STUDENTS' PERCEPTIONS AND ATTITUDES REGARDING SCIENCE FOLLOWING THE IMPLEMENTATION OF THE "REWILDING" SCIENCE ACTION

Gabriel Gorghiu (iD), **Mihai Bîzoi** (iD), **Laura Monica Gorghiu** (iD),
Claudia Lavinia Buruleanu (iD)
Valahia University of Targoviste, Romania
E-mail: ggorghiu@gmail.com, mihaibizoi@yahoo.com, lgorghiu@gmail.com,
laviniaburuleanu@yahoo.com

Abstract

The performance of any economy is based on scientific knowledge and technological innovation. Consequently, a highly motivated workforce with skills in science and engineering is key to any prosperous economy. Science education has a critical role in providing scientific literacy to students, as well as in training young people to choose careers linked to STEM education. Understanding the science concepts and their application is nowadays challenging for students, due to lack of interest and motivation. "Science is not for me" is, unfortunately, a frequent phrase heard when discussing with young people. It is clear that the way science is taught must be adapted to the student's profile and needs. In this respect, in Romania, the CONNECT project comes to meet this gap by designing and implementing four structured scenarios, embracing the format of Science actions. In order to evaluate the impact of each Science action in terms of students' perceptions and attitudes concerning science, an instrument based on a 5-point Likert scale was developed in the frame of the project partnership. The feedback of 83 students who participated in the Rewilding Science action was collected, being emphasized that students are feeling more confident to solve problems in science and consider that learning science is enjoyable, even learning science is not easy. Although the majority of the respondents would like to do projects with others using science to improve the world, they - in the same ratio - would not like to be seen as experts in science.
Keywords: *science education, Rewilding Science Action, students' perceptions and attitudes, CONNECT project*

Introduction

Nowadays science education needs to adapt and accommodate a variety of changes (Höttecke & Allchin, 2020), developing a real culture for scientific literacy which should be its main objective (Cofré et al., 2015). However, finding ways to improve and optimize learning can be challenging (Moro et al., 2021).

In that sense, a lot of attention was paid in recent years to STEM education (Takeuchi et al., 2020), mainly due to the lack of interest manifested by primary and secondary school students (van Griethuijsen et al., 2015). More, measuring the students' interest in

science became compulsory, through adopting existing instruments or developing new ones (Taber, 2018). For example, by integrating a new approach into the core curriculum, the CONNECT project tries to gather students and scientists together for solving real problems. In this respect, the CONNECT project's goal is to create an inclusive and sustainable model that may facilitate the adoption of open schooling by a large number of secondary schools, through implementing science-action gamification projects in the core curriculum (CONNECT, 2022). The teaching/learning materials developed in the frame of the project are based on the *Care-Know-Do* model, an innovative one, adapted for each topic proposed by each project partner. In this respect, two types of scientific actions are available for teachers/schools: structured scenarios and open scenarios. Starting from the idea that nature is our source of life, being essential for a good quality of life, among the project resources, the *Rewilding* Science action is proposed as one of the fourth structured scenarios. To sustain that, it was stated that troubling nature has profound implications for education (Sitka-Sage et al., 2017). The outdoor learning movement is rapidly growing, with parents and schools having the mission to reconnect a generation of children with nature (Bates, 2020).

From its initial emphasis on protecting large, connected areas for carnivore conservation, rewilding is nowadays met into a diversity of concepts, and specific actions assisting the restoration of self-sustaining, resilient ecosystems. In Europe, rewilding actions are focused on reaching the EU's environmental ambitions, with the EU Biodiversity Strategy for 2030 and the EU Green Deal being the most recent.

The current rewilding success is linked to public enthusiasm (Genes et al., 2019) and to the understanding of the context of rewilding projects (Carver et al., 2021). Support from the general public and also the involvement of private landowners are considered, in the context of constructing a sustainable, balanced landscape, crucial for the long-term maintenance of benefits (García-Ruiz et al., 2020).

The UN Decade on Ecosystem Restoration aiming to prevent, stop and reverse the degradation of ecosystems is a suitable context in which the rewilding topics can be brought, by policy- and decision-makers, to the forefront of discussions about how to reach post-2020 biodiversity goals. By implementing rewilding activities, the UN Sustainable Development Goals Life on land and Partnerships for the goals are accomplished.

Research Problem

In the face of economic, environmental, and social challenges, education is more critical today (National Research Council, 2012). Recent studies underline that in Western European countries the primary and secondary school students' interest in science and technology is low and seems to be decreasing (van Griethuijsen et al., 2015; Nugent et al., 2015). A trained workforce is compulsory for the economic growth and development of any country. STEM education has an overwhelming contribution in training skilled professionals able to contribute to society's welfare, so making science education more appealing for students of this new generation is more and more important.

This research was necessary to understand the Romanian students' perceptions and attitudes regarding science education. From this starting point, the teachers and various stakeholders will be able to punctually fill the needs of young people in order to learn STEM content, to acquire skills and knowledge for careers based on science education.

The *Rewilding* Science action was designed considering that whether the teacher/ learning activities take the format of the *Care-Know-Do* model, the students' engagement and participation in all the steps of the proposed activities will increase. Thus, the science action was structured according to the four steps scenario: (a) *Care* (getting involved in the issue); (b) *Know 1* (applying the scientific ideas); (c) *Know 2* (learning how to conduct an investigation); (d) *Do* (creating an output for public/community). The context of the *Rewilding* Science action was chosen in the way of being linked with real life, by including a problem to solve, fitting also parts of the science curriculum, and providing interest for students aged 7-14.

The learning objectives, following the above-mentioned steps are:
• understanding the scientific context (*Care*);
• applying feeding relationships in a new context (*Know 1*);
• learning the skills to "analyse evidence to support a claim" (*Know 2*);
• coordinating scientific knowledge and skills in a performance assessment (*Do*).

Research Focus

The research was focused on the students' perceptions and attitudes acquired at the end of the *Rewilding* Science action implementation. In this respect, it was analysed mainly in what measure the students' statement "science is not for me" remained alive after they participated in the activities proposed in the frame of the *Rewilding* module.

Research Aim and Research Questions

This research aimed to evaluate the students' perceptions and attitudes related to the implementation of the *Rewilding* Science Action - an original model to sustain and promote science education.

Today's world needs young people who can think in scientific terms in their everyday lives, but also aspire to a career in science. However, according to recent research results, the students consider that the study of science is difficult and not necessary/suitable for them.

The research premise started from the idea that students lacked the so-called "science capital", which refers to their scientific knowledge, attitudes, skills, and experiences. Some key factors which influence the students' aspirations to see themselves in the position of future scientists were identified, such as lower familiarity with the science area, lack of the models to be followed, and also restricted employment opportunities having a scientific background.

At the end of the implementation process of the *Rewilding* Science Action, the research questions were oriented on: (a) how confident are the students with science?; (b) how do the students feel about science? In this respect, it was interesting to measure the students' perceptions and attitudes concerning science, considering how science is taught and learned in the Romanian school today.

Research Methodology

General Background

A solution to the issues referring to the development of the scientific capital is to change the way students learn Science and make Science Education more accessible and attractive to students, exploiting a range of opportunities and starting from the curriculum, by motivation, engagement, and impact. Motivation means learning Science through scientific methods. The engagement refers to the student's interaction with scientists, to involve students' families in a participatory process that promotes the Sciences and also to stimulate a common interest in the Sciences within families, but also for future careers in Sciences. The impact of the Science actions of the CONNECT project refers to students' contribution to solving the community challenges and being aware of the impact of Science in the world. Moreover, the promotion of the concept of "open schooling" contributes overwhelmingly to the promotion of the Sciences.

The Science actions are learning activities that make Science more relevant to students, showing them how scientific research and innovation can change their lives and how they can use Science to make a positive impact as young researchers. The Science actions offered by the CONNECT project are intended to complement the existing units, in line with a range of topics from the school curriculum, being easy for teachers to use them.

In the frame of the CONNECT project, the Science Action *Rewilding* prepares students to plan a campaign in order to convince the local community to reintroduce an animal to its former habitat. The Science Action *Rewilding* is designed to integrate different activities, which can be adapted to existing science lessons.

Rewilding Romania aroused the students from middle school interest, benefiting from the support of students' teachers and families, respectively STEM specialists.

Sample

During the second semester of the 2021-2022 school year, 1182 secondary school students from 7 Romanian counties participated in the implementation process of the CONNECT project science actions, and most of them answered a specific questionnaire concerning their perception related to science. From all the filled questionnaires, 83 accurate feedbacks referred to the implementation of the *Rewilding* Science action. The number is relatively small considering that other Science actions (oriented on *Plastic Biodegradation*, *Carbon Footprint* and *Green Energy*) were selected as appropriate by science teachers, being adopted in conjunction with the Romanian secondary school curricula, but also with the planning of the school-year activities in the second semester. The gender distribution of the sample was almost equal: 43 female students and 40 male students.

Instrument and Procedures

The CONNECT Project evaluation team created an instrument for collecting the students' feedback, introducing most of the questions with possible answers based on a

5-point Likert scale (*Totally disagree - Disagree - Neither disagree nor agree - Agree - Totally Agree*).

Data Analysis

Data analysis was made by exploiting the Microsoft Excel facilities, by examining the students' answers distribution related to each category of questions. For the present research, the considered sets of data were focused on the students' perceptions and attitudes regarding their feeling and trustful in science.

Research Results

The analysis of the students' feedback concerning the implementation of the *Rewilding* Science Action takes into account this CONNECT project resource as used by teachers within the topic of the interdependence between species, taught mainly during Biology lessons. It includes 4 different steps that can be used in the frame of the existing science lessons, presented in brief in Table 1.

Table 1

Description of the Implementation Steps of the Rewilding Science Action - Rewild Romania

Activity	Learning objective	Student's activities	Involvement
CARE: The challenge Rewild Romania	Care about the issue Understand the scientific context	Learn about each animal. They vote for one.	Teacher STEM professional Family
KNOW 1: Bisons	Apply feeding relation-ships to a new context	Explore a case study about bisons' rewilding in the Făgăraș moun-tains. Complete a similar prob-lem independently.	Teacher
KNOW 2: Beavers	Learn the skill "weight evidence to support a claim"	Consider the claim that rewilded beavers are good for the environ-ment. Persuade others that beavers should return to the Danube Delta.	Teacher STEM professional
DO: Campaign	Coordinate scientific knowledge and skill in a performance assess-ment	Plan and deliver a cam-paign to persuade an audience that an animal should be rewilded.	Teacher Specialist STEM Family

The general picture of the data obtained based on the students' responses to the questionnaire is provided in Table 2.

Table 2

Students' Feedback on the Perception and Attitudes Concerning Science Collected After the Implementation of the Rewilding Science Action - Rewild Romania (n=83)

Items	Totally disagree	Disagree	Neither disagree nor agree	Agree	Totally Agree
Feeling confident talking about science	1	6	20	35	21
Feeling confident doing science projects with other people (with other colleagues)	1	2	15	27	38
Using science to come up with questions and ideas	1	3	16	43	20
Feeling confident to solve problems in science	2	4	11	33	33
Feeling confident about personal knowledge in science to learn new topics	1	2	10	50	20
Knowing how to justify personal views using arguments and evidence	1	1	4	40	37
Learning science is enjoyable	0	1	9	41	32
Learning science is easy	4	11	39	19	10
Considering that science activities are fun	0	0	11	53	19
Willing to do projects with others using science to improve the world	0	1	5	42	35
Willing to be seen as an expert in science	2	5	32	23	21
Willing to have a job involving science	0	12	46	12	13

The first research question was how confident the Romanian students were with science, a general picture of answers to this question is provided by the first six items mentioned in Table 1.

According to the students' feedback, being asked how confident they were talking about science and doing science projects, a significant number of students (20, respectively 15, corresponding to 28% and 18% respectively from the total of respondents) kept a neutral position (neither disagree nor agree) in relationship with the above-mentioned topics assessed. 56 students out of a total of 83 *totally agree* and *agree* feeling confident talking about science. Although only 25% of students are feeling confident talking about science, almost 46% are feeling confident doing science projects with other people (with other colleagues).

It is important to notice that more than half of the respondents, students who participated in the *Rewilding* Science action, agreed that they used science to come up with questions and ideas and an equal number of students (33, representing almost 40% of the total of the respondents) *agreed* and *totally agreed* to feel confident to solve problems in science.

Personal knowledge in science - which makes students able to learn new topics - represented another topic in discussion. 50 students out of the total of 83 respondents answered that they were feeling confident with this issue, while a per cent by 24% *totally agreed* with this statement. Relatively surprising - having in view the complexity and the challenge of the topic -, except for 6 students, the others *agreed* and *totally agreed* regarding how to justify personal views using arguments and evidence.

The second research item was oriented on how the students felt about science.

Learning science seems to be enjoyable for a large majority of the students (88%) participating in this research, suggesting that their teachers have the facilities needed to make the activities attractive. However, learning science seems to not be ready to hand, almost half of the respondents *neither disagreed nor agreed* with the statement "learning science is easy". On the other hand, science activities are considered "fun" by 87% of students, and 93% of the respondents would like to do projects with others using science "to improve the world".

If the next two items are analysed in the context of the aim of the research, a consistent number of students (32 from a total of 83) remained neutral (*neither disagreed nor agreed*) within the perspective to be seen as experts in science. Only 25 respondents stated that they would like a job that involved science.

Discussion

As the *Rewilding* Science Action can easily be adapted for nowadays students, their feedback following its implementation was probably correlated with the teachers' involvement in the scenario, an aspect that remains to be analysed in future research, especially taking into account the need to know the teachers' understanding of the integration of science practices with science content (Bismack et al., 2022).

The students from the target group are feeling confident doing science projects with other people - the DO stage (create a *Rewilding* campaign) means that a group of students collect evidence for claims, plan the presentation and present it. Thus, the students collect evidence for the claims (the animal can survive in Romania; people want it to be rewilded; the animal has a positive effect on the food network, and it has other benefits), and in this way, students become confident talking about science.

Epistemic beliefs play a role in forming the students' interest in science (Jaber & Hammer, 2016). The students participating in Rewilding activities are feeling generally confident talking about science, although there are a significant number of respondents without a clear perception of that. Because the third part of the interviewed students is not feeling confident talking about science, it is obvious that teachers and stakeholders should create opportunities for students to formulate questions and ideas, to encourage them to discuss and explain natural phenomena. The teachers should cultivate the students' confidence in oral communication, and they should understand what students say and do, and also contribute actively to deepening the students' reasoning. In the frame of the CONNECT project activities, *Rewilding* is configured by science and traditional ecological knowledge (TEK), the last one providing a complementary body of knowledge to science. It should be noticed that the secondary school students were actively involved in discussions about endangered animals in Romania, they argued about the food chain and the importance of the return of a particular animal in terms

of ecosystem restoration. Thus, Rewilding - as transformative change - proved to offer a motivation for students' engagement in science education, using science to come up with questions and ideas. Learning about each animal (during the CARE stage), in order to understand the scientific context that sustains the enlargement of the students' basis of ideas, different algorithms of thinking are consolidated with possibilities to be extrapolated in other areas of science. The home task is fun, with structured discussions where the family is involved by talking about the different animals who are candidates for rewilding, and finally, voting for their favourite.

Inquiry and investigation, production of ideas and solutions, and application of knowledge to new problems support scholars in learning sciences (National Research Council, 2012; Darling-Hammond et al., 2020). Students answered that they were feeling confident to solve problems in science, and the KNOW 2 stage sustains their responses. Thus, the students learn the skill of "weight evidence to support a claim". In this stage, the teacher clarifies the need for the new skill and where it fits, models the thinking process, offering coaching/support for students, but finally, the students make their decision. During the assessment, several pieces of relevant evidence plus full reasoning that connects the evidence to the claim are highly noted.

The productive instructional strategies constitute one of the four areas of science of learning and development (SoLD) (Darling-Hammond et al., 2020). Meaningful work that builds on students' prior knowledge and engages them in rich, engaging tasks was identified as a part of the productive instructional strategies. The students enrolled in the CONNECT project and were feeling generally confident about personal knowledge in science to learn new topics, and only 3 respondents out of 83 *totally disagreed* or *disagreed* with this statement. This feature contributes to the KNOW 1 stage, the learning objective being oriented on applying feeding relationships to a new context. After exploring a case study about bison rewilding in Făgăraș mountains, the students completed a similar problem independently.

The science includes not only concepts and facts but also scientific ways of thinking and reasoning (McNeill, 2011). Well-designed collaborative learning opportunities were identified as another part of the productive instructional strategies. Those encourage students to explain and elaborate their thoughts and co-construct solutions (Darling-Hammond et al., 2020). In the frame of the CONNECT project, out of 83 respondents, 77 students considered that they knew how to justify personal views using arguments and evidence. The *Open Schooling* pillar enables schools to create a flexible learning environment, inspiring students to explore the world through science. More than that, during the KNOW stages the students acquire knowledge and skills specific to Science. The students materialize their knowledge and skills in participatory scientific actions, including the evaluation process (DO stage).

Looking toward the future of education in the 21ˢᵗ century, a robust STEM curriculum is unquestionably required (Bidarra & Rusman, 2017). This is achievable by fostering students' curiosity, developing hands-on activities, and making activities more enjoyable. Strong positive correlations between STEM dimensions and STEM knowledge and science enjoyment respectively were established (Falk et al., 2016). For learning science, it was attributed the term "enjoyable" by a consistent majority of students (Table 2). This can be explained through the design of the *Rewilding* activities in a non-formal framework. Some distinct periods of the Romanian school year, such as

"School in a different way" and "The green week" were considered suitable by teachers to unfold the specific activities of the CONNECT project. The interaction with scientists at their working places, visiting the bisonniere, and specific activities in virgin forests, such as the study of fauna and flora are certainly enjoyable. Fostering children's curiosity and enjoyment is facilitated by innovative and imaginative approaches to learning in natural environments (Prince, 2022). This one is possible by following a nature-led, human-enabled approach, the role of the teacher being determinant.

Generally, ''authentic" science opportunities are valued by teachers who successfully taught outside. The teachers who were less successful in teaching outside valued the outdoors for the potential for fun (Glackin, 2016). However, both science opportunities and fun activities can be achieved in the frame of *Rewilding* Science Action. The fun tasks to apply scientific ideas, the inclusive strategies for students' skill development, and the support from a scientist make learning science easy and Science activities fun (Table 1). In the above-mentioned context, there are more opportunities for students to undertake extra research. In the frame of the CONNECT project activities, there are opportunities for students to consider the viewpoints of various stakeholders, such as researchers, farmers, and businesses.

Improving the world by doing projects with others using science seems to be a concern of the students. Why can the *Rewilding* Science Action lead to this approach? According to Loynes (2022), "wild" experiences can contribute to a change in human-nature relations and can promote pro-environmental values and behaviours. The students understand better the role of wild animals within the food webs, the contributions of ecosystems to human well-being, and the potential of rewilding to diminish the undesirable effects of extreme climate on biodiversity (Thakur et al., 2020).

Increasing the diversity of individuals who choose science careers is supported, in recent years, by a growing interest in improving science education (Stockwell et al., 2015). The professional models of the scientists encourage and sustain the students' statement "I would like to be seen as an expert in science" (Table 2). However, a significant number of respondents are not fully convinced that working in science is attractive. This indecisiveness could be due to the relatively limited time spent by students in the frame of *Rewilding* activities to incline the balance towards an agreement with the statement of the question in the discussion.

Middle school years are considered a critical developmental stage in terms of students' interests in STEM, respectively their likelihood of entering into STEM careers can be increased (Jiang et al., 2021). As it was mentioned previously, nowadays working areas require young people intending to get a career in science. According to recent research, too many students believe that "science is not for me", and that situation is hard to change. According to data from Table 2, only 25 out of 83 students agreed with the statement "I would like a job that uses science", although *Rewilding* provides an easy-to-use and effective approach for involving a scientist that gives students insight into STEM careers and makes this issue more real. Consequently, a lot of efforts should be continuously made, by all the parties involved in school education, in order to determine a desirable change in this approach by students, starting from the early education stage.

Conclusions and Implications

This study has surveyed how the *Rewilding* Science action - proposed in the frame of the CONNECT project - brought students closer to the sciences. The action - developed as an open schooling approach - tries to encourage and support the cooperation between schools with scientists and local communities, in order to help young people to acquire skills to solve real problems. In this sense, monitoring the students' feedback immediately after the action implementation becomes essential to provide evidence of the results and also to determine whether improvements should be considered in terms of bringing more students near science and its actual challenges.

This research provides empirical evidence referring to students' perceptions and attitudes after the implementation of STEM-related experiences in the format of meaningful and enjoyable activities, integrated within the curriculum in a great measure.

Nature and the way we take care of it represent the foundation on which we can build a better life in Romanian ecosystems. By understanding how rewilding activities affect nature, students make important steps to be aware that science learning could offer solid scientific knowledge, but also premises for successful STEM careers.

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Declaration of Interest

The authors declare no competing interest.

References

Bates, C. (2020). Rewilding education? Exploring an imagined and experienced outdoor learning space. *Children's Geographies*, *18*(3), 364-374. https://doi.org/10.1080/14733285.2019.1673880

Bidarra, J., & Rusman, E. (2017) Towards a pedagogical model for science education: Bridging educational contexts through a blended learning approach. *Open Learning: The Journal of Open, Distance and e-Learning*, *32*(1), 6-20. https://doi.org/10.1080/02680513.2016.1265442

Bismack, A., Davis, E. A., & Palincsar, A. S. (2022). Science practice-readiness: Novice elementary teachers' developing knowledge of science practices. *Science Education*, *106*(2), 364-384. https://doi.org/10.1002/sce.21698

Carver, S., Convery, I., Hawkins, S., Beyers, R., Eagle, A., Kun, Z., Van Maanen, E., Cao, Y., Fisher, M., Edwards, S.R., Nelson, C., Gann, G.D., Shurter, S., Aguilar, K., Andrade, A., Ripple, W.J., Davis, J., Sinclair, A., Bekoff, M., Noss, R., Foreman, D., Pettersson, H., Root-Bernstein, M., Svenning, J.C., Taylor, P., Wynne-Jones, S., Featherstone, A.W., Fløjgaard, C., Stanley-Price, M., Navarro, L.M., Aykroyd, T., Parfitt, A., & Soulé, M. (2021). Guiding principles for rewilding. *Conservation Biology*, *35*, 1882-1893. https://doi.org/10.1111/cobi.13730

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Cofré, H., González-Weil, C., Vergara, C., Santibanez, D., Ahumada, G., Furman, M., Podesta, M. E., Camacho, J., Gallego, R., & Perez, R. (2015). Science teacher education in South America: The case of Argentina, Colombia and Chile. *Journal of Science Teacher Education*, *26*, 45-63 https://doi.org/10.1007/s10972-015-9420-9

CONNECT (2023). *Inclusive open schooling through engaging and future-oriented science*. https://www.connect-science.net/about-the-project/

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97-140. https://doi.org/10.1080/10888691.2018.1537791

Falk, J. H., Staus, N. L., Dierking, L. D., Penuel, W. R., Wyld, J., & Bailey, D. (2016). Understanding youth STEM interest pathways within a single community: the Synergies project. *International Journal of Science Education*, *Part B*, *6*, 369-384. https://doi.org/10.1080/21548455.2015.1093670

García-Ruiz, J. M., Lasanta, T., Nadal-Romero, E., Lana-Renault, N., & Álvarez-Farizo, B. (2020). Rewilding and restoring cultural landscapes in Mediterranean mountains: Opportunities and challenges, *Land Use Policy*, *99*, 104850, https://doi.org/10.1016/j.landusepol.2020.104850

Genes, L., Svenning, J. -C., Pires, A. S., & Fernandez, F. A. S. (2019). Why we should let rewilding be wild and biodiverse. *Biodiversity and Conservation*, *28*, 1285-1289. https://doi.org/10.1007/s10531-019-01707-w

Glackin, M. (2016). 'Risky fun' or 'Authentic science'? How teachers' beliefs influence their practice during a professional development programme on outdoor learning. *International Journal of Science Education*, *38*(3), 409-433. https://doi.org/10.1080/09500693.2016.1145368

Höttecke, D., & Allchin, D. (2020). Reconceptualizing nature-of-science education in the age of social media. *Science Education*, *104*, 641-666. https://doi.org/10.1002/sce.21575

Jaber, L. & Hammer, D. (2016). Engaging in science: A feeling for the discipline. *Journal of the Learning Sciences*, *25*(2), 156-202. https://doi.org/10.1080/10508406.2015.1088441

Jiang, Y., Popov, V., Li, Y., Myers, P. L., Dalrymple, O., & Spencer, J. A. (2021). "It's like i'm really there": Using VR experiences for STEM career development. *Journal of Science Education and Technology*, *30*(6), 877-888. https://doi.org/10.1007/s10956-021-09926-z

Loynes, C. (2022). Wild adventure. A restorying. In S. Hawkins, I. Convery, S. Carver, & R. Beyers (Eds.), *Routledge handbook of rewilding* (1st ed.). Routledge. https://doi.org/10.4324/9781003097822

McNeill, K. L. (2011). Elementary students' views of explanation, argumentation, and evidence, and their abilities to construct arguments over the school year. *Journal of Research in Science Teaching*, *48*(7), 793-823. https://doi.org/10.1002/tea.20430

Moro, C., Phelps, C., Redmond, P., & Stromberga, Z. (2021). HoloLens and mobile augmented reality in medical and health science education: A randomised controlled trial. *British Journal of Educational Technology*, *52*(2), 680-694. https://doi.org/10.1111/bjet.13049

National Research Council. (2012). Education for life and work: Developing transferable knowledge and skills in the 21st century. Committee on defining deeper learning and 21st century skills. J. W. Pellegrino & M. L. Hilton (Eds.), *Board on testing and assessment and board on science education, division of behavioral and social sciences and education*. The National Academies Press.

Nugent, G., Barker, B., Welch, G., Grandgenett, N., Wu, C. R., & Nelson, C. (2015). A model of factors contributing to STEM learning and career orientation. *International Journal of Science Education*, *37*(7), 1067-1088. https://doi.org/10.1080/09500693.2015.1017863

Prince, H. (2022). Rewilding children and young people. The role of education and schools. In S. Hawkins, I. Convery, S. Carver, & R. Beyers (Eds.), *Routledge handbook of rewilding* (1st ed.). Routledge. https://doi.org/10.4324/9781003097822

Sitka-Sage, M. D., Kopnina, H., Blenkinsop, S., & Piersol, L. (2017). Rewilding Education in Troubling Times; or, Getting Back to the Wrong Post-Nature. *Visions for Sustainability*, *8*, 20-37. https://doi.org/10.13135/2384-8677/2334

Stockwell, B. R., Stockwell, M. S., Cennamo, M., & Jiang, E. (2015). Blended learning improves science education. *Cell*, *162*(5), 933-936. https://doi.org/10.1016/j.cell.2015.08.009

Taber, K. S. (2018). The use of Cronbach's Alpha when developing and reporting research instruments in Science Education. *Research in Science Education*, *48*, 1273-1296. https://doi.org/10.1007/s11165-016-9602-2

Takeuchi, M. A., Sengupta, P., Shanahan, M. -C., Adams, J. D., & Hachem, M. (2020). Transdisciplinarity in STEM education: A critical review. *Studies in Science Education*, *56*(2), 213-253. https://doi.org/10.1080/03057267.2020.1755802

Thakur, M. P., Bakker, E. S., (Ciska) Veen, G. F., & Harvey, J. A. (2020). Climate extremes, rewilding, and the role of microhabitats. *One Earth*, *2*(6), 506-509. https://doi.org/10.1016/j.oneear.2020.05.010

van Griethuijsen, R. A. L. F., van Eijck, M. W., Haste, H., den Brok, P. J., Skinner, N. C., Mansour, N., Gencer, A. S., & BouJaoude, S. (2015). Global patterns in students' views of science and interest in science. *Research in Science Education*, *45*, 581-603. https://doi.org/10.1007/s11165-014-9438-6