

Involving Live Animals in Science Education: Exploring Cross-Border Practices among Slovenian-Language Primary Schools in Slovenia and Italy

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ABSTRACT

Involving live organisms into the educational process is recognized as one of the most effective strategies for younger children to acquire scientific knowledge about animals and develop positive attitudes to them. The described approach provides benefits that extend well beyond science education. Previous research has shown the need for further study of the demographics of educational practices involving animals in various international contexts. Our aim was to determine the current ways this approach is practiced in science lessons at Slovenian-language primary-level schools in Slovenia and Italy. A total of 208 primary school teachers completed an online survey, with the majority of responses revealing no significant differences between the two countries. Overall, most teachers reported not including live animals in their lessons at all, while those who employ this approach do so very rarely. The reasons most frequently stated for involving animals were to make students more motivated, encourage their active learning, and develop empathy and respect for living beings. Teachers perceived the biggest barriers to implementing this approach as organizational constraints, concerns with hygiene or allergies, and financial costs. Notably, over one-third of all respondents self-assessed their knowledge of appropriate methodological approaches for including live animals in lessons as very poor or poor. Most teachers stressed the need for training programs on this topic, along with systemic regulation that encompasses professional assistance and suitable conditions for integrating animals into the curriculum. Our results indicate that teachers' knowledge of methodological approaches, animal care and breeding, as well as animal biology, forms a crucial foundation for incorporating live animals in the educational process.

KEY WORDS: Children, living animals, primary school, science education, teachers

INTRODUCTION

The Importance of Involving Live Animals in the Educational Process

Involving live organisms into the educational process is acknowledged to be one of the most effective educational strategies for learning about animals and the roles they play in ecosystems (Hummel and Randler, 2012). This approach has been acknowledged in research in which children learned about farm animals (Larsson, 2022; Novotna et al., 2025), insects (Rop, 2008), sea stars and crabs (Sherwood et al., 1989), and different local animals (Lindenmann-Matthies, 2005). Studies on the effectiveness of learning the same biology content – to do with spiders, beetles and earthworms (Killerman, 1998) and amphibians (Tomažič, 2008) – through interventions that involved live animals, unlike conventional interventions that rely solely on visual materials (pictures, videos), found significantly greater progress in knowledge and its retention in the former. Live animals can act as powerful motivators for learning science: They encourage new explorations, promote spontaneous and self-initiated learning, and can lead to progress in science skills, especially regarding observation

skills (Hummel and Randler, 2012; Melchiori and Barzotti, 2018; Rop, 2008). Keeping animals in the classroom can foster positive attitudes toward science (Sorge, 2008).

Direct contact with living animals has been shown to be one of the most effective educational approaches not simply for gaining scientific knowledge, but also for developing positive attitudes to animals and living beings generally (Balcombe, 2000; Binngießer et al., 2013; Bjerke et al., 2001; Lindenmann-Matthies, 2005; Hummel and Randler, 2012; Kahn and Kellert, 2002; Nicoll et al. 2008; Pagani et al., 2007; Prokop and Tunnicliffe, 2008; Soga et al. 2016). Numerous studies have found significant improvements in attitudes, along with a reduction in fear and other negative feelings concerning animals – even with generally less ‘popular’ ones, such as spiders (Wagler and Wagler, 2014; Albo et al., 2019), snakes (Ballouard et al., 2012), insects (Kos et al., 2023), snails (Prokop and Fančovičova, 2017; Randler et al., 2012; Rybska, 2018); earthworms (Kos et al., 2023); toads and frogs (Kos et al., 2023; Tomažič, 2008, 2011) and mice and woodlice (Randler et al., 2012).

The mentioned animals are important components of ecosystems, and negative attitudes toward them could see

them become even more endangered. Direct contact with living beings in early childhood is essential for the development of environmental ethics. Knowledge and attitudes regarding living beings have reciprocal links (Prokop and Tunnichliffe, 2008). The more a child internalizes a positive attitude to animals, the more they will want to learn about them. As they come to know more about animals, they will be better able to recognize their role in the ecosystem, and in adulthood be more willing to invest effort and act with respect to the protection of animal species and their habitats. Positive direct experiences with living animals can be a significant life experience that leads to a lifelong sense of care and responsibility for the natural world (Chyleńska and Rybska, 2019; Jacobs et al., 2014; Kahn and Kellert, 2002; Kaltenborn et al., 2006; Lewis, 2007; Palmer et al., 1998; Tanner, 1980; Tomažič and Šorgo, 2017; Torkar, 2014).

The benefits of animals being present in the educational process extend far beyond the frame of science education, enriching children's lives by providing broader experiences across the curriculum and supporting their well-being (Herbert and Lynch, 2017). As shown in both theoretical frameworks and numerous scientific studies, including animals in the educational process hold the potential to: (a) Support the development of curriculum knowledge in literacy and numeracy, increase reading motivation, and enhance language skills (Herbert and Lynch, 2017; Fine, 2006; Pinto and Foulkes, 2015) as well as provide opportunity for cross-curricular learning in other developmental areas (Herbert and Lynch, 2017); (b) develop empathy and the recognition of other living beings' needs among children, leading to greater social responsibility and providing an underlying basis for the teaching humane values (Daly and Suggs, 2010; McNicholas and Collis, 2000; Zasloff et al., 1999; Zilcha-Mano et al., 2011); (c) help students develop fine and gross motor skills (Beetz et al., 2011; Kropp and Shupp, 2017); and (d) provide a calm and non-judgmental presence that supports children in times of stress, helping to reduce their anxiety (Crossman, 2017; Hirschenhauser and Brodesser, 2023; Jalongo et al., 2004). The majority of this research refers to interventions with school dogs, cats, and horses, as well as school pets, such as rabbits, hamsters, mice, and chickens. Although there is a shared fundamental belief that animals can make a positive difference in the education of school-aged children, Lewis et al. (2022) and Moe et al. (2025) point to limitations with the methodology of existing research that make it difficult to draw solid conclusions on the effectiveness of such interventions and show the need for further research.

Formal Framework for Science Education in Slovenia and Italy and the Science Subject Curriculum on the Primary School Level as Concerns the Possibility of including live Animals in Education

In Slovenia, students in grades 1–3 encounter science content in the subject “Learning about the environment” and in grades 4–5 in “Science and technology.” The content of these subjects,

knowledge standards, and educational goals are determined by curricula prepared by the Professional Council of the Republic of Slovenia for Education (Ministrstvo za vzgojo in izobraževanje, 2023). Topics that allow for live animals to be incorporated mainly appear in the clusters Living Beings and Environmental Education. In lower grades, this includes learning about the life needs of living beings (food, water, air, and space), distinguishing living from non-living things, learning about reproduction, and habitats. Students learn about the connection between parents and offspring, the life cycle, and how environmental changes impact animals (Program osnovna šola, Spoznavanje okolja. Učni načrt, 2011). In grade 4, the goals expand to classifying animals into groups based on shared characteristics (vertebrates, invertebrates), identifying species from the local environment, and linking external appearance with lifestyle. In grade 5, content on respiration, the roles of water, food chains and webs, decomposers, together with the impact of humans on nature, is added (Program osnovna šola, Naravoslovje in tehnika. Učni načrt, 2011).

In the Italian education system, one can also find Slovenian-language schools that were set up to serve the Slovenian national minority living in the areas bordering the country, notably in the provinces of Trieste and Gorizia, and the Municipality of San Pietro al Natisone. These schools are public institutions fully integrated into the Italian school system that follow the Italian legislation and curricular guidelines. Nonetheless, instruction is provided in Slovenian, and the curricula include specific elements aimed at preserving and promoting the Slovenian language and cultural heritage. In the Italian school system, the curriculum is determined by the national guidelines (Indicazioni nazionali per il curricolo della scuola dell'infanzia e del I ciclo di istruzione), which give schools a reference framework while designing their own curricula (Ministero dell'Istruzione, dell'Università e della Ricerca, 2012). Schools adapt the guidelines to their educational and didactic needs and develop a curriculum that reflects the context in which they operate. In 2018, the Scientific Committee, established by the Italian ministry to monitor implementation of the national guidelines, prepared a document entitled “National Guidelines and New Scenarios” (Indicazioni nazionali e nuovi scenari). The document builds on certain aspects of the 2012 national guidelines, offers an updated overview of the contents, and takes civic competences related to all disciplinary areas into account (Ministero dell'Istruzione, dell'Università e della Ricerca, 2018). The national curriculum and guidelines for the subject of science define general objectives for the topic of living beings and animals. In grades 1–3, emphasis is given to observation and field experimentation by observing the life of plants and animals, raising small animals in the classroom, recognizing similarities and differences between species, and understanding their needs. In grades 4 and 5, observation shifts to environmental changes over time, also including learning about the interdependence of living organisms and developing

the basic elements of plant and animal classification (Ministero dell'Istruzione, dell'Università e della Ricerca, 2012).

Legal Aspects Concerning the Use of Live Animals in Education in Slovenia and Italy

The school environment is governed by specific legal standards and regulations on the keeping and use of animals for educational purposes. Schools must comply with national laws and regulations on animal welfare, living conditions, and health.

In Slovenia, teachers must adhere to the Regulation on Protected Wild Animal Species (Uredba o zavarovanih prosto živečih živalskih vrstah, 2004), the Animal Protection Act (Zakon o zaščiti živali, 1999), and the Nature Conservation Act (Zakon o ohranjanju narave, 1999). Pursuant to the Regulation on Protected Wild Animal Species, the removal of animals from nature, also protected ones, is permitted for educational purposes, provided that they are subsequently returned to nature alive and healthy. It is permitted to take a maximum of 10 animals (excluding mammals, birds, and other endangered species) for a period of less than one-quarter of their reproductive cycle; in any case, no longer than 3 months. The Animal Protection Act requires the caretaker of an animal to provide living conditions appropriate to the species and needs of the animal, including nutrition, care, space, light, temperature, and separate accommodation for incompatible animals. Animal caretakers must possess basic knowledge of the animals' needs and appropriate handling.

In Italy, the removal of protected animal species from nature is expressly prohibited (Ministero dell'Ambiente e della Sicurezza Energetica, 2013; Legge 11 febbraio 1992, n. 157, 1992). Special permits issued by competent authorities, such as the Ministry of the Environment and local authorities are required to use protected animal species for educational purposes. The legislation contains no specific regulations prohibiting the temporary introduction of animals into public institutions, such as schools, for educational purposes. Animals that can be brought into schools without a special permit are typically domestic animals, such as dogs, cats, hamsters, guinea pigs, rabbits and fish. These species are classified as neither protected nor endangered, and thus the restrictions on protected species do not apply to them. Many schools allow domestic animals to be present in lessons if the management has provided approval in advance. Such decisions are based on a school's internal rules and do not require external legal permits, as is the case with protected animal species. All interventions with animals must comply with the national guidelines established by the Ministry of Health (Ministero della Salute, 2015).

Aim of the Research and the Research Questions

As established by many of the studies mentioned above, contact with live animals promotes the holistic development of children. Such experiences can prove especially important during the early years; namely, a crucial period for shaping

young individuals' relationships and attitudes to the living world (Kahn and Kellert, 2002).

In an international survey involving 650 educators from 23 countries, Lewis et al. (2022) highlighted the lack of knowledge about the demographics of educational practices involving animals in various international contexts, the types of animals involved, and the reasons teachers give for deciding on such practices. Across our research, we aimed to determine the way this approach is currently practiced in science lessons at the primary school level and to compare the results for Slovenian schools in Slovenia and Italy. Six research questions were formulated:

1. How frequently do teachers use live animals in primary science education?
2. Which reasons do teachers most often state for incorporating live animals in their science educational practice?
3. How do teachers integrate live animals into their science lessons?
4. What are the main barriers or reasons teachers provide for not using live animals in their lessons?
5. How do teachers self-assess their knowledge of animal biology, the proper breeding and handling of live animals, and appropriate methodological approaches for integrating live animals into lessons?
6. Does a correlation exist between a teacher's decision to include live animals in lessons and their self-assessed knowledge of animal biology, the proper breeding and handling of live animals, and appropriate methodological approaches for integrating them into lessons?

METHODOLOGY

We adopted a descriptive, comparative, cross-sectional quantitative survey design.

Sample

The convenience sampling method was used. The sample included 208 primary school teachers, who teach in the first cycle of primary education. The teachers were from Slovenian-language schools in Italy (specifically the areas of Trieste, Gorizia and Špeter, 106 teachers) and from schools in Slovenia, particularly the Gorizia region (the neighboring region at the border with Italy, 102 teachers).

Ethics

All procedures adhered to the European Commission's recommendations of ethical dimensions in research methodology – Ethics in Social Science and Humanities (European Commission, 2021) and principles stated in Ethical Guidelines for Educational Research (British Educational Research Association [BERA], 2018), including compliance with the GDPR (General Data Protection Regulation). In relation to the protection of personal data, the personal data is adequately protected and used only for the agreed purposes, compatible with the law. Participants provided informed consent, which included the information that

Table 1: Number (f) and percentage (f %) of teachers' responses to the question on the main reasons for using live animals in teaching

Reason	Italy		Slovenia		Total	
	f	f %	f	f %	f	f %
Better understanding of scientific/biological concepts	18	15.0	29	17.3	47	16.3
Encouraging active learning	21	17.5	31	18.5	52	18.1
Increasing students' motivation	27	22.5	33	19.6	60	20.8
Connecting theory with direct experience	12	10.0	23	13.7	35	12.2
Developing empathy and respect for living beings	24	20.0	25	14.9	49	17.0
Developing scientific observation skills	18	15.0	27	16.1	45	15.6
Other	0	0.0	0	0.0	0	0.0
Total	120	100.0	168	100.0	288	100.0

research material obtained may lead to publication. Anonymity and confidentiality were strictly maintained. According to Slovenian legislation, this study did not require ethics approval from an ethical committee or a similar body.

Data Collection and Survey Instrument

Data were collected through an online questionnaire on the 1KA platform, structured into five sections:

1. Inclusion practices, frequency, and animal selection;
2. Perceived pedagogical benefits and barriers;
3. Teacher self-assessment (5-point Likert scales on animal biology, handling/breeding, and methodology);
4. Institutional support and training needs;
5. Demographic background.

The questionnaire content was developed based on relevant literature on primary science education. The initial draft of the survey instrument was reviewed by three experts in science pedagogy and educational research methodology to assess construct relevance, content validity, and item clarity. Following their feedback, minor modifications were made.

Data Analysis

Data were analyzed using the IBM Statistical Package for the Social Sciences software. Descriptive statistics were calculated for both categorical and numerical variables. The Kolmogorov-Smirnov test was employed to assess the normality of the data distribution. Further analysis involved the likelihood-ratio test and Pearson's Chi-square test.

RESULTS

Teachers' Perspectives on the Benefits of Using Live Animals in the Classroom

Overall, teachers in both countries most frequently cited increasing students' motivation, encouraging active learning, and developing empathy and respect for living beings (as the primary reasons for using live animals in class (Table 1). The differences between countries were not statistically significant ($\chi^2 = 2.443$; $df = 5$; $p = 0.785$).

Frequency of Incorporating Live Animals into Lessons

In general, the results show that the majority of teachers in the sample (62.5%) do not include live animals at all (Table 2). The

Table 2: Number (f) and percentage (f %) of teachers' responses to the question of whether they ever use live animals in their teaching

Country	Yes		No		Total	
	f	f %	f	f %	f	f %
Italy	35	33.0	71	67.0	106	100.0
Slovenia	43	42.2	59	57.8	102	100.0
Total	78	37.5	130	62.5	208	100.0

Table 3: Number (f) and percentage (f %) of teachers' responses to the question on how often they use live animals in teaching

Country	Three times or more per month		Once or twice per month		Five to seven times per year		Two to four times per year		Once a year		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Italy	0	0.0	0	0.0	2	5.7	20	57.1	13	37.1	35	100.0
Slovenia	1	2.3	1	2.3	5	11.6	18	41.9	18	41.9	43	100.0
Total	1	1.3	1	1.3	7	9.0	38	48.7	31	39.7	78	100.0

differences between countries were not statistically significant ($\chi^2 = 1.852$; $df = 1$; $p = 0.174$).

Overall, most of the teachers, who involve live animals in their practice, used them two to four times per year or once a year. Just two teachers reported using them monthly (Table 3). The differences between countries were not statistically significant ($G^2 = 4.194$; $df = 4$; $p = 0.380$).

Ways of Including Live Animals in the Educational Process

Teachers in both countries mainly used live animals for guided observation (Table 4). The differences between countries were not statistically significant ($G^2 = 3.286$; $df = 3$; $p = 0.350$).

Animal Groups Used in Lessons

Overall, the most commonly used animals were insects, earthworms and amphibians. Other groups, such as fish, reptiles, or birds, were rarely used in either country (Table 5). Statistically significant differences were found between Italian

Table 4: Number (f) and percentage (f %) of teachers' responses to the question on how they use live animals in teaching

Method of use	Italy		Slovenia		Total	
	f	f %	f	f %	f	f %
Guided observation	31	79.5	37	67.3	68	72.3
Animals kept in the classroom (teacher responsible)	2	5.1	9	16.4	11	11.7
Students participate in animal care	5	12.8	7	12.7	12	12.8
Other	1	2.6	2	3.6	3	3.2
Total	39	100.0	55	100.0	94	100.0

Table 5: Number (f) and percentage (f %) of teachers' responses to the question on which animal groups are most frequently used in science lessons

Animal group	Italy		Slovenia		Total	
	f	f %	f	f %	f	f %
Mammals	14	16.7	10	9.7	24	12.8
Insects	30	35.7	31	30.1	61	32.6
Fish	5	6.0	4	3.9	9	4.8
Reptiles	7	8.3	7	6.8	14	7.5
Birds	2	2.4	1	1.0	3	1.6
Amphibians	5	6.0	29	28.2	34	18.2
Earthworms	19	22.6	18	17.5	37	19.8
Other	2	2.4	3	2.9	5	2.7
Total	84	100.0	103	100.0	187	100.0

and Slovenian teachers regarding the animal groups used in science lessons ($G^2 = 18.171$; $df = 7$; $p = 0.011$). These differences stem mostly from the use of amphibians, which were much more frequently included by Slovenian teachers than by Italian ones.

Main Reasons for Not Using Live Animals in Teaching

Overall, the most commonly reported reason was organizational constraints, followed by concerns with hygiene or allergies, financial costs, and legal issues (Table 6). Among "Other" responses, teachers mentioned the lack of a suitable space at school or home and no school policy supporting animal inclusion. Statistically significant differences were established between Italian and Slovenian teachers concerning the reasons for not using live animals in science or environmental lessons ($\chi^2 = 22.457$; $df = 9$; $p = 0.008$). Italian teachers more frequently mentioned the financial costs than Slovenian ones, while Slovenian teachers more often mentioned a fear of parental disapproval.

Teachers' Self-Evaluation of their Competences Regarding Involving Live Animals in Lessons

Teachers' self-evaluation of their knowledge of methodological approaches to involving live animals in lessons

Overall, teachers in both countries most often evaluated their knowledge as poor or average (Table 7). Significant differences were found between Italian and Slovenian teachers ($\chi^2 = 17.362$; $df = 4$; $p = 0.002$). Slovenian teachers more frequently rated

their methodological knowledge as good, whereas the most common rating among Italian teachers was poor.

Teachers' self-evaluation of their knowledge about the proper handling and care of live animals

As shown in Table 8, teachers in each country most frequently rated their knowledge about the proper handling and care of live animals as good or average. The differences between countries were not statistically significant ($\chi^2 = 5.506$; $df = 4$; $p = 0.239$).

Teachers' self-evaluation of their knowledge of animal biology

Overall, teachers in both countries most often rated their knowledge of animal biology as moderate or good. A statistically significant difference was established between Italian and Slovenian teachers regarding their self-assessed knowledge of animal biology ($G^2 = 9.516$; $df = 4$; $p = 0.049$). As shown in Table 9, more Slovenian teachers rated their knowledge as excellent than Italian teachers.

Teachers' Self-Assessments of their Competences in Relation to the Frequency of Including Live Animals in Teaching Practice

Teachers' self-assessment of their knowledge of methodological approaches relative to the frequency of including live animals in teaching practice

Significant differences were found between teachers who include live animals in their lessons and those who do not, as to their self-assessed knowledge of appropriate methodological approaches ($\chi^2 = 52.927$; $df = 4$; $p < 0.001$). Cramer's V (0.504; $p < 0.001$) indicates a moderate to strong and statistically significant association between these variables.

Teachers who use live animals most frequently rated their methodological knowledge as good or excellent (58.9%), while only 10.3% rated it as poor or very poor. Conversely, teachers who do not include live animals rarely rated their methodological knowledge as good or excellent (18.4%), whereas the majority (56.2%) described it as poor or very poor (Table 10).

Teachers' self-assessment of their knowledge of proper animal handling and breeding relative to the frequency of including live animals in teaching practice

Statistically significant differences were established between teachers who include live animals and those who do not as

Table 6: Number (f) and percentage (f %) of teachers' responses regarding the main reasons for not using live animals in lessons

Reasons for not using live animals in lessons	Italy		Slovenia		Total	
	f	f %	f	f %	f	f %
Ethical concerns	17	8.4	18	11.3	35	9.7
Doubts about hygiene, allergies, etc.	34	16.8	26	16.4	60	16.6
Fear of animals	5	2.5	7	4.4	12	3.3
Financial costs	34	16.8	14	8.8	48	13.3
Limited availability of animals	21	10.4	12	7.5	33	9.1
Lack of knowledge and experience	17	8.4	11	6.9	28	7.8
Legal concerns	19	9.4	22	13.8	41	11.4
Fear of parental disapproval	7	3.5	19	11.9	26	7.2
Organizational constraints	42	20.8	30	18.9	72	19.9
Other	6	3.0	0	0.0	6	1.7
Total	202	100.0	159	100.0	361	100.0

Table 7: Number (f) and percentage (f %) of teachers' responses regarding their self-assessed knowledge of appropriate methodological approaches for involving live animals in lessons

Country	Very poor		Poor		Average		Good		Very good		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Italy	9	8.5	43	40.6	28	26.4	17	16.0	9	8.5	106	100.0
Slovenia	12	11.8	17	16.7	29	28.4	34	33.3	10	9.8	102	100.0
Total	21	10.1	60	28.8	57	27.4	51	24.5	19	9.1	208	100.0

Table 8: Number (f) and percentage (f %) of teachers' responses regarding their self-assessed knowledge of properly handling and caring for live animals

Country	Very poor		Poor		Average		Good		Very good		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Italy	3	2.8	20	18.9	35	33.0	33	31.1	15	14.2	106	100.0
Slovenia	2	2.0	16	15.7	22	21.6	45	44.1	17	16.7	102	100.0
Total	5	2.4	36	17.3	57	27.4	78	37.5	32	15.4	208	100.0

Table 9: Number (f) and percentage (f %) of teachers' responses to the question on how they evaluate their knowledge of animal biology

Country	Very poor		Poor		Average		Good		Very good		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Italy	1	0.9	16	15.1	45	42.5	36	34.0	8	7.5	106	100.0
Slovenia	0	0.0	13	12.7	29	28.4	42	41.2	18	17.6	102	100.0
Total	1	0.5	29	13.9	74	35.6	78	37.5	26	12.5	208	100.0

Table 10: Number (f) and percentage (f %) of teachers' responses to the question on whether they include live animals in teaching relative to their self-assessed knowledge of methodological approaches for integrating live animals into lessons

Inclusion of live animals	Very poor		Poor		Average		Good		Very good		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Yes	1	1.3	7	9.0	24	30.8	31	39.7	15	19.2	78	100.0
No	20	15.4	53	40.8	33	25.4	20	15.4	4	3.0	130	100.0
Total	21	10.1	60	28.9	57	27.4	51	24.5	19	9.1	208	100.0

concerns their self-assessed knowledge of animal breeding and handling ($\chi^2 = 43.967$; $df = 4$; $p < 0.001$). Cramer's V (0.460; $p < 0.001$) again suggests a moderate to strong association.

Teachers who include live animals most frequently rated their knowledge of breeding and handling as good or excellent (76.9%), with only 6.4% rating it as poor or very poor. Among teachers who do not include animals, just 38.5% rated their knowledge as good or excellent, while 27.6% considered it to be poor or very poor (Table 11).

Teachers' self-assessment of their knowledge of animal biology relative to the frequency of including live animals in teaching practice

Statistically significant differences were also found in teachers' self-assessed knowledge of animal biology ($G^2 = 39.311$; $df = 4$; $p < 0.001$). Cramer's V (0.423; $p < 0.001$) shows a moderate to strong and statistically significant association between the inclusion of live animals and teachers' knowledge of animal biology.

Teachers who include live animals most often rated their knowledge as good or excellent (70.5%), while a mere 5.1% considered it to be poor or very poor. In contrast, among teachers who do not include live animals, only 37.7% rated

their biological knowledge as good or excellent, and 20.0% rated it as poor or very poor (Table 12).

Teachers' Opinions on What Would Support Them While Planning Lessons Involving Live Animals

Overall, teachers in both countries most frequently indicated a preference for collaborating with external experts and participating in workshops or professional training (Table 13). Two teachers selected "Other": One suggested that precise recommendations and guidelines within the curriculum would be useful, while the other reported having never considered planning lessons with live animals because it was not included in their school's curriculum. The differences between countries were not statistically significant ($G^2 = 2.869$; $df = 5$; and $p = 0.720$).

DISCUSSION AND CONCLUSION

Our study focused on the use of live animals in primary science education and compared classroom practices in Slovenian schools in Slovenia and Italy. The research questions addressed teachers' perspectives on the educational value held by this approach, the frequency and methods of including live animals in lessons, and the challenges teachers face while so doing.

Table 11: Number (f) and percentage (f %) of teachers' responses to the question on whether they include live animals in teaching relative to their self-assessed knowledge of animal breeding and handling

Inclusion of live animals	Very poor		Poor		Average		Good		Very good		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Yes	1	1.3	4	5.1	13	16.7	34	43.6	26	33.3	78	100.0
No	4	3.0	32	24.6	44	33.9	44	33.9	6	4.6	130	100.0
Total	5	2.4	36	17.3	57	27.4	78	37.5	32	15.4	208	100.0

Table 12: Number (f) and percentage (f %) of teachers' responses to the question on whether they include live animals in teaching relative to their self-assessed knowledge of animal biology

Inclusion of live animals	Very poor		Poor		Average		Good		Very good		Total	
	f	f %	f	f %	f	f %	f	f %	f	f %	f	f %
Yes	1	1.3	3	3.8	19	24.4	34	43.6	21	26.9	78	100.0
No	0	0.0	26	20.0	55	42.3	44	33.9	5	3.8	130	100.0
Total	1	0.5	29	13.9	74	35.6	78	37.5	26	12.5	208	100.0

Table 13: Number (f) and percentage (f %) of teachers' responses to the question regarding what would most help them while planning lessons with live animals

Support for lesson planning	Italy		Slovenia		Total	
	f	f %	f	f %	f	f %
Reading professional literature (e.g., teacher manuals)	39	17.0	42	20.2	81	18.5
Collaboration with external experts	77	33.6	68	32.7	145	33.2
Workshops or professional training	55	24.0	55	26.4	110	25.2
E-resources	30	13.1	18	8.7	48	11.0
Possibility of external funding for animal care	27	11.8	24	11.5	51	11.7
Other	1	0.4	1	0.5	2	0.5
Total	229	100.0	208	100.0	437	100.0

We also examined the relationship between how often teachers use live animals in their teaching and their self-assessed knowledge of methodological approaches, animal care, and animal biology.

Teachers' Perspectives on the Importance of Including Live Animals in Lessons

In the responses related to teachers' perspectives on the educational value held by this approach, teachers reported several reasons for using live animals in their teaching, including boosting students' motivation, encouraging active learning, fostering empathy and respect for living beings, improving the understanding of scientific and biological concepts, and developing observation skills. Our results align with the findings of the international study by Lewis et al. (2022), in which teachers most frequently mentioned the development of pupils' empathy, responsibility, knowledge, understanding of the world, and alignment with specific curriculum topics as the main reasons for their decision to incorporate animals into the educational process. These results are also consistent with the research of Herbert and Lynch (2017), and Zasloff et al. (1999), which particularly highlighted the importance of teaching humane values. The results of our research clearly show that teachers recognize the numerous benefits of using live animals in lessons, as demonstrated by previous literature: The motivational value of such interventions (Hummel and Randler, 2012; Melchiori and Barzotti, 2018); the development of empathy (Daly and Suggs, 2010; McNicholas and Collins, 2000; Zasloff et al., 1999; Zilcha-Mano et al., 2011); active learning (Hummel and Randler, 2012; Melchiori and Barzotti, 2018); and the promotion of science skills (Rop, 2008).

From a curricular perspective, while both cohorts share these pedagogical values, they operate within different framework traditions. In Slovenia, the national primary curriculum (Učni načrt: Spoznavanje okolja and Naravoslovje in tehnika) explicitly embeds direct observation of living organisms as a core component of early scientific literacy and environmental education. In Italy, although the Indicazioni Nazionali promotes inquiry-based learning and biodiversity, animal inclusion is more often linked to cross-curricular goals, such as civic education or emotional growth rather than the core science syllabus. Culturally, while educators in both countries value humane education, the Slovenian framework provides a more systematic endorsement of direct contact with nature, reinforcing positive attitudes toward its educational value. Recognizing these curricular drivers is essential, as teacher belief in these benefits is a key pre-requisite for classroom implementation.

Frequency of Implementation and Barriers to the Approach

Most teachers in the two countries do not include live animals in their lessons at all. Among those who do, the majority use them only once or 2–4 times a year. The study established no statistically significant differences between teachers in Italy and Slovenia.

The organizational aspect was most frequently cited by teachers in both countries as the main reason for not incorporating live animals into their lessons more often. Other major obstacles included concerns about hygiene and allergies, financial costs, and compliance with legal regulations. Some teachers added that their schools (and homes) lack a suitable space for keeping animals or that this type of activity is not foreseen in the school curriculum. Moreover, in the international study (Lewis et al., 2022), teachers most frequently cited the lack of support of senior management and supportive networks, along with health and safety regulations, economic costs, and logistical challenges, as obstacles to implementing educational interventions with live animals. In the research by Zasloff et al. (1999) and Herbert and Lynch (2017), the teachers highlighted the care of the animal to be just one more thing added to their workload and perceived classroom animals as an added burden.

From legal and institutional perspectives, these shared barriers reflect strict regulatory and logistical environments in both educational systems. In both countries, stringent health and safety protocols, concerns regarding student allergies, hygiene regulations, and civil liability rules regarding child welfare create substantial administrative hurdles. Institutionally, the lack of clear, standardized guidelines for keeping live organisms on school premises – combined with a shortage of dedicated physical infrastructure (such as properly equipped nature corners) – leads many educators to perceive animal care as a personal legal risk and an added workload, rather than a supported institutional practice.

Ways of Incorporating Live Animals into the Educational Process and the Animal Groups Used

Teachers in each country most frequently use live animals for guided observation, while classroom breeding is much less common. Only rarely do students participate in animal care. It is likely that teachers recognize how direct contact with living beings can strongly stimulate students' curiosity and interest. On the other hand, they may face limitations like a lack of knowledge or confidence to implement more complex approaches, such as keeping animals in the classroom. It is important to stress that different ways of including live organisms in lessons not only make students more engaged but also foster essential skills among them, such as observation, analytical thinking, and empathy toward living beings (Hummel and Randler, 2012; Rop, 2008; Zasloff et al., 1999). Achieving this requires well-trained teachers who understand experiential learning and encourage students to actively explore their environment (Torkar, 2014).

In science lessons, the teachers who participated in our study use invertebrates much more frequently than vertebrates. In the international study by Lewis et al. (2022), the question about which animal groups educators involve in their educational practice referred to the use of animals in general, not specifically for teaching science. Still, the teachers stated that they most often incorporate vertebrates in activities with children: Dogs, guinea pigs, rabbits, chickens, and fish.

They used invertebrates less frequently. The dominance of vertebrates as classroom animals was also reported in the research by Zasloff et al. (1999).

These choices reflect pragmatic adaptations to primary science teaching in both countries. From an educational perspective, short-term guided observation of invertebrates aligns well with primary science learning objectives, such as observing life cycles, physical adaptations, and biodiversity, without requiring long-term commitments. Institutionally, using invertebrates circumvents major logistical hurdles, as vertebrates demand continuous care (including during weekends and school holidays), dedicated space, higher financial maintenance, and complex administrative arrangements. In Slovenia, an additional burden associated with keeping mammals and birds in schools is the requirement for an appropriate veterinary certificate, due to potential zoonoses.

How do Teachers Evaluate their own Knowledge of Methodological Approaches for Integrating Live Animals into Teaching, Appropriate Handling and Care of Live Animals, and Animal Biology? Do These Factors Influence the Frequency with Which They Include Live Animals in their Pedagogical Practice?

As much as 40% of all teachers self-assessed their knowledge of appropriate methodological approaches for involving live animals in lessons as very poor or poor. A bigger share of teachers in Italy evaluated their knowledge as poor compared to those in Slovenia. Most teachers in both countries assessed their understanding of animal handling and breeding as moderate. Similarly, the majority rated their knowledge of animal biology as average, although more Slovenian teachers described it as good than their Italian colleagues. The differences observed between the two countries may be attributed to varying emphases on the educational value of contact with live animals in teacher education programs, as well as differences in established pedagogical practices.

From institutional and training perspectives, these disparities reflect differences in initial teacher education and continuous professional development across the two countries. In Slovenia, primary teacher education programs traditionally incorporate dedicated practical science didactic modules and experiential fieldwork, which fosters higher teacher self-efficacy in environmental science instruction. In contrast, while Italian primary education degree programs emphasize general pedagogical and disciplinary foundations, practical laboratory training specifically focused on live organism management varies greatly between universities and is rarely a mandatory core component.

Our findings suggest that Slovenian teachers are generally better equipped in this field than Italian teachers. Nevertheless, in both groups, the greatest perceived gap concerns methodological approaches for teaching with live animals. Further, in the international survey by Lewis et al. (2022) and in the research of Zasloff et al. (1999), many educators

cited the lack of practical advice on this type of approach while mentioning barriers to including animals in educational practice and highlighting the need for more guidance and support.

The results indicate that teachers' knowledge of methodological approaches, animal care and breeding, as well as animal biology, forms a crucial foundation for incorporating live animals into teaching. It may be anticipated that teachers with greater expertise in these areas will be more likely to incorporate live animals in their science curriculum than those who feel less competent.

Limitations and Directions for Further Research

Our results contribute to the growing body of research regarding the involvement of animals in educational practices across different regional and international contexts. However, several limitations must be acknowledged. First, our sample comprised elementary school teachers from a specific cross-border geographical area (Slovenia and the neighboring Friuli Venezia Giulia region in Italy). While convenience sampling facilitated access to this specific cross-border population of Slovenian-speaking educators, it introduces potential sampling bias and limits the statistical generalizability of the findings beyond these target regions. Consequently, the findings primarily reflect the pedagogical and cultural dynamics of this specific area and may not be fully generalizable to broader national contexts or other international settings.

Furthermore, the sample was limited to the elementary school level and did not include the educators teaching different age groups. To gain a more comprehensive perspective on the use of live animals in science education, future research should address these constraints.

Expanding the sample size to include representative nationwide contexts in both countries, as well as secondary education levels, would allow for broader comparisons. In addition, future studies could investigate the longitudinal impact of specific initial teacher training modules and dedicated professional development programs on educators' self-efficacy, methodological competence, and willingness to incorporate live organisms in their teaching practices.

CONCLUSION

Our research shows that, despite teachers' awareness of the educational benefits of having contact with animals, the use of live animals in primary science education remains a relatively underutilized educational strategy in both studied contexts.

The findings clearly highlight that overcoming this gap requires addressing systemic, legal, and institutional barriers alongside pedagogical ones. Specifically, there is an urgent need for clear administrative and safety guidelines regarding live organisms in schools, as well as institutional support in terms of adequate infrastructure and resources. Furthermore, the observed cross-border disparities emphasize the importance of strengthening both initial teacher education and continuous

professional development. Training programs that effectively combine theoretical knowledge with practical, hands-on methodology (such as animal handling, care, and experiential science activities) would offer teachers a solid foundation. Enhancing teachers' self-efficacy and providing systematic institutional backing are essential steps toward enabling the safe, thoughtful, and meaningful integration of live animals into primary classroom practices.

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