities and to foster the presence of ER in schools, a robotic teacher community (Roteco) has been created. Teachers may obtain assistance, share experiences, and access instructional resources through a digital platform, which will help them and spread the use of robotics in the classroom. For instance, the site enables educators to simply submit their activities, connect with other educators and professionals, choose and download didactic activities from their peers together with the relevant resources, and stay updated on the newest information, events, research, and further education courses in the field of ER. In the first years of the platform's existence, already more than 1,400 teachers have joined it. The project and the findings of two surveys are presented in this publication. The first survey was carried out in 2020 with 87 teachers and the second one in 2021 with 48 teachers from the community. The findings highlight the community's greatest accomplishments as well as the motivations for teachers' recruitment into the Roteco community and their contributions to its expansion. The results of this project allow for discussion on how to support teachers to implement ER activities in schools in a systematic way.

KEYWORDS

computational thinking, teacher training, curriculum, community, educational robotics

Introduction

Research on educational robotics (ER) in recent years has emphasized numerous potentials of using robots as didactic tools in schools raising the interest of researchers and educators. For example, the engaging nature of ER improves students' motivation (Lee et al., 2008; Alimisis, 2013), and fosters the development of disciplinary skills, especially in mathematics (Benitti, 2012) and technical and scientific skills (Chioccariello, 2009), raises students' interest in STEM while reducing gender stereotypes (Park and Han, 2016; Chalmers, 2017; Sullivan and Bers, 2018), fosters complex mental processes (Chioccariello, 2015) and promotes the development of 21st-century cross-curricular competencies like communication, teamwork, and creativity, as well as computational thinking and coding skills (Tzagkaraki et al., 2021). Recent work has indeed demonstrated that ER activities are often carried out in collaborative settings thus promoting collaboration and communication between students (Nugent et al., 2009; Ardito et al., 2014). Students are also challenged to apply their creativity when designing and building robots and when developing solutions to robotic problems (Park and Han, 2016). A final and important point is working with robots requires students to code and solve problems by developing algorithms, therefore, fostering their computational thinking skills (Atmatzidou and Demetriadis, 2016). Paaskesen (2020) says that when creating and utilizing robots critical thinking, analytic reasoning, as well as cross-cutting and transdisciplinary thinking, are required. However, it should be noted that some studies claim that robots have little to no effect on skill development or learning (Benitti, 2012).

In summary, ER can be a great teaching tool to explore creative uses of technology and to have a better understanding of the rapidly evolving digital world, as well as its benefits and drawbacks. After discussing these topics with students, teachers must then also move toward new and creative teaching approaches that incorporate the use of technology such as ER (Paaskesen, 2020).

Thanks to ER it is possible to carry out activities that, in addition to fostering the playful aspect, can stimulate a range of skills and abilities, of course, if they are proposed and handled critically and sensitively by the teachers. If the teacher reflects critically on the teaching-learning process, robots can become "objects to think with," as Papert (1991) and Resnick et al. (1998) argued. But as Paaskesen (2020) emphasizes, it is crucial to choose robots made for instructional objectives rather than those made with the intention of stimulating our sensations and emotions (Sicart, 2014; Paaskesen, 2020).

At the basis of ER activities, learning is considered as the active construction of knowledge in interaction with the world and thus through the manipulation of objects, as highlighted historically by Piaget's (1954) constructivism. Papert, having worked with Piaget on studies of mathematical learning (Catlin and Woollard, 2014), takes up the basic principles of Piaget's theory and based on these coined the term constructivism, which forms the basis of ER activities. The underlying notion is that, from a learning-by-doing approach, the creation and manipulation of physical objects play a crucial part in the learning process (Moro et al., 2011). Students must utilize their knowledge to build and plan a solution to a problem, then manipulate objects—such as robots—to verify the solution's effectiveness. Damiani (2015) emphasizes the importance of manipulation and the role of the body in learning, stating that "our body not only performs a sensory and executive mediating function between the brain and the external world but also constitutes the main device through which, by realizing experiences, we develop learning and produce knowledge" (p. 119). The manipulation of objects also makes learning visible and encourages the verbalization of one's reasoning and the sharing of discoveries. The physical embodiment of ER allows also to increase students' engagement and is more advantageous than other often utilized teaching methods (Papadakis et al., 2021). In all this, the social role of learning, which enables the development of transversal competences through confrontation with others, should not be forgotten.

The fundamental aspects of constructionism and thus of the classical framework of ER activities can be summarized as the following: situated learning linked to direct experience, active construction of knowledge by the individual, manipulation of cognitive artifacts that can facilitate learning and its sharing (Moro et al., 2011). Additionally, ER activities should be centered on the students, the activities should be joyful and give children some space to play, experiment, and explore, rather than activities conducted by the teacher and based on instructions (Paaskesen, 2020). Despite the increased research and educational interest in ER and the proven learning benefits that ER can provide, it is still not fully incorporated into the obligatory school system (Eguchi, 2014; Chevalier et al., 2016; Negrini, 2020) even though ER is recommended by the Swiss curricula. Specifically, in Switzerland, three different compulsory school curricula exist: in the curriculum for the German-speaking part (Lehrplan 21)[1] and in the curriculum for the French-speaking part (Plan d'étude romand)[2] ER activities are recommended (in a subject called "Medien und Informatik" and respectively "Éducation numérique"). The curriculum for the Italian-speaking part (Piano di studio della Scuola ticinese)[3] suggests students should learn how to program technological objects integrated into other subjects (e.g., mathematics). The number of hours dedicated to computer science and digital literacy varies in each canton in Switzerland since the compulsory schools are organized on a local, cantonal (state) level. It is, therefore, possible that some schools have established

1 https://www.lehrplan21.ch/
2 https://www.plandetudes.ch/
3 https://scuolalab.edu.ti.ch/temieprogetti/Pagine/pianodistudio.aspx

dedicated hours for these subjects and for other schools these subjects are taught voluntarily, for instance in special school project weeks. Also Tzagkaraki et al. (2021) highlight how appropriate curricula are needed to foster the integration of ER in schools.

Other reasons for a weak presence of ER in compulsory education might include the absence of didactic materials that teachers can use for an effective designing of activities (Mubin et al., 2013; Khanlari, 2016), the inadequate availability of technological resources (robots and computers) mainly due to the cost of the tools (Kradolfer et al., 2014; Castro et al., 2018), lack of awareness of the educational advantages of ER (Alimisis, 2013; Negrini, 2020), concern over their computer science expertise and the need for continuous in-service training (Ertmer, 2005; Khanlari, 2016; Negrini, 2020), the lack of time to plan and implement such activities (Chevalier et al., 2016; Khanlari, 2016; Castro et al., 2018; Negrini, 2020), insufficient technical and didactic support (Khanlari, 2016; Chalmers, 2018), the concern that human interaction may be replaced by robots (Reich-Stiebert and Eyssel, 2016) or more in general the adversity of using technologies in class (Negrini, 2020). Khanlari (2016) also highlighted that to implement ER in classes, teachers expressed the need to be accompanied by expert teacher assistants, and to have support materials, such as guides and manuals. The learning environment, the curriculum, and the educational philosophy are all essential components in order to integrate ER in schools (Papadakis et al., 2021).

Those results show that to assist teachers in implementing ER activities in their classes, the focus should not be on the robot itself but rather on the support of teachers with training and didactic materials that have been previously planned and tested as well as giving them the instruments to design open-ended activities with their classes (see for example Nørgård and Paaskesen, 2016; Papadakis et al., 2021). This would allow teachers to design their activities, according to the educational needs of their classes, starting from existing activities that they can readjust saving time in instructional design. For this purpose, a teacher community where novice teachers in ER can find support, advice, and the didactic materials of more expert teachers in ER can be of great help.

To lower the barrier for teachers introducing ER activities in their classrooms, Roteco–the Swiss robotic teacher community was established in 2019. This manuscript presents the Roteco community as an example of a community of practice for teachers in ER. The purpose is to share the experience gathered and the lessons learned since the project started, which might be of interest to anyone who aims at reaching teachers to introduce a novel pedagogical approach. Section "Online teacher communities" presents a brief literature review on teacher communities. In section "The Roteco community" the Roteco community, platform and the Roteco activities and events are presented. Section "Results and main achievements of the community" highlights the main achievement of Roteco and the results of platform analytics data as well as two surveys that allow reflection on how teachers participate in the community. The conclusion discusses the results and possible strategies to involve more teachers.

Online teacher communities

The teaching profession is defined by a perpetual need to upgrade expertise, acquire new content, and alter lesson plans (Richardson, 1990). This is further highlighted by the digitalization of our society and the new competences that technology use necessitates, even by teachers. Professional development for teachers traditionally takes place in short courses organized by the schools or by other institutions that offer professional training. This is also the case for ER courses. But according to the literature, these brief workshops are mostly theoretical and can lack relevance and practical applicability in schools (Guskey, 2002), making them less likely to promote the acquisition of new skills or have a lasting impact on pedagogy (see Duncan-Howell, 2010). To be effective, professional development must provide chances for teachers to engage in learning over a longer period and to address teachers' needs, self-efficacy and pedagogical beliefs (Duncan-Howell, 2010; Nørgård and Paaskesen, 2016; Papadakis et al., 2021). A way to reach those objectives is for example through communities of practice (CoP). A CoP can be seen as:

"On the one hand, a CoP is not really a thing but rather a process in which social learning occurs because the people who participate in this process have a common interest in some subject or problem and are willing to collaborate with others having this same interest over an extended period. The product of this process is the sharing of ideas, the finding of solutions to common problems, and the building of a repository (in the participants and in the group) of available and new knowledge and expertise. On the other hand, a CoP is a physical or virtual entity, reified in the group that is formed to carry out this process" (Kirschner and Lai, 2007, p. 128).

Or as Duncan-Howell (2010) states, "online communities are an active learning environment in which learners participate in conversations and inquiry, via chat rooms, email lists, and postings (Leask and Younie, 2001), that authentically establish relevance and meaning (Moore and Barab, 2002). They also offer opportunities for peer support and guidance (Bond, 2004; Cornu, 2004; Matei, 2005)" (p. 326).

According to Hur and Brush (2009), the interest in developing online teacher communities has significantly expanded, and the keys to effective teacher professional development include ongoing support and encouraging teacher involvement. A CoP can have favorable effects on three dimensions: the cognitive, the emotional, and the ideological, according to Dionne et al. (2010). For instance, peer learning and community information sharing helps instructors' knowledge and skills in the cognitive component to grow. The cooperation and encouragement of other coworkers

have an impact on the affective dimension, and a CoP can promote the group commitment to a shared objective in terms of the ideological dimension. A CoP is a readily available source of "knowledge [that] is situated in the day-to-day lived experiences of teachers and best understood through critical reflection with others who share the same experience" (Vescio et al., 2008, p. 81). Thanks to the technologies these days, learning is more participatory and open allowing access to worldwide communities and enabling the creation and information exchange amongst educators (Cope and Kalantzis, 2009; Ravenscroft et al., 2012). Teachers can find in those communities the materials, knowledge and support they need (Merriam, 2001; Lieberman and Mace, 2010). For instance, Duncan-Howell (2010) demonstrated that teachers in a CoP desired participatory learning that concentrated on applicable, practical classroom practices.

In the last years, different reviews of online communities appeared (Macià and García, 2016; Lantz-Andersson et al., 2018). According to these evaluations, people join a community based on their aspirations and professional interests (Macià and García, 2016). Teachers who are active in a community seem to regard themselves as experts in their field of instruction (Wesely, 2013). The CoPs are used to exchange knowledge, experiences, and resources (Macià and García, 2016). However, most teachers passively use CoPs, benefiting from the shared materials and comments made by others but rarely participating in an active way (Seo and Han, 2013). Ling et al. (2005) claimed that 50–80% of the communication and resources exchanged in a community are done by just 4–10% of community participants. Reasons for this passivity were studied by Preece et al. (2004). They discovered a number of causes for this passivity, including (i) participants do not feel the need to post; (ii) participants believe that participation will not benefit others; (iii) participants want to understand the dynamics of the community before getting involved; and (iv) participants cannot post new messages due to technical issues. Zuidema (2012) furthered by saying that inattentive behavior may be related to teachers' existing hectic schedules, time restraints, or lack of abilities. The virtual environment where CoPs are held might also affect participation. The virtual platforms need to have excellent usability, navigation, structure, content, and social elements to motivate teachers to participate. This means avoiding poor designs that are not in line with teachers' interests (Brass and Mecoli, 2011). Furthermore, some teachers may also choose to be passive because they fear "losing face" or receiving negative comments from other teachers (e.g., Tsiotakis and Jimoyiannis, 2016).

Other authors, on the contrary, examined the reasons why people participate in communities. Among the main reasons were the will to improve the welfare of the community, the will to give back help because they have received help from other members, the empathy for other members' struggles and the will to help them as well as the possibility to gain new knowledge by participating in discussions and activities (Hew and Hara, 2007) or simply because they want to belong to a community (Ellis et al., 2004).

Possible measures to promote participation were proposed by Wenger et al. (2002). For instance, they suggested setting up frequent events (like webinars), encouraging conversation (via forums, emails, etc.), or setting up in-person meetings and supporting one-on-one and small group contact. In addition to these steps, they also stressed the importance of the moderator or community leader in promoting the involvement of the community. Moderators can promote interactive activities, encourage community members to participate, answer members' questions or share knowledge (Wenger et al., 2002).

The Roteco community

The idea of the Roteco community emerged in 2018 and then in 2019, thanks to the funding of the Swiss Academies of Arts and Sciences, the https://www.roteco.ch platform was put online. Scuola universitaria professionale della Svizzera italiana (SUPSI), Ecole polytechnique fédérale de Lausanne (EPFL), and Eidgenössische Technische Hochschule (ETH) Zurich were the three institutions that managed the community and also represent three linguistic regions of Switzerland. The three organizations that support the Roteco initiative are also in charge of managing the three language communities of the platform (German, French, and Italian) and animating them. To boost ER in schools by assisting primary, secondary, tertiary, specialized, or in-training teachers, the project has gone through numerous phases. To increase and broaden the impact in the various Swiss cantons, eleven Swiss Universities of Teacher Education have joined the project: Eidg. Hochschulinstitut für Berufsbildung (EHB) Lugano, Pädagogische Hochschule (PH) Bern, Pädagogische Hochschule Fachhochschule Nordwestschweiz (PHFHNW), PH Luzern, PH Schaffhausen, PH Schwyz, PH St. Gallen, PH Thurgau, PH Wallis, PH Zug, PH Zürich, and Service écoles-médias (SEM) Geneva. PH Fachhochschule Nordwestschweiz (FHNW) has also replaced ETH Zurich as the leading institution for the German-speaking part of Switzerland. The Roteco project has grants until 2024.

The Roteco platform

As already presented in Negrini et al. (2021), the main instrument for building the community is the website https://www.roteco.ch. The platform's development is continuing, even though its initial edition launched online in February 2019. Teachers can sign up on this platform, make a profile, publish their educational activities, choose from those of other users or the official resources provided by training institutes, and download the pertinent materials to use in their classes. The platform allows for members to search and contact other

members subscribed on the Roteco platform. In the areas of ER and computer science education, teachers are kept up to date on news, interviews, research, events, contests, books, and training sessions. Social features have been included to promote a sense of community and streamline interactions between members, such as the ability to "like" or comment on an activity shared by another teacher. The platform will eventually feature a forum and the ability to "follow" a teacher's activity to add them to one's favorites and facilitate more interactions. Roteco is currently available in three languages—German, French, and Italian — and will be expanded over the coming months to include an English content side. The entire Roteco platform is covered by Creative Commons. The Roteco website is set up with a Home Page that provides an overview of the project and directs visitors through each step of the visit. The majority of the sections—News, Events, Courses, Stories, which are articles written by ER professionals, and Resources—can be accessed without registering. Only the learning activities (Activities) and teacher-teacher social interactions require a login (names, emails, profile, comments, likes, etc.) In future platform development, the activities area of the platform will be partially accessible to all expanding the visibility of such instructional resources. Around 1,400 members have already shared around 850 activities (May 2022) for the school levels kindergarten to high school and including special needs education. Different tools, robotics, and unplugged activities are present on the platform. Numerous projects combine robotics with other disciplines like mathematics, arts, geography, natural sciences, languages, music and other disciplinary fields. The activities' goals are stated, and detailed instructions are provided on how to carry them out in the classroom. Videos, links to other websites, and images of the various steps are occasionally provided.

Changes to the platform are always a work in progress due to adjustments from the feedback received from the users, the surveys and ongoing brainstorming with Roteco's different partners.

The Roteco events

Roteco is an ecosystem using a website to promote the work of the pioneers and create a domino effect for other teachers who find engaging in such activities daunting. The project links individuals through the work of community managers who animate the group by creating contests to encourage teachers to create and share resources on the Roteco platform. The bridge between research and practice is also promoted. For example, when a researcher is looking for a field to test a pedagogical resource, the community is informed via the platform and a supportive link to a teacher or classroom is created.

Roteco is also available on Facebook (134 followers), Twitter (643 followers), and YouTube (51 videos, 100 followers) to help support the development of a community. Additionally, a Roteco newsletter that updates the community about new ER courses, events, and developments is sent out every 2 months. There have been 18 newsletters sent since August 2019 (6 per year). The authors of the primary article of the newsletter are Roteco partners that have the opportunity to highlight their cantonal (state/regional) programs. Not only is Roteco available online, but community managers also make an effort to attend as many conferences and events as possible. This gives Roteco community managers the chance to speak with teachers in person, encourage the use of ER in classrooms, and get knowledge of recent advancements in the field and then share it with the Roteco community.

The events are a key point in the creation of the community. Thus, Roteco participates in different ways in these events. Some of the Roteco team participates in events organized by third parties in which Roteco has a booth with active demonstrations of Roteco resources and interaction with the attendees. Roteco also does workshops to highlight what the community has shared. Since 2019, the Roteco team has participated in approximately 20 physical events. Other events take place online. Roteco has co-created free monthly webinars (19 in total so far) with the Mobsya Association which produces the Thymio educational robot. Additionally, since 2021, Roteco has its own Roteco community free webinars falling on a month when its bi-monthly newsletter does not appear. These Roteco community webinars cover topics such as how to teach math or language with ER. In the webinars, we invite members of the community to present their activity to actively involve them and inspire the other participants. For example, in the webinar in September 2022 a robotics escape game made by the Espace des Inventions, a museum and Roteco collaborator, is presented. For the remainder of 2022, Roteco plans to hold physical meetings for partners, and *RotecoCamps* animated by Roteco partners and attended by teachers during the Swiss National Centres of Competence in Research (NCCR) Robotics Day 2022. In 2023 a Roteco hackathon is planned.

Distribution of Roteco resources

The Roteco budget is distributed between the following categories: human resources (66.4%), partner engagement (16.5%), platform development (7.6%), material resources and travel expenses (3.8%), and Newsletter (5.7%).

Human resources comprise the largest portion of the budget and this includes the salaries of community managers and project managers. This is a necessary part of the budget as the main role of the community managers is to create, grow and maintain a link between ER and its target audience. Roteco community managers undertake numerous tasks to make this happen. One important example is community moderation and presence both virtually and in person. The community manager promptly answers questions from users as well as checks and

replies to comments on the platform and social networks. Creative solutions are continuously needed from Roteco community managers to maintain and increase the engagement rate of the community. This can be achieved in part by creating innovative and interesting content. In addition, when teachers have technical questions it is important to not only answer the question but also to take those opportunities to as well start building relationships with the teachers. When Roteco's community managers receive questions via email, they aim to answer them as soon as possible, understanding that a teacher needs solutions and answers quickly. Also, teachers are validated by community managers when they submit an educational resource on the Roteco platform by personally informing them that their resource will be translated to the other languages on the platform. It also means that the resource will be shared with a larger number of teachers. Substantial effort is put into the translation of all Roteco content. Community managers are also central to the relationship with other institutions, partners as well as event organizers. Through all of these efforts, the Roteco community managers have been able to build the community with numerous contacts and communication avenues. Having these relationships including with the different Swiss cantons (states) communication departments significantly helps in promoting Roteco competitions, events, etc. Finally, Roteco community managers analyze research data and summarize it or adapt it to the needs of the teachers.

The second-largest portion of the budget is the monetary resources for partner engagement. The third-largest portion is expenses related to the platform for platform maintenance and modification for the platform is key to Roteco for communication and sharing of resources. The smallest portion of the budget is expenses related to material, travel and formatting and distribution of the Roteco newsletter.

Results and main achievements of the community

The outcomes and the community's major accomplishments are presented in the sections that follow. A description of the platform's analytics is provided in the first section. The findings of two surveys—the first conducted in 2020 with 87 instructors and the second in 2021 with 48 community teachers—are presented in the second part. The findings outline the factors that led teachers to join the Roteco community as well as their contributions to its expansion.

Platform analytics

The Roteco platform was launched online in February 2019. Since then, approximately 1,400 teachers and educators have registered with the community. The following graph (**Figure 1**) shows the number of new teachers per month who have registered on Roteco. Two waves are evident. The first starts in November 2019 and ends in April 2020. In November 2019, the first strategy was launched to increase the number of teachers. This strategy focused on contacting and informing all educational departments in the Swiss cantons to have them present the Roteco project to their teachers. During the summer school break the number of registrations decreased, and a second wave is visible from October 2020. In March 2021, closer collaboration with the Mobsya Association, a non-profit organization that produces the educational robot Thymio II, was launched, through which more teachers were reached. People who download the visual programming language (VPL) software on https://www.thymio.org automatically received an invitation to register on Roteco. The number of new registrants then stabilized in the last months at around 40 per month.

Most of the registrants are French-speaking (740) coming from the French-speaking cantons of Switzerland, and also from France, Belgium and some of the French-speaking countries of Africa (e.g., Morocco, Tunisia, Algeria, and Côte d'Ivoire). The German-speaking registrants (390) are mostly from the German-speaking cantons of Switzerland with some teachers coming also from Germany or Austria. The Italian-speaking registrants (266) are from the Italian-speaking regions of Switzerland or Italy.

Since February 2019, the Roteco platform has registered more than 200,000 page views and 43,000 users with an average session duration of 3:30 min.

On the platform (per status on April 20, 2022) teachers can find 857 activities with 141 different authors (approximately 10% of the registered members), 112 articles about ER and computational thinking and 371 short news pieces. Since February 2019, there have been 169 training courses for teachers and 274 events have been announced on Roteco.

Roteco also organized different webinars and calls to action. In total Roteco hosted and organized five webinars for its community with a participation of approximately 1,291 teachers. This number does not correspond to the number of registrations of these webinars (some participants register but do not come and watch on YouTube at a later date) but rather to the number of views of the videos and number of attendees. Each webinar is recorded and broadcast to reach a larger number of people.

There were five calls to action in the form of competitions with low participation rates. This low participation rate could be due to the form of the contest that requires submitting a resource for Roteco. Currently, we are testing an easier call to action with the submission of only a photo as documentation. We hope to increase the participation rate of these contests in this easier presentation manner.

Surveys with the community

Procedure and sample

To explore more in detail, the use of the Roteco platform and the needs of the community members, two surveys have been

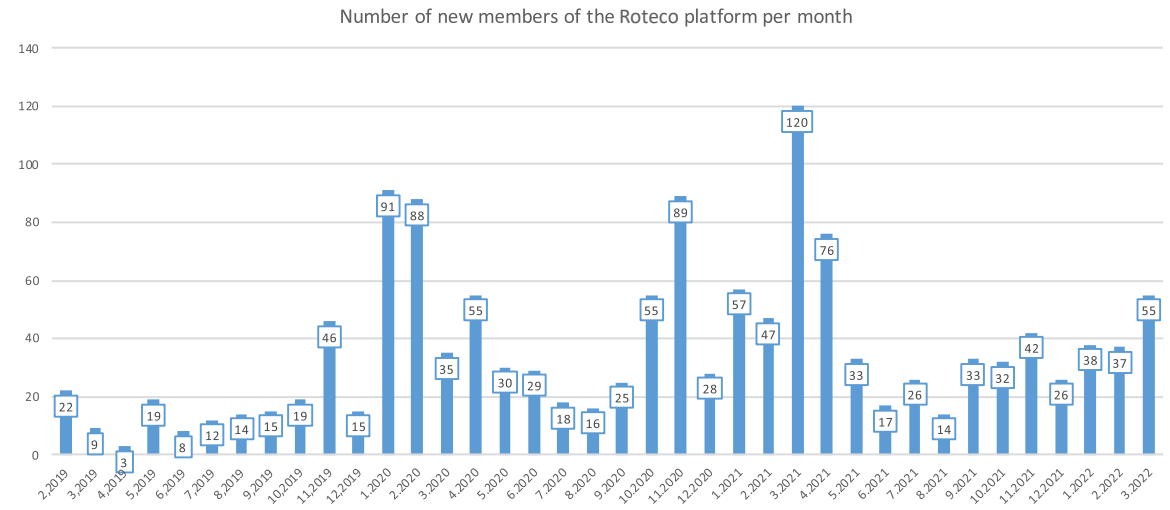

FIGURE 1
Number of new members registered on the Roteco platform per month.

undertaken. The first one was in May 2020 (Negrini et al., 2021) and the second one was in October 2021. A custom-made questionnaire was utilized for both surveys. On the Roteco platform, everyone was requested to respond to the questions using one of the three official languages of Roteco: German, French or Italian. To develop the questionnaire, the Roteco team carried out a brainstorming session discussing the questions to ask the community members in order to gather information on how they use the platform. As previously mentioned in Negrini et al. (2021), the surveys asked respondents about their use of Roteco (e.g., how often do you use the activities on Roteco?), their behavior on the Roteco platform (e.g., how often do you interact with other teachers on Roteco?), their desire to be a part of a community (e.g., Why did you join Roteco?), as well as the usability of the Roteco platform (e.g., Which technical problems did you have on Roteco?). Only for the second survey in October 2021 there also was added an adapted version of the Unified Theory of Acceptance and Use of Technology (UTAUT) questionnaire (Venkatesh et al., 2003) to measure ER acceptance by the Roteco members (not analyzed in this manuscript). Both surveys also asked for community members' demographics, languages they speak, topics they teach, and competences in ER. The type of the questions included simple Yes/No question items, open-ended question items, and questions based on a 6-point Likert scale (e.g., 1 = never to 6 = often). The first poll had 38 questions, while the second had 73 questions and required responses in between 5 and 10 min. Before conducting the two polls, there was no pilot. A copy of the questionnaires is available at this website's URL: https://www.roteco.ch/wp-content/uploads/2022/04/Questionnaires-Roteco.zip.

As already described in Negrini et al. (2021), in the initial survey 87 people took part (51 male, 36 female; 20 spoke German, 31 spoke French, and 36 spoke Italian). Twenty-six participants were primary school teachers, 25 from secondary school, eight from preschool, from high school, seven were university teachers, five taught in special education schools, and four in a professional school. In addition, five respondents said they do not teach. Most respondents were experienced teachers, having taught for 20 years or more (23) or between 11 and 20 years (28). In the sample, there also were three participants new to the teaching profession: two who were enrolled in a university for teacher education and one in his/her first year of the profession. The rest of the participants had 1–5 years (12) and 6–10 years (16) of teaching experience. There were also "pioneers," with 55 teachers indicating they were specialists in using information and communication technology (ICT), 21 feeling intermediate, and only 11 calling themselves beginners (Negrini et al., 2021).

In the second survey 48 people participated (31 male, 16 female, one without indication; 13 spoke German, 20 spoke French, and 15 spoke Italian). Most of the respondents are teachers of primary school (16) followed by secondary school (8), high school (5), university (5), special education schools (1), and pre-primary school (1). Additionally, some participants answered that they do not teach (5) or teach in other institutions as the one mentioned (7). Also in this case numerous teachers that participated in the survey stated that they are experienced teachers being teaching 11–20 years (15) or 20 years and more (13). The other 13 had been teaching between 1 and 5 years (8) or 6–10 years (5). Most of them answered as experts with the use of technologies (30), intermediate (12), and only a few as beginners (6).

In both samples, it is visible that especially experienced teacher experts in the field of ICT participated in the study. There is also a majority of male teachers.

Results

Figure 2 shows the reasons why participants joined Roteco. The results compare the findings of the second survey (2021) with the results of the first survey (2020) already published in Negrini et al. (2021). Most of them joined to remain informed about robotics (83% in 2020; 67% in 2021) or to be inspired by colleagues (69% in 2020; 77% in 2021). Getting instructional resources (57; 52%) and being a member of a community (55; 40%) are the other two often cited factors. Less frequent reasons for entering Roteco included those that required the community members to put more effort, such as to communicate with other educators (49; 21%), share instructional resources (45; 33%), or find events (39; 39%) or courses (33; 31%). In addition, some teachers (9; 4%) said they joined Roteco because their training programs required it.

Figure 3 demonstrates that the majority of survey respondents modestly utilize Roteco. Both surveys' results are comparable. The use of the platform and the teachers' level of ICT proficiency, their age, or their gender could not be determined to be significantly correlated. The most frequent responses to the question "Why do not you use Roteco?" were "I do not have time" (45% in 2020; 35% in 2021), "I do not do robotics in my class" (8; 17%), or "I have just registered on Roteco.ch" (6%; not asked in 2021). "There are no activities for the robots I use" (5; 6%), said some teachers, and "it is too difficult" (6; 2%) or "there are too many other resources online" (3%; not asked in 2021).

Even though the Roteco platform is used moderately, the participants say that the most useful sections are the activities page (84% in 2020; 89% in 2021), followed by the information about the courses (54; 56%), the short news pieces (56; 54%), the section on robots and resources (48; 43%) the information about events (34; 48%) and the stories (articles) (29; 27%).

The platform analytics show that only approximately 10% of the Roteco members share activities. Again, in this case, no significant correlations could be found between sharing activities on the platform and the level of competences in the field of ICT of the teachers, their age, or their gender. In the two surveys, we asked why teachers do not share them. The "lack of time" is cited as the primary reason (38% in 2020; 39% in 2021). Additionally, teachers reported that they "do not have activities to share" (23; 27%), that they are "beginners in the field of robotics" (17; 16%), that they are "unsure about the quality of their activities" (17; 15%), that they have just registered on Roteco (8%; not asked in 2021), and that the lessons they created are already available on the platform (6; 15%).

When asked if they see a value in being a part of Roteco (Figure 4) and to a CoP, the majority of the respondents (38%) completely agree. Only around 11% disagree. This question was asked only in the 2021 survey.

To improve participation in the community a question was posed to ask what Roteco can do to improve participation. The most common answer was the organization of webinars (37% in 2020; 35% in 2021), meeting in person (46; 33%), or "call to action" like contests for the community members (19; 33%), the organization of summer schools (not asked in 2020; 25%), hackathons (not asked in 2020; 23%), social events (17; 20%) and a forum where teachers interact on the platform (not asked in 2020; 20%) or a chat (16%; not asked in 2021).

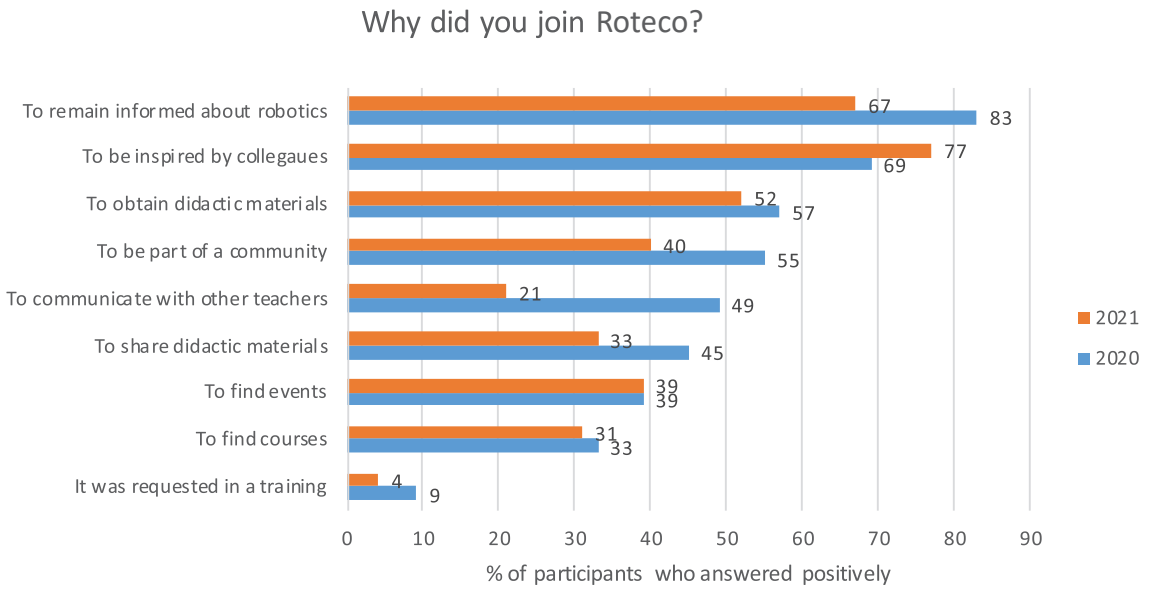

FIGURE 2
Reasons why teachers joined Roteco.

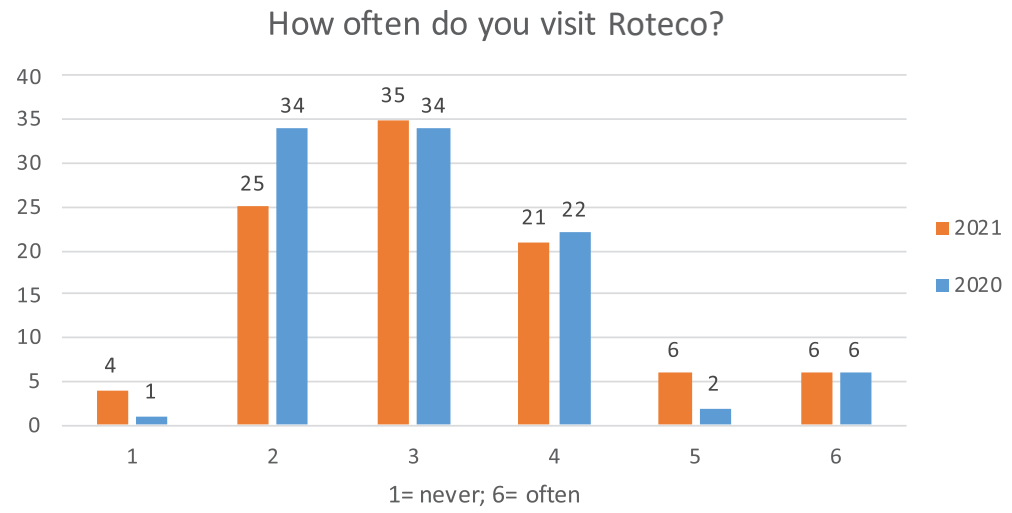

FIGURE 3
How often do you visit the Roteco platform?

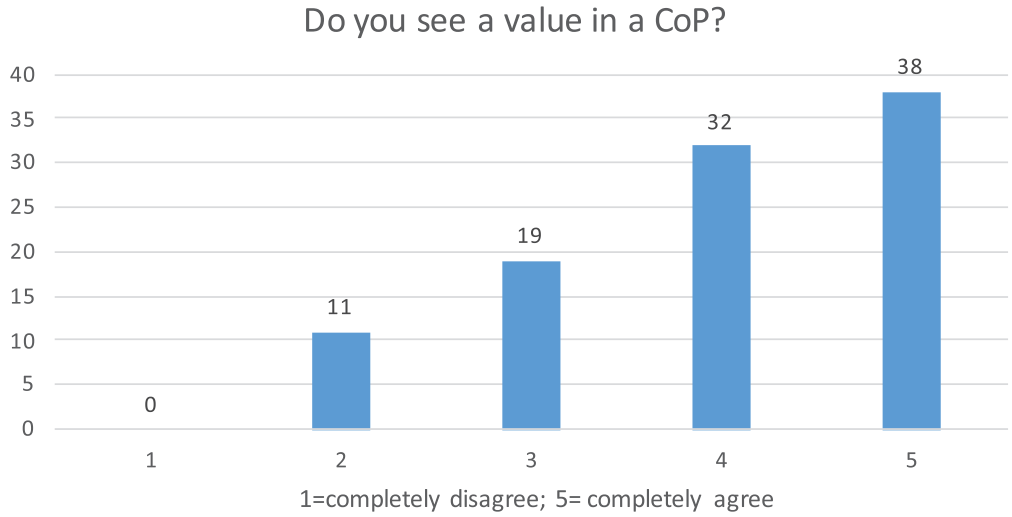

FIGURE 4
Do you see a value in a communities of practice (CoP)?

Conclusion

The Roteco community wants to help educators in implementing ER activities in class. Teachers, their training, and proper curriculum are some of the key components for integrating ER, as prior research has shown. Teachers must be trained and assisted in the correct way so that they can learn how to use new educational technologies as they become available (Papadakis et al., 2021). To introduce technologies in class is challenging for many teachers, because for each tool teachers have first to understand it and must figure out how to use it for pedagogical activities (Papadakis et al., 2021). This creates a gap between their actual use and teachers' ability to use them (Papadakis et al., 2021). Furthermore, there is also the need for appropriate curricula (Tzagkaraki et al., 2021). Educational robotics activities should be promoted based on open projects where students can learn by doing and have space to play, experiment, and explore, but they should avoid activities conducted by the teacher and based on instructions.

A teacher community can support teachers in implementing ER activities based on a learning-by-doing approach in the long term and contribute to closing the gap between teachers' capacity to use technology and their actual use of it. This is one of the main goals of the Roteco community.

Now 3 years on, it can be seen that the Roteco community is growing: there are more than 1,400 teachers registered on

the Roteco platform where it is possible to find more than 800 activities in three languages. The platform has also been visited over 200,000 times by people from all over the world. The interest in the platform and also the need of having a community on these topics appears to be there. In the last survey more than 60% of the participants agreed that a CoP has a great value for their teaching practice. However, the data shows us also that the participation is rather passive: only 10% of the Roteco members share their activities. This result is indeed not surprising but in line with other studies (Ling et al., 2005; Seo and Han, 2013). The lack of time, the absence of activities to share, or teachers who are unsure of the quality of their activities are a few examples of the causes of this inactivity. The outcomes in this instance are also consistent with the research (Preece et al., 2004; Zuidema, 2012; Tsiotakis and Jimoyiannis, 2016). The passivity of most of the members is not necessarily to be seen as negative. In their review, Macià and García (2016), for instance, state that a crucial component of CoP is peripheral participation, which represents those who gain from the content provided but infrequently make an appearance. Communities can benefit from having passive members since passive involvement is frequently a prerequisite for active participation. Nevertheless, a community cannot survive if only a few members are active "there is so much happening on the Internet that people do not return to silent communities" (Preece et al., 2004, p. 203). The aim of Roteco is not to be only a repository for ER activities but to build a community to help teachers implement ER activities and innovate teaching practices.

To foster participation Wenger et al. (2002) propose organizing regular events and promoting discussions through different strategies. Roteco has followed these suggestions by organizing regular webinars and also following the results of the survey where participants asked for more of a possibility to get to know each other. There is a good response to the webinars and the participation is satisfactory. During the webinars, which are purposefully not too formal, community members can get to know each other and share their thoughts and questions. The possibility for community members to present their activities during webinars has also permitted involving them more actively. In the future, Roteco also plans to organize in-person meetings where the community can meet. For example, *RotecoCamps* and Roteco hackathons are being planned and organized. Besides the webinars or the in-person meeting another strategy to promote the interaction on the platform is the organization of the "call to action". However, the experience has shown that only a few teachers participate in those calls to action. The reasons for this low participation can be seen as the same as for not sharing their activities: no time, not sure about the quality, nothing to share, etc. Another solution chosen by Roteco to try to improve participation is to develop a forum on the platform where teachers can also pose their questions and interact with other teachers. In any case, the role of the community manager will remain crucial to fostering discussions on the forum and answering teachers' questions. The last step that is foreseen in the next months is the translation of the website to English as well to grow the community also for English-speaking teachers since the platform analytics show that there are also several visits on the platform from English-speaking countries.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LN: project lead, data collection, writing first draft sections "Introduction," "Online teacher communities," "Results and main achievements of the community," and "Conclusion," review and editing (all sections). SM: data collection, writing first draft section "The Roteco community," review and editing (all sections). DA and MS: review and edit (all sections). All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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