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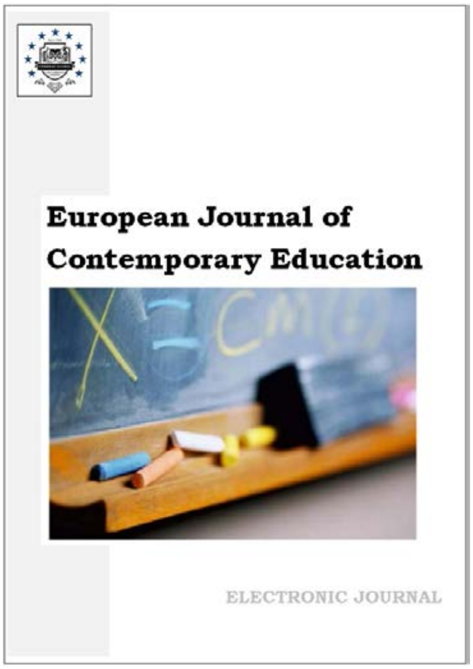

The Problems of Contemporary Education

Interest in Living Organisms and Conceptual Understanding of Food Chains

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Abstract

Science education emphasises not only real conceptual understanding but also fostering students' interest in various domains of natural sciences. Interest in educational content is considered one of the factors that can influence students' level of knowledge, although the nature of this relationship remains a subject of ongoing discussion. An important component of education at ISCED 2 involves information about living organisms and their interrelationships, including abstract concepts such as food chains. The aim of this study was to investigate students' conceptual knowledge of food chains and their level of interest in living organisms, and to analyse the relationship between these two variables among students aged 10–11 years (ISCED 2). The study involved 489 primary school students in the fifth grade. The results showed an insufficient conceptual knowledge of food chains and a mildly positive interest in living organisms. Students scored highest in the dimension "Importance of Organisms" and lowest in the dimension "Fungi". The correlation analysis indicated that students with higher levels of conceptual understanding also exhibited greater interest in living organisms. These results suggest that fostering a positive attitude towards living organisms could be an important prerequisite for the development of conceptual knowledge related to food chains.

Keywords: food chains, conceptual knowledge, interest in organisms, biology.

1. Introduction

Research in science education has long focused on understanding fundamental scientific concepts, many of which are considered essential to the development of scientific literacy. Cherrett (1989) identified fifty of the most important ecological concepts, from which Munson (1994)

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selected twenty components important for science education. These concepts included food chains and food webs. Food chains represent a fundamental element of ecological systems, as they mediate the flow of energy between their components and reveal complex relationships between species (Zheng, 2023; Hui, 2021; Preston, 2018). Essentially, they are simplified models that represent the existing relationships within a particular community (Griffiths, Grant, 1985). In science education, these models are used as a tool to help students recognise the complex relationships between each link in the chain as well as the consequences of disrupting these relationships (Wennersten et al., 2023; Brodie, 2007). Due to their complexity, they are considered a concept that poses certain difficulties for students in the classroom. The interpretation of chains is cognitively demanding and requires an understanding of systemic relationships and the indirect flow of energy between organisms (Wennersten et al., 2023). Inadequate acquisition of this concept can negatively affect students' ability to interpret complex and multi-layered ecological relationships within an ecosystem (Mambrey et al., 2022), which is a significant problem in education (St Y, 2025; Preston, 2018) and requires in-depth investigation.

2. Conceptual Knowledge and Food Chains

Curricula in developed countries promote an approach to science education that emphasises a genuine understanding of scientific concepts and their appropriate application (Thibaut et al., 2018; Schweingruber, Beatty, 2017). True understanding goes beyond the memorisation of facts and requires their integration into a logically organised structure. In this context, conceptual knowledge plays an important role as it is a key element in the transition from factual knowledge to true understanding (Bransford et al., 2018). It refers to knowledge that is based on the formation of relationships between concepts and the understanding of these relationships (Rittle-Johnson et al., 2001). Such conceptual knowledge can be visualised as a network of relationships between concepts (Miller, Hudson, 2007). Its main characteristics are generalisability and flexibility, as it enables the transfer of knowledge across different problems within the same domain (Schwartz et al., 2008). The acquisition of conceptual knowledge also enables students to assign information to specific problems (Konicek-Moran, Keeley, 2015; Ellis, 2013), identify the source of a problem, formulate specific questions, and apply the acquired knowledge when designing solutions (Mestre, 2002; Rittle-Johnson, Alibali, 1999). At the same time, it helps to reduce errors in problem-solving (Al-Mutawah et al., 2019) and supports the meaningful use of knowledge not only in the educational process but also in everyday life (Nieswandt, 2007; Novak, 2002).

One of the areas of science education where the development of conceptual knowledge is required is food chains (Qorimah et al., 2024; Södervik et al., 2021; Preston, 2018; Eilam, 2002). Understanding food chains and food webs forms the basis for developing a conceptual understanding of ecological interactions, systems thinking and recognising the complex interconnectedness of organisms within ecosystems (Odhiambo, 2021; Eilam, 2002). Students need to be able to connect individual links in the food chain, recognise them as part of a wider food web and understand how changes at one level affect the whole system (Lankers et al., 2023; Preston, 2018). According to Eilam (2002), the acquisition of this concept requires the development of systematic thinking and the ability to model complex relationships that are often not directly observable. In addition, students need to work with abstract ideas and visualisations that represent energy and information flows within an ecosystem (Odhiambo, 2021). Mastery of this concept goes beyond factual knowledge as it involves working with visual representations, relationships between concepts, and the application of knowledge in real-world contextualised situations (Mulyono et al., 2025).

Nevertheless, education often faces the problem of students having to memorise as many concepts as possible through rote learning (DeBoer, 2019; Chin, 2004). As a result, students may reproduce various concepts as they were presented to them or as they were defined in textbooks, but they lack a deeper understanding (Widiyatmoko, Shimizu, 2018). Even when students recognise the relationships between concepts, their conceptual understanding remains superficial (Knuth, 2000). This situation often stems from the tendency to routinely solve tasks without truly utilising acquired conceptual structures. These problems are evident in the context of food chains, which students often perceive as simple linear sequences without a deeper understanding of the systemic relationships and energy flows within the ecosystem (Mambrey et al., 2022; Södervik et al., 2021). Rather than perceiving them as complex networks of interactions, students tend to approach them routinely, as memorisation schemes that merely serve to name organisms according to their trophic level (Preston, 2018). Inadequate conceptual understanding consequently limits students' ability to apply this knowledge when interpreting ecological phenomena or solving problem-based tasks (D'Avanzo, 2003; Eilam, 2002). Therefore, it is necessary to look for ways to change this situation. One possible way to support students' conceptual understanding is to increase their interest in the field of education. Interest leads students to actively ask questions, look for connections and explore relationships between concepts more deeply, which is a key prerequisite for the development of conceptual knowledge (Romine et al., 2020).

2.1. Student Interest as a Component of Science Education

Students' interest in exploring world around them is a prerequisite for asking curiosity-driven questions, which are important for the development of scientific thinking and a broader interest and motivation to engage with scientific topics (Jirout, 2020). Interest should therefore be seen as a process that significantly influences both educational and career success (Harackiewicz et al., 2016). From an educational perspective, it is important to distinguish between individual, situational and topic interest. Personal interest refers to a stable orientation towards certain areas of knowledge, whereas situational interest is a temporary state triggered by specific features of a situation (Schiefele, 2009). Topic interest is typically elicited by a specific stimulus, such as a word, a statement, or a short text (Ainley et al., 2002), and some authors understand it as a form of personal interest or a combination of personal and situational aspects (Nieswandt, 2007; Čipková et al., 2018). Students' interests are thus also shaped by their interaction with the lesson content, classroom activities, and the way these stimuli relate to their personal experiences. Interest should not only be understood as a motivational state, as it is a complex construct that includes affective, cognitive, and behavioural components (Krapp, Prenzel, 2011). Due to this multidimensionality, interest is closely related to students' motivation to learn as well as their cognitive and behavioural engagement during lessons (Renninger, Hidi, 2015; van Aswegen, Pendergast, 2023).

Science education is also associated with the re-evaluation of existing concepts through the process of conceptual change (Nadelson et al., 2018; Treagust, Duit, 2008). This change is usually triggered by dissatisfaction with existing knowledge or by the fact that new information is more understandable, credible and applicable in new situations (Gennen, 2023). Creating of new conceptual knowledge and re-evaluating existing concepts is a challenging process that requires active cognitive engagement and student motivation (Blumenfeld et al., 2006). It is precisely an appropriate level of student interest in a specific area that increases the likelihood that they will engage with a deeper understanding of the content (Renninger, Hidi, 2016) and participate more actively in the reconstruction and construction of their own knowledge (Duit, Treagust, 2003; Sinatra et al., 2015).

3. Study Aims

Educational outcomes are influenced by several variables (Costa et al., 2024), including personal factors on the part of the student, such as their interest in a specific subject area. Research has confirmed a significant influence of interest, for example, on the level of factual knowledge (Toli, Kallery, 2021) and the development of scientific skills (Stang, Roll, 2014). In line with these findings, it seems relevant to investigate the relationship between students' interest in living organisms and their conceptual understanding of food chains that include living organisms. Based on this, the following research questions were formulated:

– What conceptual knowledge do students aged 10–11 years have about food chains and food webs?

– How interested are students aged 10–11 in living organisms?

– What is the relationship between students' conceptual knowledge and their interest in living organisms?

4. Methodology

4.1. Research Sample

The analysis is based on data collected from 489 students (249 boys and 240 girls) aged 11–12 years, who were in the 5th year of lower secondary education (ISCED 2) at the time of the research. These students attended a total of 14 primary schools. The prerequisite for the participation of these schools in the research was the consent of the school management and the students' legal guardians. The average grade in biology on the last school report was 1.6.

4.2. Research Instruments

To assess the conceptual knowledge of fifth-grade primary school students regarding food chains, we used a custom-designed test consisting of 13 items (see Appendix A for examples of items). The number and difficulty of the items were selected for their suitability for students who are in transition from the concrete operations stage to the formal operations stage. When testing conceptual knowledge, it is recommended to use tasks that do not limit students' responses (Chang et al., 2010), support a deeper understanding of concepts and facts (Collins et al., 2018), emphasise relationships between concepts (Leshem, Trafford, 2017; Gerace et al., 2001), encourage critical thinking (Zoller, 2002), and provide space for explaining phenomena and processes as well as for identifying possible misconceptions (Nurrenbern, Robinson, 1998; Haláková, Prokša, 2007). The test, therefore, included various types of tasks, the details of which are listed in Table 1.

Table 1. Specification Table of Test Items

Item	Cognitive Process Dimension (Bloom)	Subtype of Conceptual Knowledge	Task Type	Item	Cognitive Process Dimension (Bloom)	Subtype of Conceptual Knowledge	Task Type
1	remember	knowledge of theories, models, and structures	custom fill	8	understand	knowledge of principles and generalisations	marking text
2	apply	knowledge of theories, models, and structures	ordering	9	understand	knowledge of theories, models, and structures	single matrix
3a 3b	remember understand	knowledge of theories, models, and structures	two-tier choice	10	remember	knowledge of theories, models, and structures	marking text
4	understand	knowledge of theories, models, and structures	single choice	11a 11b	analyse understand	knowledge of theories, models, and structures	ordering
5a 5b	analyse understand	knowledge of classifications and categories	two-tier choice	12	apply	knowledge of theories, models, and structures	ordering
6	understand	knowledge of classifications and categories	single matrix	13	evaluate	knowledge of principles and generalisations	file
7	understand	knowledge of theories, models, and structures	single choice				

The clarity of the wording of the individual test items was verified with a sample of three fifth-grade students from a selected primary school (Samaie, Mohammadi, 2017). This verification also set the time required to complete the test at 45 minutes. For each correctly solved task in the test, participating students could earn one point.

The content and construct validity were verified by the assessment of two experts from the field of education (Heale, Twycross, 2015). These experts evaluated the instrument in terms of its content and construct relevance, the clarity of the individual items and their appropriateness for the target group. Based on their recommendations, some items were modified to ensure suitability for fifth-grade primary school students.

As the individual test items were not scored dichotomously, the reliability of the instrument was assessed using Cronbach's alpha (Tavakol, Dennick, 2011). The reliability coefficient of 0.877

indicates a good internal consistency of the research instrument and confirms its suitability for investigating students' conceptual knowledge (Luthfiyah et al., 2023).

The difficulty index of the test items ranged from 7.98 % to 63.70 % (M = 22.05 %). The discrimination index values of the items (Mitra et al., 2009) ranged from 0.49 to 0.82 (M = 0.61). All items achieved scores indicating a very good discrimination index, demonstrating their ability to discriminate between students with higher and lower conceptual knowledge.

To determine the students' attitudes towards organisms (plants, fungi, animals), we used a custom-designed questionnaire consisting of 39 items, which were rated on a 5-point Likert scale. All items were positively worded (Baumgartner et al., 2018; Steinmann et al., 2022) and were converted into numerical values from 5 (strongly agree) to 1 (strongly disagree) for the analysis. The validity of the questionnaire was assessed by an exploratory factor analysis using Varimax rotation. The suitability of the factor analysis was checked by the Kaiser-Meyer-Olkin (KMO) test and the Bartlett's test of sphericity. The KMO value was 0.90, and the Bartlett's test of sphericity yielded a significant result, thereby rejecting the null hypothesis (Dziuban, Shirkey, 1974). The grouping of items was based on Velicer's MAP test (Velicer et al., 2000), which identified four dimensions: Animals, Importance of Organisms, Plants, and Fungi. Five items were excluded from the analysis because their factor loadings were distributed across several dimensions (Table 2). The reliability of the questionnaire, measured with the Cronbach's alpha coefficient, reached a value of 0.925, which is considered excellent.

Table 2. Results of the Exploratory Factor Analysis

	α	I	II	III	IV
Animals	0.895				
23. I enjoy observing animals in their natural environment (e.g., in the park, in the garden, etc.).		.678			
24. Animals are interesting.		.758			
28. I enjoy reading books and magazines about animals.		.599			
30. I enjoy watching films about animals.		.657			
31. Animals are important for my life.		.494			
32. I enjoy learning new information about animals.		.720			
33. Knowledge about animals is important to me.		.727			
34. Being able to name animals is important to me.		.658			
37. Biology lessons about animals are interesting to me.		.731			
38. I believe that the protection of animals is important.		.668			
Importance of Organisms	0.831				
1. Plants are an important part of the environment.			.433		
3. Fungi are important for maintaining biodiversity in nature.			.625		
13. Fungi are an important part of nature.			.556		
14. Plants play an important role in food chains as part of ecosystems.			.422		
17. Fungi are an important part of the environment.			.628		
18. It is important to preserve native plant species in their natural habitats.			.515		
19. Plants are important for maintaining biodiversity in nature.			.721		
21. Animals are an important part of the environment.			.597		
29. Fungi play an important role in communities as part of the food chain.			.476		
35. Animals play an important role in communities as part of the food chain.			.529		

Plants	0.836				
2. Growing plants is relaxing for me.				.597	
4. I enjoy observing plants in their natural environment (e.g., in the park, in the garden, etc.).				.596	
5. Plants are interesting.				.631	
9. Being able to name plants is important to me.				.527	
10. Plants are important for my life.				.453	
11. I enjoy learning new information about plants.				.533	
12. Knowledge about plants is important to me.				.632	
15. Biology lessons about plants are interesting to me.				.531	
16. I believe that plant protection is important.				.461	
Fungi	0.816				
20. Fungi are important for my life.					.572
22. Fungi are interesting.					.688
25. I enjoy learning new information about fungi.					.702
27. I enjoy observing fungi in their natural environment (e.g., in the park, in the garden, etc.).					.699
36. I enjoy reading books and magazines about fungi.					.724
Eigenvalue		*11.41*	*3.34*	*2.53*	*1.68*
% of variance explained		*29.25*	*8.57*	*6.49*	*4.30*
6. Knowledge about fungi is important to me.					
7. I enjoy reading books and magazines about plants.					
8. I enjoy watching films about plants.					
26. I believe fungal protection is important.					
39. Hunting wild animals should be banned.					

4.3. Data Analysis

The data were analysed quantitatively to determine basic descriptive characteristics of the test (mean, median, mode, variance, standard deviation, etc.). To assess the normality of data distribution, the Shapiro–Wilk test was used. The test indicated that the data obtained from both the test and the questionnaire were not normally distributed ($p < 0.05$). Therefore, to determine statistically significant differences between two independent samples, the non-parametric Mann–Whitney (Wilcoxon) W-test was used to compare the medians of the two groups. To examine correlations between the variables under investigation, Spearman's rank correlation coefficient was used.

5. Results

Students' Conceptual Knowledge of Food Chains and Food Webs

The students were able to achieve a maximum score of 13 points on the test. No student achieved the maximum, while 11 students achieved the minimum of 0 points. The overall mean score was 4.71 points (SD = 3.30), and the median was 3.95 (Table 3). The average success rate in the test was 36.22 %.

Table 3. Descriptive Characteristics of the Test for Individual Statistical Samples

	Total	**Gender**	
		Boys	**Girls**
Count	489	249	240
Average	4.71	4.81	4.60
Median	3.95	3.88	3.98
Mode	1.5		0
Variance	10.87	11.52	10.23
Standard deviation	3.30	3.39	3.20
Coeff. of variation	70.04 %	70.52%	69.54 %
Minimum	0	0	0
Maximum	12.5	12.5	12.5

	Total	Gender	
		Boys	Girls
Range	12.5	12.5	12.5
Stnd. skewness	6.14	5.08	3.41
Stnd. kurtosis	-2.08	-1.19	-2.03

Based on the success rate in the conceptual knowledge test, Semilarski et al. (2019) defined three levels of conceptual understanding. Students with a high level achieved a success rate above 80 %, those with a medium level achieved above 60 %, and students with a low level of conceptual understanding achieved below 60 %. According to this categorisation, 8.38 % of students achieved a high level, 11.25 % a medium level, and 80.37 % a low level of conceptual understanding in the test administered. This result indicates that the majority of the students involved in the research showed a limited understanding of biological concepts and had difficulties in correctly identifying and applying these concepts. Their ability to recognise and explain relationships between biological concepts was also low.

In terms of the specific subtypes of conceptual knowledge, students achieved a success rate of 40.87 % in knowledge of theories, models, and structures; 25.33 % in knowledge of classification and categorisation; and 26.18 % in knowledge of principles and generalisations. The analysis of the results also focused on assessing students' success in individual biological concepts. Students achieved the highest success rate in the tasks focused on food chains (I = 43.12 %). Comparable success rates were recorded in the tasks related to food chain links (I = 34.75 %) and food webs (I = 31.62%). The lowest success rate was observed in the domain focused on food sources (I = 26.49 %). Regarding specific test items (Table 4), students were most successful in the task requiring them to supply the species name of the organism forming the last link (third-order consumer) in a simple food chain (Item 1). They also scored above 50 % in the item in which they had to select a correctly ordered simple food chain containing a producer and consumers (Item 4). The success rate in food chain tasks decreased when the students had to construct a food chain from a selection of organisms including decomposers (Item 2, Item 12) or when they had to justify the correctness/incorrectness of the constructed food chains (Item 9). The lowest success rate was achieved in Item 13, where students were asked to explain how the extinction of Daphnia in a food web would affect other organisms (I = 20.65 %). The success rate was similarly low for two-tier items, where students were asked to categorise an organism in a food chain (Item 3a) or group an organism based on its food source (Item 5a), and justify their answer (Item 3b, Item 5b). A success rate below 30 % was also recorded in Item 6, in which students were asked to categorise organisms into groups based on a key they had selected.

Table 4. Student Performance on the Test Items

Biological Concept	Item	Item success rate [%]	
food chain	1	63.70	
food chain	2	33.03	
food chain components	3a	28.63	20.96
	3b	13.29	
food chain	4	54.50	
food sources	5a	27.40	21.27
	5b	15.13	
food chain components	6	29.39	
food chain components	7	49.49	
food sources	8	31.71	
food chain	9	34.02	
food chain components	10	39.14	
food web	11a	53.46	42.58
	11b	31.70	
food chain	12	30.37	
food web	13	20.65	

As part of the analysis, we were also interested in whether there was a difference in students' conceptual knowledge according to gender. The average score for girls was 4.60 (SD = 3.20), while for boys it was 4.81 (SD = 3.39). Using the Mann-Whitney (Wilcoxon) W-test, no statistically significant differences in test performance were found according to gender ($W = 29046.0$; $p > 0.05$).

Students' Interest in Living Organisms

An analysis of the students' answers to the questionnaire items showed that they achieved an average score of 3.93 (SD = 0.66), with a median of 4.03. This score indicates a slightly positive interest in living organisms. The highest mean score was found in the dimension Importance of Organisms ($x = 4.17$), and the lowest in the dimension Fungi ($x = 3.17$) (Table 5). The data analysis using Spearman's correlation coefficient (Table 5) revealed predominantly moderately positive correlations ($0.50 < r \leq 0.70$) between the individual dimensions. A weak positive correlation ($0.10 < r \leq 0.30$) was found between the dimensions Fungi and Animals, and between Fungi and Importance of Organisms. This suggests that students who show a greater interest in fungi also tend to have a greater interest in animals and a greater awareness of the importance of organisms, but these relationships are weak and are likely to be influenced by other factors.

Table 5. Spearman's Correlation Coefficients Between Dimensions of Students' Interest in Living Organisms

	Animals	**Plants**	**Fungi**	**Importance of Organisms**
Animals		0.536***	0.382***	0.518***
Plants			0.543***	0.616***
Fungi				0.351***
Importance of Organisms				
Mean	4.07	3.90	3.17	4.17
SD	0.88	0.83	1.07	0.70

*** $p < .001$

Analysing the results by gender showed that girls achieved a slightly higher score ($M = 3.94$, $SD = 0.65$) than boys ($M = 3.92$, $SD = 0.67$), but the differences were not statistically significant ($W = 30948.0$; $p > 0.05$). Similarly, no significant differences were found between the individual dimensions in relation to gender.

The relationship between students' conceptual knowledge and their interest in living organisms

The study also investigated whether there is a correlation between students' conceptual knowledge and their interest in living organisms. Spearman's correlation analysis revealed a moderately positive correlation ($r = 0.52$; $p < 0.001$) between students' conceptual knowledge and their interest in living organisms. This suggests that students with a better conceptual understanding tend to show a greater interest in living organisms. In other words, as students' conceptual knowledge increases, their interest in living organisms generally increases as well.

6. Discussion

An essential component of science education is the development of science concepts that not only consist of isolated terms but also encompass the connections between them in the form of conceptual knowledge (Ravetz, 2020; Yi, Choi, 2012; Hodson, 2002). Such knowledge enables the identification and interpretation of relationships among concepts, thereby forming a complex and interconnected understanding of natural phenomena (Rittle-Johnson et al., 2001). Conceptual knowledge regarding food chains is crucial for a deeper understanding of ecological relationships and the sustainability of natural systems, as it enables students to recognise the dynamic interactions between organisms and their environment (Hui, 2012). However, the results of this study showed that students aged 10 to 11 years have a low level of such knowledge. The inadequate understanding of the concept of food chains has also been highlighted in other studies (e.g., Zulyusri, 2021; Preston, 2018; Eromosele, Ekholuenetale, 2016). One of the main reasons for a limited or superficial understanding of biological concepts is the presence of numerous misconceptions (Lucariello, Naff, 2013). For instance, Özkan et al. (2004) point to an insufficient understanding of the role and importance of decomposers within food chains. Our results also indicate that students' performance on food chain tasks decreased when the task involved constructing a food chain that included decomposers. Consistent with the findings of Purwanti and Kuntjoro (2020), many students in our study perceived decomposers solely as organisms responsible for breaking down organic matter and did not recognise their crucial role in the nutrient cycle. The data also revealed a common misconception about the organisation of organisms within food chains. Students tended to organise organisms according to their size rather than their actual trophic relationships. Several authors have noted that this misconception is common among students (e.g., Allen, 2025; Eilam, 2022; Reiner, 2001). Another notable misconception was that students did not consider parasitism, such as the common tick, as a form of trophic interaction within food chains. This misconception was also documented in the study by Eilam (2022). Gender has been recognised as another important factor influencing the true understanding of scientific concepts (Sagala et al., 2019). However, in our study, no statistically significant differences were found between boys and girls in their test performance. Other factors that influence student success include task context (Nehm, Ha, 2011), motivation, attitudes and interests (Yusup et al., 2023). Long-term studies (e.g., Steidtmann et al., 2023; Van Griethuijsen et al., 2015) repeatedly report a gradual decline in students' interest in science and science education. The results of our study show a slightly positive interest of students towards living organisms. The highest scores were observed in the dimensions of the Importance of Organisms and Animals. This could be related to the fact that animals tend to be more attractive to students than other organisms (Fančovičová, Prokop, 2011). Conversely, the lowest scores were found in the dimensions of Fungi and Plants. This lack of interest could be related to the inadequate representation of plants and fungi in the curriculum (Thomas et al., 2022; Moore et al., 2025). In the case of plants, this can be attributed to the phenomenon known as "plant blindness", a cognitive bias in which people fail to notice or undervalue plants in their environment (Thomas et al., 2022). A similar phenomenon occurs with fungi, leading to an inadequate understanding and appreciation of their ecological importance (Karakaya et al., 2023).

The correlation analysis showed that students with a higher interest in living organisms tended to perform better on tests measuring conceptual knowledge of food chains. This suggests that fostering an interest in living organisms among students aged 10–11 years (ISCED 2) can simultaneously support the development of their conceptual understanding. This assumption is also supported by the findings of other studies (e.g., Jansen et al., 2016; Krapp, Prenzel, 2011; Köller et al., 2001), which emphasise a positive relationship between students' interest in science topics and their deeper understanding of science concepts. However, interest alone, without appropriate pedagogical support, does not necessarily lead to significant improvements in conceptual understanding (Renninger, Hidi, 2020; Swarat et al., 2012). According to Renninger and Hidi (2020), students whose interest in a particular topic is systematically encouraged are more likely to engage with the content repeatedly and actively seek out new knowledge. These findings emphasise the importance of targeted and systematic teacher support in cultivating students' interest in living organisms, which can ultimately contribute to a deeper understanding of ecological concepts such as food chains.

7. Conclusion

The findings of this study highlighted a low level of students' conceptual knowledge regarding food chains, alongside a moderately positive interest in living organisms. Data analysis revealed a moderate positive correlation between these two domains, indicating that students who scored higher on the conceptual knowledge test also showed a greater interest in living organisms. These results suggest that students' interest is a multi-layered psychological construct that significantly influences their cognitive processing and deeper understanding of the subject matter (Knekta et al., 2019). In the context of biology teaching, this emphasises the need to implement teaching approaches that deliberately promote not only the development of conceptual knowledge but also the cultivation of a positive interest in thematic areas of science teaching.

8. Limitations of the Study

With regard to this study, certain limitations must be taken into account. In order to assess the students' interest in living organisms, a questionnaire with a 5-point Likert scale was used, on which the students could indicate their interest in relation to certain statements. However, it should be noted that the statements provided may not fully capture all aspects of the students' interest in the area under investigation, which could affect the accuracy of the measurement. Nonetheless, the psychometric properties of the questionnaire have shown that it is suitable for capturing students' interest in the dimensions of Plants, Animals, Fungi, and the Importance of Organisms. The study focused exclusively on the concept of food chains, which is only one of several topics that students aged 10–11 years (ISCED 2) are confronted with in biology lessons. Therefore, the findings relate only to this specific topic area among several areas in which students are expected to develop their conceptual knowledge.

9. Ethics contributions

This study did not require approval by an ethics committee, as it adhered to the ethical principles outlined in the Belmont Report, issued by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research in the United States. All participants (or their legal guardians, where applicable) provided informed consent prior to participation. Data collection was conducted anonymously and did not involve the gathering of any personal or identifiable information from the participating students. The research fully respected the principles of respect for persons, beneficence, and justice.

10. Conflicts of interest

The authors declare no conflict of interest.

11. Authors contributions

The authors have made substantial, direct, and intellectual contributions to the work, and have approved it for publication.

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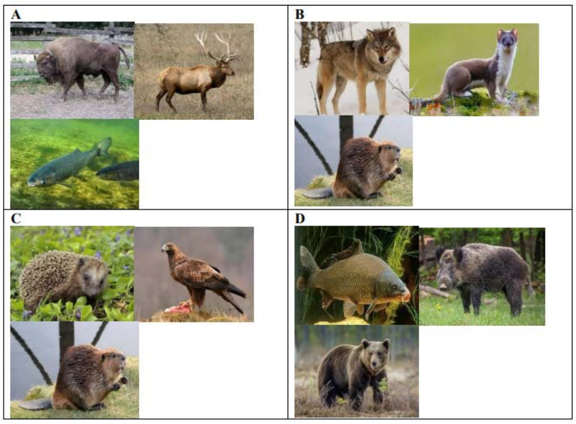
Appendix

Item 2: Construct a food chain with all the organisms listed below.
Great spotted woodpecker, spruce bark beetle, bacteria, Eurasian eagle-owl, Norway spruce

Item 5: If the roe deer belongs to the group of organisms in option A, to which group of pictures (A to D) does the red squirrel belong? Explain your answer.



My answer: ....
I justify my answer by stating that: ....
....

Item 6: Classify the listed organisms into three categories based on their shared characteristics.

1. Group: ....
2. Group: ....
3. Group: ....

Item 9: Decide whether the following food chains are correct or incorrect. Give reason for your answer.

a) European perch → Eurasian beaver → brown bear — Correct / Incorrect
Reason for your answer: ....
b) Water flea → common carp → great cormorant — Correct / Incorrect
Reason for your answer: ....
c) Eurasian red squirrel → red fox → common tick — Correct / Incorrect
Reason for your answer: ....
d) European garden spider → hawfinch → eagle owl — Correct / Incorrect
Reason for your answer: ....