

# DEVELOPING GENERAL AND SUBJECT COMPETENCES OF PRIMARY SCHOOL PUPILS IN THE CONTEXT OF INTEGRATED EDUCATION: THE CASE OF ONE LITHUANIAN SCHOOL

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## ABSTRACT

**Aim.** The aim of the research is to provide a scientific justification for the integrated development of general and subject-specific competences of primary school pupils.

**Methods.** The exploratory qualitative case study was conducted in a private school in Lithuania. The integrated activities covered the content of Lithuanian language and science education, as well as general competences such as communication and digital competences. The activity was implemented in grade 4 with 12 pupils (8 boys and 4 girls). A semi-structured interview with the class teacher was also conducted.

**Results and conclusion.** The data from the empirical study were analysed according to the following thematic clusters: interest in the activity, group work, searching for information in the encyclopaedia and in electronic sources, working with a robot when integrating the digital skills and the content of science education, descriptions of animals as a summarising and consolidating activity. The study found that if the educational process is well thought out, if the pupils are interested, they can work independently and support each other in explaining the content, while the teacher becomes an observer, a facilitator, and can concentrate on the pupils' individual activities during this process. Well-designed tasks with the robot develop not only digital literacy skills, but also the reinforcement of subject content related to the use of concepts.

**Originality.** The case study provides valuable insights into the implementation of an educational process that integrates general and subject-specific competences,



and the detailed description of the activities shows which tasks support students' independent learning.

**Keywords:** general competences, subject competences, integrated education, primary school students.

## INTRODUCTION

In today's world, the education of pupils requires a great deal of effort if it is to be innovative, high-quality, and responsible. The aim is for pupils to be lifelong learners, to be able to manage and understand large amounts of data and information, and to be able to solve a wide range of problems. Students are expected to be creative thinkers. Pupils need skills and abilities that allow them to navigate and adapt in an ever-changing environment (Drake & Reid, 2018). Skills such as collaboration, creativity, problem-solving, and critical thinking make up the generic competences that are both important in education and are acquiring a new meaning and relevance with the rise of technological advances (Buchs, 2017; Chauret et al., 2021; Dumouchel & Karsenti, 2019; Jakavonytė-Staškuvienė, 2021a; Karsenti & Grégoire, 2015; Lacelle et al., 2017; Voogt et al., 2013). The Council of the European Union's *Recommendation on key competences for lifelong learning* (2018) notes that quality education and a broad approach to competence development lead to better progress in key competences. The role of general competences is more profound than that of a specific subject for each individual's development, employability, social inclusion, active citizenship, living in harmony with the environment. One of the strategic objectives for changing the content of education in Lithuania, as formulated in the strategic document *Bendrujų programų atnaujinimo gairės* (2019) (Guidelines for the Renewal of the General Curricula, [translated from Lithuanian by the authors]), is to develop *General Curricula* oriented towards the development of general competences. The development of general competences is associated with active learning, where students analyse situations, pose and critically evaluate problems, apply knowledge and skills in practice, learn to make decisions, and act responsibly and creatively (*Bendrujų programų atnaujinimo gairės*, 2019; *Lietuvos pažangos strategija „Lietuva 2030“*, 2012) (Lithuanian Progress Strategy "Lithuania 2030", [translated from Lithuanian by the authors], 2012), as only in this way can students develop sustainable knowledge. However, it is important to find the right ways to make targeted and purposeful changes to educational practices in school. Teachers know more about how to teach mathematics, or any other subject, than how to develop students' competences (Drake & Reid, 2018). A collaborative teacher attitude helps to create an integrated learning environment, but this is hampered by the lack of flexibility in the school's organisational structure and culture (Rousseau et al., 2015; Rey, 2016).

## GENERAL PRINCIPLES THAT ENABLE THE DEVELOPMENT OF INTEGRATED EDUCATION THAT BUILDS STUDENTS' SUBJECT AND GENERAL COMPETENCES

Creating authentic content in each classroom, taking into account the needs and aptitudes of the pupils, is based on the identity of the primary teacher, where the teacher is understood as an organiser of the educational process, a planner of activities, problem solver, monitor of pupils' achievements, and an assessor of pupils' performance. In this perspective, the classroom education process includes the following interrelated and complementary elements: integral educational content (including subject content and general competences) and strategies to support its understanding/mastery, as well as means of assessing pupils' achievements; means of providing individual support to pupils; the establishment of a system of learning situations; the use of a range of learning supports/interviews and the mobilisation of the necessary resources. Karin Bacon (2018) stresses that in order to engage children in the educational process, the educational content must be composed of the "real" world; a real world that is not separated into disciplines or subjects. Researchers (Bacon, 2018; Chevalier & Deschamps, 2019; Lasnier, 2001; Lenoir, 2009; Roiné, 2014; Reverdy, 2019; Sakho, 2017), advocates of integrated education, stress that many primary teachers are able to create problem situations and select appropriate content, but that the difficulties lie in developing a system of assistance/individual support, certain learning methods, special environments or other means of providing students with specialised teaching, as it is necessary to keep in mind not only the development of students' overall, but also their academic achievement (Chauvière, 2018). In other words, teachers still tend to think about what children should be taught, but there is a lack of attention to educational strategies, advice on how to assimilate the available material, and the ways in which it can be learned (Drake & Reid, 2018).

General education is important insofar as it fosters each person's common human, holistic values, and is particularly important for each person's socio-emotional development and digital literacy. Educators should design educational situations in such a way as to foster, first and foremost, the common human values of holistic education: helping and empathy, compassion, understanding, communication and cooperation, support, and the development of socio-emotional competences (Beaumont & Garcia, 2020; Elias, 2019; Jennings et al., 2017; Jones et al., 2019; Meyre, 2018; Rousseau et al., 2015). However, the development of social and emotional competencies is still receiving insufficient attention among primary teachers during their university training (Beaumont & Garcia, 2020; Brackett et al., 2019). In addition, the content is also very different, so the knowledge and expression of this competence often depend solely on the erudition of the teacher who teaches the subject (Beaumont & Garcia, 2020). In Lithuania, the development of children's social and emotional competences is identi-

fied as one of the priorities of the updated *Pradinio ir pagrindinio ugdymo bendrujų programų projektai* (Nacionalinė švietimo agentūra, 2021) (Draft framework programmes for primary and basic education, [translated from Lithuanian by the authors]), which is integrated in all subjects. However, there is a lack of research in this area. Moreover, the aim is to develop digital literacy skills, so that students are not only active users of information communication technologies (ICT) but also creators, which makes skills such as encoding, searching, adapting information, and learning algorithmic and repetitive situations of particular importance (Lawrence & Tar, 2018; Mohr & Welker, 2017).

The school should take into account the psychology of the learner's age, the principles of social life, aspects of citizenship, and cultural contexts when designing educational situations. The cultural foundation is a prerequisite for an integrated educational context (Drake & Reid, 2018). Human rights and the duties and freedoms associated with them are the basis for the development of all educational content. The Council of Europe (2017) and Nadia Rousseau et al. (2015) emphasise the accessibility, affordability, acceptability, and adaptability of education (according to the individual student's needs and capabilities). However, schools still do not take enough account of a learner's cognitive or behavioural problems in any subject, nor do they pay enough attention to the child's family, social, and cultural situation (Ebersold & Detraux, 2013; Roiné, 2014).

By analysing educational practices and following general principles, teachers take into account the very specific context and situation of their classroom and choose educational methods that will improve the achievement and motivation of their students. By combining the pupils' cognitive, social, and cultural contexts, the teacher can see a picture of the content of integrated education. Only such an analysis can reveal a real educational situation, a real learning outcome involving a "deep" integrative relationship between learning processes, and an integrated set of learning skills. The teacher is the creator of the educational content, which is why the competences they possess, and which are linked to their professional development and the direction they choose to take in the educational environment are particularly important (Gouvernement du Québec Ministère de l'Éducation, 2020). As Valérie Benoit (2016), Céline Buchs (2017), Andy Hargreaves & Michael Fulan (2019), Sylvie Marcotte (2020) argue, today our school communities are in essential need of continuous learning and collaborative processes to ensure that each member is able to perform their job well, as "groups, teams, and communities are much more capable than individuals" (Hargreaves & Fulan, 2019, p. 21). Research shows the value of collegial learning. Simon Burgess et al. (2019) found that when one teacher observes the work of another teacher, the students of both teachers benefit through an improved performance. Collegial learning is also associated with higher teacher job satisfaction and self-efficacy (OECD, 2020). Thus, peer learning can be identified as one of the most effective factors for

teachers' professional development (Campbell, 2019). In-service learning is also needed due to changes in educational practices, such as the integrated development of *digital competences* from pre-school age (Chauret et al., 2021; Dumouchel & Karsenti, 2019; Karsenti & Grégoire, 2015; Lacelle et al., 2017) in the context of primary, elementary, and secondary education. It is therefore crucial to continuously develop and update teachers' competences in ICT (Area et al., 2016; Mottet & Gagné, 2017), even though some educators lack competences in this area themselves. One of the appropriate tools for developing the digital competence through integrated content is the use of robotics elements (Bobko et al., 2018; Smyrnova-Trybulska et al., 2017; Smyrnova-Trybulska et al., 2020).

The situation and context of primary education in Lithuania in relation to integrated education. For many years, Lithuania has been trying to base practice on the idea of integrated education (Jakavonytė-Staškuvienė, 2017). This is also reflected in the foundational strategic document of Lithuanian education policy, *Geros nokyklos koncepcija* (2015) (The Good School concept, [translated from Lithuanian by the authors]), which encourages the development of creative school communities. In addition, the concept emphasises the personal qualities to be developed, such as openness, communicativeness, flexibility, adaptability, the creation of an identity, a value "backbone", and a personal meaning in life. This makes the development of the personality's value orientation, the social, civic, and moral maturation of the person, particularly relevant. All this can be developed through an integrated approach. *2021–2022 ir 2022–2023 mokslo metų pradinio, pagrindinio ir vidurinio ugdymo programų bendrieji ugdymo planai* (Nacionalinė Švietimo Agentūra, 2021) (General curricula for primary, primary and secondary education for the academic years 2021-2022 and 2022-2023, [translated from Lithuanian by the authors]) are a positive development in the Lithuanian education policy in terms of integrated education, as the school decides on the forms of organisation of the educational process, the measures to help pupils to achieve a higher level of learning achievement and progress, and the provision of educational assistance, the preparation and implementation of project work, etc. The school decides on changes of the form of the educational process or the distribution of the learning period, for example, to intensify the educational process, to implement the content of the educational process by means of project activities, to teach one or two subjects a day, and in less conventional ways, such as through *integrated content*. This means that the initial conditions for integrated education are in place at the policy level, while further decisions are left to the school community. The document *Bendrujų programų atnaujinimo gairės* (2019) also refers to *integrality*, although the concept is explained too narrowly, covering only academic knowledge, i.e., "strengthening the interconnectedness of content across different subjects in order to support the development of a holistic worldview in the learner" (p. 14, [translated from Lithuanian by the authors]). In order to develop students' general competences, it is

important to ensure multidimensional links between the different curricular areas, subjects and the real world. Interdisciplinary integration helps the pupil to develop a comprehensive view of the phenomena under study. Interdisciplinary integration reveals the broader context of the subject and helps to address issues that often cross subject boundaries. As the organisation of educational practice in Lithuania according to the updated curriculum content is planned to start in 2023, now is the right time to look at what kind of environments would allow this to happen in practice and what kind of skills teachers have to create such educational situations and contexts, which is why an exploratory qualitative empirical study was chosen. The aim of the exploratory study was to investigate integrated activities in primary education in practice when integrating the content of Lithuanian language and science and the communicative and general digital competences.

## EMPIRICAL STUDY STRATEGY, SCHOOL AND CLASSROOM CONTEXT, CASE STUDY MODEL

### **Stage 1: planning the study of developing subject and general competences.**

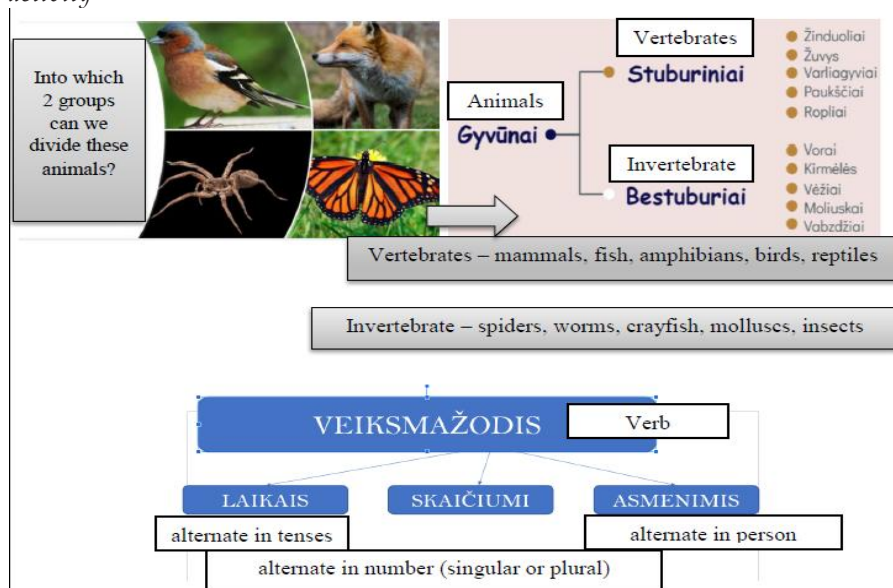
The first step was to decide on the appropriate strategies and content of the activities (which subject and generic competences would be developed in the activities). As this is a revision lesson (the tenses and purposeful use of verbs in a sentence in Lithuanian, and the identification of vertebrates and invertebrates in science, where and how they live and what they eat), it was decided to combine these subjects in the design of the activities. Among the generic competences, two were chosen: the targeted development of digital competence (Chauret, 2018; Chauret et al., 2021) through the use of a robot, and the development of communication competence, where students are encouraged to collaborate in a targeted way. Pupils were encouraged to effectively search for information and build on it by solving a crossword puzzle and programming the robot. The theme of the activity, the questions and the problems were linked to problem-based learning and integrated education in Lithuanian language and science (Mohr & Welker, 2017). The activities were carried out in targeted working groups formed by the teacher, with students of different abilities who could negotiate and collaborate in the tasks. In addition, tablets were chosen and individually owned by all students for targeted information and concept searches during the tasks. In this way, the focus was on the development of communication and general digital competences.

In preparation for this lesson, the teacher reflected on the integrated tasks of Lithuanian language and science education. At the beginning of the lesson the teacher reminded the children some concepts of both Lithuanian language and science. The way the tasks were presented to the pupils can be seen in Figure 1:



**Figure 1**

Explanations of key science and English language concepts that will be used in the activity



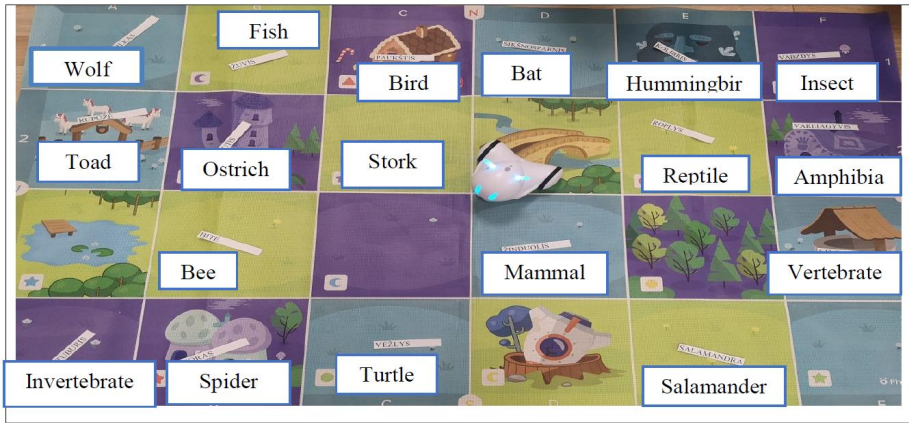
Source: own research.

Figure 1 shows that the teacher, in preparation for the activity, reflects in advance on how to recall the concepts from both subjects that will be used in the lesson. It is important that children are provided with visual material (Doubet & Hockett, 2017; Evagorou et al., 2015; Hockett, 2018), and that content is presented in diagrams, which aids retention. The distribution of animals into vertebrates and invertebrates will be done in the lesson by every student. Children are also given a diagram of verb parsing as a reminder. In the lesson, the children will work in groups of three to complete the tasks of writing down the correct verbs and analysing the given verbs according to the scheme given in Figure 1. In addition, they will have to write down the correct names of the animals that are described according to certain clues. The children will be able to work in turns, searching for the information they need in an encyclopaedia and on a tablet (by typing in key words on certain websites). Pupils are encouraged to help each other (Benoit, 2016; Buchs, 2017; Hargreaves & Fulan, 2019). They are also informed that they will work in groups for 30 minutes.

In addition, the teacher has thought about how the robot programming activity can be targeted and linked to the development of language and science concepts. The carpet that has been prepared, with the science concepts that the students will use to program the robot, can be seen in Figure 2:

**Figure 2**

*Example of a task with integrated programming skills and animals classified as vertebrates or invertebrates*

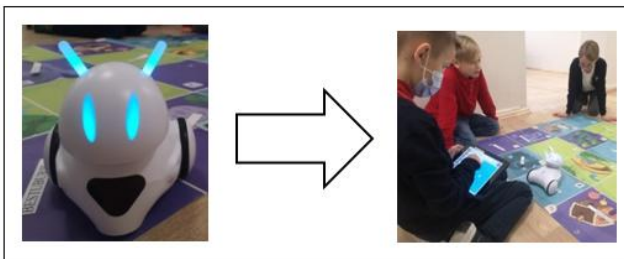


Source: own research.

It is important to stress that while the children are working in groups to discuss and find answers about vertebrates and invertebrates, another activity is taking place in parallel: one child at a time, they come to the carpet and program the robot to travel according to the classification, i.e. so the designated animal is classified as vertebrate or invertebrate. This provides a targeted and integral learning of the skills necessary for digital competence (Slangen, 2016; Pedro et al., 2019; Piedade et al., 2020). The robot whose movements are programmed by children can be seen in Figure 3:

**Figure 3**

*An example of working with the Photon robot, where students program and at the same time classify an animal as vertebrate or invertebrate*



Source: own research.

To consolidate what the children have done in the activity, they had to write a description of one animal at home, answering the questions: “What kind of animal is it?”, “What does it eat?”, “Where does it live?”. Impor-



tantly, the children were assigned different animals, and to summarise the material covered in the lesson, the children had to use the verbs correctly in their creative work, writing them down correctly, and to refer to specific information about the animal, both in terms of describing it and in terms of classifying it as a vertebrate or an invertebrate.

### **Stage 2: classroom research (case study and semi-structured interview with the teacher).**

School context. The study was conducted in a private school in a major Lithuanian city. This school not only implements the national primary curriculum, but also integrates engineering education, STEAM, and the targeted use of information technology, while also developing students' digital competences. IT technologies such as tablets, Photon robots, Blue-bot, iMo cubes are used in lessons. The school does not only work on a classroom basis, but also uses integrated education – an integrated day, as well as cross-curricular integration (when dealing with any topic or problem, it tries to develop a wide range of students' subject-specific and general competences). The distinctive feature of the integrated day is that the teacher chooses topics and issues from the pupils' world and real-life realities, thus creating a close link with classroom life and tailoring the content to the children's interests. The integrated day is a natural day for pupils. Learning time is allocated according to the needs of the pupils, and motivation is very important, as the subject areas are directly related to the pupils' daily lives. This way of teaching is more challenging for the teacher as it requires very careful preparation and planning of activities. Classes have up to 18 pupils, which is optimal for high quality learning, and more attention is paid to the individual learning needs of pupils and to differentiation and individualisation according to the pupil's abilities.

Teacher competence and context of work. Grade 4 teacher has a degree in primary education from a Lithuanian university. She has been working at the school for 2 years and has a total of 3 years of teaching experience. She has a distinctive characteristic of actively and purposefully using information technology in various subjects, linking technology to the subject matter of the activity, and creating interactive tasks for the pupils herself. This teacher was chosen for the study because she is able to find and integrate the content of different subjects, to select activities for pupils according to their abilities during integrated lessons, and knows how to help children to remember the necessary information faster. Moreover, during integrated lessons the teacher makes pupils' learning more meaningful, enhances, extends, and links pupils' knowledge and skills, arouses pupils' motivation for learning, develops pupils' ability to communicate and collaborate, distributes the learning time in a quality manner, and encourages pupils to work in teams. There are 16 pupils in this Year 4 class. The class includes pupils with a wide range of abilities and knowledge. One pupil has special educational needs. There are 6 girls and 10 boys.

The case study process. Two classrooms (3 and 4) were selected in the context of the case study (Baškarada, 2014; Thomas, 2021; Yin, 2018); a convenience sample was used. Due to the limited scope of the paper, we will only describe in detail the activities of students in grade 4. In the lesson, students worked in mixed ability and gender groups. All activities were videotaped and the researchers analysed the footage, recording the students' work in an observation protocol. The groups were made up of pupils of different abilities and academic achievements. The groups were deliberately assigned by the teacher to one student with higher academic achievement, one student with intermediate academic achievement and one student with learning difficulties. The study was conducted on 11 November 2021. The participants were 12 pupils (aged 10-11). The total duration of the integrated activity was 1 hour 30 minutes. The study was conducted in accordance with the principles of research ethics. Parents of the children gave individual consent for the activities to be filmed and analysed under confidentiality conditions.

To further deepen the data obtained and its analysis, a semi-structured interview (Baškarada, 2014; Dane, 2011; Yin, 2018) was conducted on 27 December 2021 with the classroom teacher, who provided further contextual details and shared her insights on the integrated activities carried out. The teacher was asked to articulate the strengths of the activity, the most successful episodes, and to comment on what, how, and why it would be useful to improve in the future. This research process allows for a detailed qualitative analysis of the activities.

### **Stage 3: Analysis of the data (qualitative content analysis based on the thematic principle).**

The videos were analysed according to thematic clusters (Baškarada, 2014; Thomas, 2021; Yin, 2018):

- activity engagement when integrating English language and problem-solving skills (Bacon, 2018; Chevalier & Deschamps, 2019; Lasnier, 2001; Lenoir, 2009; Reverdy, 2019; Roiné, 2014; Sakho, 2017),
- group work, where children learn by questioning, while developing communicative competence in an integrated way (Benoit, 2016; Buchs, 2017; Hargreaves & Fulan, 2019),
- searching for information in encyclopaedias and electronic sources, where communication and cognitive competences are developed simultaneously with the content of English language and science education (Slangen, 2016; Pedro et al., 2019; Piedade et al., 2020),
- working with a robot when integrating digital competence and science education content based on the analysis of linguistic concepts (Slangen, 2016; Pedro et al., 2019; Piedade et al., 2020),
- a description that integrates language and science content skills (Schoroškienė, 2010; Jakavonytė-Staškuvienė, 2021b).

Evidence is coded according to its meaning, attributing images or interview statements to one aspect or another. The logical progression of the data analysis of the study on the integrated development of general and subject competences of primary school students is presented in Figure 4.

Figure 4

*Data analysis model for the study on the integrated development of general and subject competences of primary school pupils*

Context of the case								
Description of the case								
Topics - aspects of integration of general and subject competences	Sub-themes (analysis layers)		Sources of data				Summary	
			<i>Integrated activity plan</i>	<i>Video</i>	<i>Protocol of classroom activities</i>	<i>Interview - teacher</i>		<i>Students' written descriptions</i>
	Case 1	<i>Interest in the activity</i>	X	X	X	X		
	Case 2	<i>Group work</i>	X	X	X	X		
	Case 3	<i>Search for information</i>	X	X	X	X		
	Case 4	<i>Working with a robot</i>	X	X	X	X		
Case 5	<i>The animal description</i>	X	X	X	X	X		

Source: own research.

The description of the data was done through the presentation of the interest activity; the students' group work, the search for information in different sources (encyclopaedia and websites using personal tablets), the work with the robot and the features of the animal description. The analysis of the themes was carried out through several layers of analysis (sub-themes), illustrated by data examples and complemented by data from a semi-structured interview with the teacher (Baškarada, 2014; Bioy, et al., 2021; Creswell, 2007; Dane, 2011). Finally, the findings of the exploratory study are summarised and conclusions are drawn by demonstrating elements of integrated education in practice.

## ANALYSIS OF EMPIRICAL DATA


Before the classroom activity, the teacher had prepared activity sheets for each student, a book and tablets were placed in a place accessible to all children, and a carpet suitable for robot activities was laid in another part of the classroom. A 66 minutes and 48 second long video of the lesson was recorded. 12 pupils took part in the activity, 4 girls and 8 boys.

**Interest in the activity.**

The integrated activity started with an interest task, linked to a targeted grouping of pupils. At the beginning of the lesson, each pupil found a different verb on their desks. The interest activity was aimed at developing students' higher-order thinking skills. The way it was carried out can be seen from the data in Figure 5:

**Figure 5**

*Example of how to get students interested in integrated activities*

Students' and teacher's activities	Researchers' comments
<p>2021-11-11, Grade 4, 12 students.  <i>Interest in the lesson (1:29-3:16 min)</i>                      Teacher: "You have been given some words, what do you think you should do with them."                      M1: "Maybe make a sentence, because we have the habitual past tense on the table, like of the verb 'to run'. Maybe I have to write this verb in the habitual past tense."                      B1: "Maybe change our word to the habitual past tense, the simple past tense, the present tense, the future tense."                      Teacher: "Try to relate to the fact that a word given is of one particular tense and different tenses are written on the tables."                      M2: "I think we need to conjugate according to the tense</p>	<p>A good interest task, aimed at developing students' higher-level thinking skills, as they reason and look for links between the verb and the tense of the verb in the group. Consequently, pupils are engaged, and the depth of their reasoning can be observed.                      It is didactically correct that the teacher listens to several students' different reflections, allowing each child to think. In addition, she gives the pupils some clues.</p>
 <p>assigned to the group."                      Teacher: "you are thinking very well. "                      B2: "I think we need to turn 'they live' into a past simple form (because this tense has been assigned to their group)."                      B3: "To turn the word we received into the tense written on the card which we received."                      Teacher: "you need to sit at the tables according to the verbal tense of the word that you were given."</p>	<p>It is also important that, after the activity, the pupils sit in different groups as planned by the teacher. This is a hidden purpose of the activity, because the children are not told directly to sit in a specific place, and, from the point of view of an outside observer, it happens very naturally without any explanations as to who is sitting in a particular group and why.</p>

*Note:* M - girl's answer, B - boy's answer.

The time indicated is the duration of the educational process in the video; screenshot adapted from: Integrated education activities [Video], own research, (2021, November 11).

Source: own research.

Engagement is a crucial part of an integrated activity (Martin & Bolliger, 2018), as students are led to be interested in the content of the activity (Kahu et al., 2017; Martin & Bolliger, 2018; Lucas et al., 2020). Importantly, in this

lesson, interest activity was directly related to the content of a Lithuanian language lesson which was being reinforced – verbs. Through reasoning, the children looked for a deeper meaning of the verb they were assigned, thus thinking about how words are related.

### **Group work**

Once the pupils are in their groups, they are informed that they will be able to discuss the tasks among themselves and search for information on the Internet (by typing certain key words) as well as in an encyclopaedia about animals. Working in groups, the children will have to solve a crossword puzzle and then write the tense, person, and number next to certain verbs. The time limit for the group work is also told, which is 30 minutes.

To analyse the group work situation, we asked the teacher in a semi-structured interview how she thought the children worked in groups. The teacher emphasised the children's friendliness:

The children are quite friendly and able to work in a team: they can help each other, find things for each other, explain to each other, and usually there are no difficulties or questions about group work because we often work in groups. <...> There were some groups that were more productive, others were more difficult because of their composition.

Importantly, the teacher herself noticed that there were children who worked better in groups and those who tended to do the work individually. The teacher took into account the following aspects of grouping:

I look at it from all sides: that there is at least one stronger or faster learner in the group who can maintain the pace of the group. There is also a child with a weaker ability, i.e. a child who is struggling in a subject. Others are relational, if I know that they get along, I don't put them in the same group because it will be harder for the group to work, the children will get distracted.

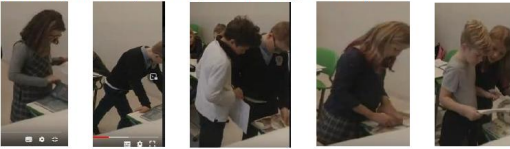

It is important that there are children of different abilities in the group. It is also possible to give clear responsibilities to each member of the group (Burke, 2011). In addition, it is important to take into account personal qualities, as there are cases where children cannot work constructively in one group because they are passive or conflicted (Burke, 2011). The principles of group work applied in this lesson are in line with the European Commission's recommendations on education included in *European ideas for better learning: the governance of school education systems* (2018). This way of learning makes children more interested in the educational process, more likely to listen to each other's opinions, to help each other, and to agree, and all of these skills are very much needed in life.

Search for information in encyclopaedias and electronic sources. This element of the lesson is significant because the pupils searched for relevant information on invertebrates and vertebrates. They did this using 2 different sources: a book (encyclopaedia) and tablets. Figure 6 shows how the pupils performed in this activity:



**Figure 6**

*Examples of students' use of different sources of information*

Students' and teacher's activities	Researchers' comments
<p>2021-11-11, Grade 4, 12 students.  <i>Aspect of using a book (encyclopaedia)</i>            Teacher (13:07-13:54): One activity requires the use of a source book at the back of the classroom. The sentences are missing some of the information that is in the book. In addition, the task contains a clue as to which page in the book the information is on. Please note that there are 4 groups and one book, so you will need to divide your time in a way that you do not have to wait in line for the book. Just do the tasks out of order.            (18 min; 18 min; 31 min; 37:38 min; 45 min):</p>  <p>Other students are simultaneously searching for information on their tablets in a targeted way:</p> 	<p>An important aspect of classroom work is the targeted use of learning tools, i.e. tablets and a nature reference book as two alternative sources.</p> <p>A useful exercise is the targeted use of a named source. It is important that the fourth-graders are also given help, i.e. the pages indicated, otherwise they would spend a lot of time just searching for information.</p> <p>The teacher's commentary is very useful and helpful for the children to understand how to divide up the work and activities so that they do not waste time using one tool.</p> <p>This is what the children do, they go to the book at different times.</p> <p>The deep ability to search for information on the Internet and to use it as a basis for tasks is evident.</p>

*Note:* The time indicated is the duration of the educational process in the video; screenshot adapted from: Integrated education activities [Video], own research, (2021, November 11).

Source: own research.

Regarding the use of tablets and a book in the classroom, the teacher made the following observation:

- Most of the time we use tablets to find information. Mostly it is the pupils themselves who search for information. Sources are found on the Internet. This lesson was a less frequent activity in what we do. We are less likely to use a real book. <...> On the other hand, they had to try to plan their time in their team because they could do several different tasks at the same time. Meaning, they could observe and go to the book when it was free. <...> Maybe we use books less because it is important that they contain the right information. In this case, the topic was about animals, so books are more likely to be available at school.

We would emphasise the use of both alternative tools (tablet and book), especially if the children's science book contains the necessary information (Abtokhi et al., 2018; Le Grange, 2010).




### Working with a robot

This activity purposefully integrates understanding of natural science content based on conceptual knowledge, i.e. classifying animals as vertebrates or invertebrates, with digital literacy skills, developed through the way the activity is carried out (by guiding the programmed robot to the correct concept) (Bobko et al., 2018; Pedro et al., 2019; Piedade et al., 2020; Slangen, 2016). The aspects of the activity, which we have managed to capture in the video, can be seen in Figure 7:

**Figure 7**

*Example of students working individually with a robot*

Students' and teacher's activities	Researchers' comments
<p>2021-11-11, Grade 4, 12 students. Working with a robot (15:00 - 45:00)</p> <div style="display: flex; justify-content: center; align-items: center;">  </div> <p>At the same time, while some students are looking up and revising information on their tablets, the teacher works individually with a child who is programming a robot by selecting the correct answer about vertebrates and invertebrates.</p>	<p>Elements of digital thinking and introduction to programming are integrated here. The child works individually with the teacher: the teacher teaches them the name of an animal and, by programming the robot, they have to use a carpet to refer to a vertebrate or invertebrate animal, e.g. bee – invertebrate; wolf – vertebrate. This is an example of well-differentiated work in this lesson, where all the pupils in the class are directed to work in groups and the teacher can give individual attention to each child. One child completed the task fairly quickly, in 3-4 minutes.</p>

Note: The time indicated is the duration of the educational process in the video; screenshot adapted from: Integrated education activities [Video], own research, (2021, November 11).

Source: own research.

The teacher revealed during the interview that she felt that:

the activity with the robot was a complete success. <...> For the sake of time, two robots could be used instead of one robot (so that two children could do the tasks at once) to make the activity go faster. I imagined that it would go faster, but it was slower.

The fact that this tool is found to be an attractive one for teaching programming not only by teachers but also by children has been investigated by researchers in other countries (Bobko et al., 2018; Smyrnova-Trybulska et al., 2017, Smyrnova-Trybulska et al., 2020). Researchers argue that robots are suitable for the implementation of educational content. This is confirmed by our study, as the fourth grade students not only programmed a robot, but also reinforced the use of vertebrate and invertebrate concepts by attributing specific animals.

### **Analysis of the animal description data**

At the beginning of the lesson, when introducing all the activities, the teacher mentioned that at the end of the activity the students would have to write a short description of the animal answering three questions: what does the animal look like? What does it eat? Where does it live? However, there was not enough time to complete this task, so homework was assigned as a summary of what had happened in the class.

The lesson has helped the fourth graders to reinforce their knowledge about vertebrates and invertebrates. And after completing the task with the Photon robot (programming the robot to arrive at the correct answer), they were given the name of an animal to describe. Each student had the opportunity to describe a different animal (stork, turtle, green toad, fire salamander, bat, hummingbird, bee). The teacher indicated the criteria for describing an animal, which were content-oriented: the animal's appearance, what it eats, where it lives. She did not focus on the structure of the text because the pupils have been writing descriptions from the second grade on.

After analysing the students' descriptions, it can be said that they understood the description task as simply answering questions, and that their descriptions were based only on visual details. The texts analysed lacked an overall impression, which is an important structural part of a description. Only one description contained the general impression: "Hummingbirds are very petite and small birds". This general impression was followed by a precise description of the appearance: "They are only 5.51 cm long...". The activities in the lesson have helped the children to understand and identify different animals: to describe and imagine what they look like, where they live, and what they eat. This means that the children really remembered the lesson well. This idea is close to the goal of description identified by Vaiva Schoroškienė (2010) "The listener or reader should imagine as accurately as possible what the author has seen or imagined" (p. 25).

Reading the descriptions allows one to understand and clearly imagine the animals being described. The students' descriptions are similar to business texts, with a strong emphasis on accuracy, as they give details of the objects in a coherent manner:

- "The fire salamander is 30 cm long and black and yellow", "The toad's back is marbled with green spots and covered with warts", "The stork is white, black, and has a red beak and legs".

In our opinion, these works could be initial descriptions that students could refine to higher quality in other lessons.

Difficulties encountered by pupils during the integrated activities. From the questions that the students raised, we can say that all the problem areas were related to the lack of knowledge of the concepts. Here are some specific examples from the students' activities (Figure 8):

**Figure 8**

*Examples of difficulties encountered by pupils in integrated activities*

Students' and teacher's activities	Researchers' comments
2021-11-11, Grade 4, 12 students. Difficulties related to word analysis: Situation I B1: "The fourth is a <i>slowpoke</i> ." (29 min) B2: "Who is that?" B1: "I don't know. (looks at the tablet as he enters the name) <...> oh oh oh oh oh, (surprised) I know this one, he's invertebrate." B2: " <i>Sloth</i> , I didn't think sloth referred to slowness." Situation II B3: "A <i>geek</i> , what kind of a geek is this?" (35-37 min) M1: "A <i>clam</i> , no legs." B3: "Oh, a <i>clam</i> ... <...>" Teacher: "Do you remember, we read that there are animals that have one leg?" B4: "A snail has one leg." B3: "A snail has one leg???? (surprised)" Situation III B5: "What are <i>hooves</i> ?" (43.56 min) M2: "A horse has hooves (points to its feet). Explains." B5: "Oh, I know, I understand." Situation IV B6: "Remember that an ant is an insect." (says to a friend in the group) (45 min)	Concepts as a challenge. Using concepts purposefully and understanding their meaning is crucial to explaining the essence of a science. The following examples show that animal names and misread words raise questions for pupils. Importantly, when working in a group, they can ask each other questions, and in this activity the children help each other by explaining what a word means. Internet searches also help with clarification, because when children see pictures of a particular animal, they realise that they knew it, but called it something else.

Note: M - girl's answer, B - boy's answer.

The time indicated is the duration of the educational process in the video; screenshot adapted from: Integrated education activities [Video], own research, (2021, November 11).

Source: own research.

Researcher Derek P. Hurrell (2021) argues that educators often simply use subject concepts without looking deeper into their meaning, which causes problems in both procedural and conceptual knowledge formation. Indeed, this idea is supported by the findings of our exploratory study, because if a pupil does not understand a concept describing an animal, he or she is unable to imagine it or to classify it in the right category. Practical tasks are useful when they allow pupils to develop their knowledge by using certain concepts about the object of their learning (Svensson & Holmqvist, 2021). We think that the teacher's handouts explaining which animals are vertebrates and which are invertebrates were also useful for understanding concepts. In addition, it became clear that reading skills are very important for the concept analysis, as they are directly related to the understanding of the information, because if a child misreads a word, he or she does not immediately understand its meaning in a particular context.

## CONCLUSIONS

When education is organised on the basis of an integrated curriculum, covering both subject and general competences, activities can be more flexible and more acceptable to students. It is important that the teacher is not only able to develop the content, but also has the enabling conditions, such as ICT tools (e.g. robots or tablets), encyclopaedias, and reference books. Learning with modern ICT tools enables students to perform a variety of tasks flexibly, to learn from experience by looking, feeling, measuring, and comparing different objects in the environment, as ICT creates a richer learning environment. Learning and teaching become dynamic and flexible, providing a broader range of experiences and widening students' perspectives on different phenomena. ICT contributes to enhancing students' motivation to learn. The use of ICT in the educational process and learning to use it in a targeted way develops pupils' information communication skills and general competences, such as group work, independent learning, and higher level thinking skills (problem solving, information seeking, and creative work). Integrated learning and teaching change students' attitudes towards science and enhances their motivation to learn.

After analysing the exploratory study, we can say that if the educational process is well thought out, if the pupils are interested, they can work independently and support each other in explaining the content while the teacher becomes an observer, a facilitator, and can concentrate on the pupils' individual activities during this process. Well-designed tasks with the robot develop not only digital literacy skills, but also the reinforcement of subject content related to the use of concepts. In addition, the information students gather can be the basis for high-quality creative work (e.g. describing an animal). For the development of integrated content, it is important to prepare the teacher to be both knowledgeable in subject content and skilful in general competences, to know the principles of group work, to be good at managing and continuously developing ICT skills, and to be able to reflect on his/her work.

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