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Original research paper

PREDICTORS OF ENVIRONMENTAL AWARENESS AMONG PRIMARY SCHOOL STUDENTS IN SERBIA*

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ABSTRACT

The main goal of environmental education is the development of environmental awareness, which is the basis for pro-environmental behavior. In order to determine the conditions which, favour the development of environmental awareness, a survey was conducted of students in the fourth grade of primary school, based on data from TIMSS 2019. The criterion variable was the score on the Environmental Awareness Scale, while the predictor variables included characteristics which vary at student, class, and school levels. Hierarchical linear modeling indicated the importance of variables at the individual level: home resources, literacy and numeracy readiness for school, confidence in science, usefulness of science lessons, and parent's perceptions of their child's school and expected student education level. None of the considered class and school level variables were significant predictors of environmental awareness. Between-school differences were fully explained by the final, retained model, but some variance (approx. 8%) between different classes remained unexplained by the considered predictor variables. We offer suggestions on how to increase

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The data that support the findings of this study are openly available at https://timss2019.org/international-database/. Additional variables not available in the TIMSS datasets are available within the supplementary materials of the article.

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the school's contribution to the development of students' environmental awareness through the application of effective pedagogy and school improvement. Further research is needed into the contribution of the educational environment.

Key words:
environmental awareness, predictors, primary school, environmental education, school improvement.

INTRODUCTION

Environmental protection is a prerequisite for human survival on Earth. Humans, as part of nature, pollute land, water, and air and disrupt food chains in order to ensure a higher standard of living, putting the entire living world at risk, including their own species (UNESCO, 2020). Estimates of the harmful consequences of human activities are such that there is a growing global awareness of the need for a change in humanity's relationship with the environment, which calls for re-examining and changing our needs and ways of satisfying them, determining priorities, and defining optimal development. The bearers of these demands are the young and the very young, which is understandable because they are the most vulnerable. Education has an obligation to help the youngest members of society acquire relevant information, knowledge, and skills, as well as to develop attitudes and values that will enable them to preserve the planet, relative stability, and quality of life in the near future.

With the intention of determining how far we have come and in which direction further changes are needed in the field of environmental education (EE), a study of the national documents of 46 states covering all regions was conducted. In addition, interviews with key stakeholders in education and a global survey of educators were carried out (UNESCO, 2021). According to the results of this study, we are not doing enough to ensure that what we learn is helping us with the environmental challenges we face every day. Despite the fact that no country, no region, and no continent can avoid the consequences of climate change, this topic is mentioned in less than half of the educational policies and curricula analyzed. Although changes in biodiversity are occurring more rapidly and becoming more dramatic and visible every day, biodiversity is not a topic in most (81%) of the analyzed documents. The survey indicated that teachers need better initial education and in-service professional training to become agents of change in today's challenging world (UNESCO, 2021).

The environmental contents included in the curricula of certain education systems and the way in which they were implemented have changed over time. One of the constants is the goal of EE, which refers to the development of environmental awareness among individuals and communities as a whole (Stanišić, 2008). The goal of EEis to develop environmentally literate citizenship with the "knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions to current problems and the prevention of new ones" (UNESCO-UNEP, 1976: 2). Environmental awareness consists of environmental knowledge, attitudes, values, and behavior, which are interconnected and influence each other (Andevski, 1997; Cifrić, 1989; Kundačina, 2006; Marković, 2005; Mišković, 1997). Environmental awareness does not arise spontaneously, but appears under the influence of certain social forces, as it depends on the situation and context (Kang & Hong, 2021).

Examining the relationship between environmental knowledge and behavior has yielded mixed results (Courtenay-Hall & Rogers, 2002; Kollmuss & Agyeman, 2002; Krnel & Naglič, 2009; Negev *et al.*, 2008; Van Petegem, Blieck, & Van Ongevalle, 2007). In the 1970s, the dominant belief was that there was a direct connection between environmental knowledge and environmental awareness and that this relationship is linear, which means that greater environmental knowledge leads to higher environmental awareness and positive environmental behavior (Kollmuss & Agyeman, 2002). Other studies have indicated that the relationship between environmental knowledge and individual behavior is weak or does not even reach statistical significance (Makki, Abd-El-Khalick, & BouJaoude, 2003; Negev *et al.*, 2008; Kollumuss & Agyeman, 2002; Krnel & Naglich, 2009; Kuhlemeier *et al.* 1999). It has also been concluded that knowledge about environmental protection is a necessary but not sufficient condition for pro-environmental behavior and environmental activism among individuals (Meinhold & Malkus, 2005; Marušić Jablanović & Stanišić, 2020; Stanišić & Marušić Jablanović, 2019).

The education systems of different countries are trying to find ways, methods, and programs which will result in the development of environmental awareness among their citizens. Research evidence shows that it is not enough to incorporate environmental content into the curriculum and expect future generations to behave in an environmentally responsible manner (Makki, Abd-El-Khalick, & BouJaoude, 2003; Negev *et al.*, 2008; Kollumuss & Agyeman, 2002; Krnel & Naglič, 2009; Kuhlemeier *et al.*, 1999). Raising environmental awareness seems to be a much more complex task, requiring new resources and cooperation in the process of designing, implementing, and evaluating environmental education. On the whole, in order to make a greater contribution to the development of students' environmental awareness through the study of environmental content at school, it is necessary to continue research into environmental knowledge, teachers and other actors in the education process, and the context in which EE takes place.

Many European countries have included EE in their educational goals over the last half-century (Erdoğan, Kostova, & Marcinkowski, 2009; Srbinovski, Erdoğan, & Ismaili, 2010; Stanišić & Maksić, 2014; Stokes, Edge, & West, 2001). In Serbia, Environmental content forms part of several subjects in primary school (Pravilnik o planu nastave i učenja za prvi ciklus osnovnog obrazovanja i vaspitanja i program nastave i učenja za prvi razred osnovnog obrazovanja i vaspitanja, 2017). In the first cycle of primary education, which begins at the age of seven and lasts for four years, students learn about environmental protection through the two compulsory subjects. The World around Us (first and second grade) comprises topics such as living and non-living nature, housing, human activities, and motion in space and time. The subject Nature and Society (third and fourth grade) covers the previously studied topics, which are deepened, and new ones are introduced, such as getting to know one's place of birth, heritage, the links between living and non-living nature, and studying natural phenomena. The environmental knowledge acquired is evaluated with a numerical grade and affects the students' school success.

In addition to compulsory subjects, schools also organize extra-curricular and after-school activities with the aim of developing students' environmental awareness (Pravilnik o planu nastave i učenja za prvi ciklus osnovnog obrazovanja i vaspitanja i program nastave i učenja za prvi razred osnovnog obrazovanja i vaspitanja, 2017). Teachers and their students most often organize cleaning of the school building and yard, greening of the school environment, collection of waste materials for recycling, examination of water and air pollution in the local community, etc. Student participation in extracurricular and after-school activities is based on their interests, is voluntary, and does not affect school grades.

A review of research studies on the contribution of primary and secondary education to the development of the environmental awareness of students in Serbia revealed that what was mainly assessed was how much knowledge the students had gained about the contents recommended by the study programs (Brun, 2001; Kundačina, 2006; Mišković, 1997; Stanišić, 2008). The findings indicated that schools were directed towards the cognitive component of environmental awareness and that more attention was paid to the acquisition of factual knowledge and less to functional and applicable knowledge. In addition, research has also shown that the preparation of teachers for teaching EE was entirely a matter of in-service supplementary training and was often guided by the teacher's personal, internal motives (Kundačina, 2006; Mišković, 1997; Pejić, 2002; Stanišić, 2011).

We can conclude that most studies on the effects of environmental education point to their shortcomings and seek changes in the direction of increasing the school's contribution to the development of environmental awareness among young people (Stanišić, 2015; UNESCO, 2021). Research studies on the predictors of student achievement in science revealed that their individual characteristics were more significant than the characteristics of the teacher and the school they attended

(Jošić, Teodorović, & Jakšić, 2021; Teodorović *et al.*, 2021). One might ask whether these results also refer to the students' environmental awareness, which is the main goal of environmental education. If so, a new question arises about the conditions under which the school can increase its contribution to the development of students' environmental awareness, bearing in mind that this includes cognitive, affective, and behavioral aspects.

The goal of our research is to determine the predictors of environmental awareness among primary school students. This study explores the contribution of predictor variables stemming from three different sources: 1) individual characteristics of the student, including the characteristics of the family context from which the student comes, 2) teacher characteristics, including the teacher's perceptions of the circumstances in which they taught their class, and 3) school characteristics such as location and resources, including the school principal's perceptions of the educational environment in which EE takes place. The inclusion of student, teacher, and school perspectives could help to better understand the conditions in which environmental awareness develops. The practical goal is to intervene in an educational setting in order to raise the ecological awareness of young people, who are key actors for the preservation of nature and life on Earth.

METHOD

Participants

This research was conducted on a nationally representative sample consisting of primary schools that participated in the TIMSS 2019 study in Serbia (https://timss2019.org/reports/). The initial participant pool consisted of fourth grade students and the students' parents, class teachers, and school principals. We retained data from 3,692 fourth grade students and their parents. The students came from 154 different schools and were taught in 199 separate classes, each with its own teacher. Consequently, 154 school principals and 199 teachers participated in the survey. Most of the students (99%) were between 10 to 11 years old at the time of the study with approximately equally represented males (50.1%) and females (49.9%).

Instruments and Variables

The data on the students' achievements in science and the social and educational context for student learning was collected using the TIMSS 2019 instruments (Mullis & Fishbein, 2020).

Environmental Awareness Scale – EAS was constructed from some of the TIMSS 2019 Science items (Yin & Foy, 2021). The fourth grade EAS consisted of 33 items related to the following content areas: organisms, the environment, and their interactions; ecosystems; the Earth's physical characteristics, resources, and history; and the Earth's weather and climates. Tasks were designed within three cognitive domains: levels of knowledge, reasoning, and application. Cognitive domain knowledge refers to knowledge of facts, concepts, procedures, cognitive domain reasoning – solving non-routine problems, unknown and more complex problems that require analysis, synthesis, and generalization, while the cognitive domain of knowledge application involves using knowledge to generate explanations and solve practical problems (Mullis & Martin, 2017). The largest number of items in the EAS was from the domain of application (13), followed by reasoning (12) and knowledge (8). According to the authors, EAS achievements are accurate, reliable, and comparable to the overall Science achievements and across countries. The survey of the environmental awareness of primary school students from the countries which participated in TIMSS 2019 pointed out differences at the national level. With 513 points (SE = 4.5), Serbia was somewhat higher than the centre point of the EA scale (500 points).

The TIMSS 2019 context questionnaires included the Home Questionnaire (for parents), the School Questionnaire (for school principals), the Teacher Questionnaire (for teachers), and the Student Questionnaire (for students). Almost all of the considered variables come from the TIMSS 2019 database, which is available here: https://timss2019.org/reports/. Exceptions to this rule are described in more detail below.

Criterion variable. The criterion variable was *student environmental awareness,* defined and measured by the Environmental Awareness Scale (Yin & Foy, 2021). In the present analysis, we use the first plausible value for the Environmental Awareness Scale score.

Predictor variables. The predictor variables operationalised the characteristics of individual students, teachers and schools.[1]

Student-level variables. The student-level variables were related to (1) those pertaining to the student's early home environment, early development,

[1] TIMSS variable codes, specifications of how the predictor was operationalised or derived from the TIMSS variables, and the source of information (student, parent, teacher, or principal) are given in Appendix 1.

or characteristics related to their parents and (2) those concerning their school environment.

The first subgroup of student-level variables included: student gender, home resources for learning, preschool program length in years, early literacy and numeracy activities before primary school, literacy and numeracy readiness for school, and expected student education level. The second subgroup of student-level variables included the student's sense of school belonging, student bullying, frequency of scientific experiments, how much the student likes learning science at school, teacher's instructional clarity in science lessons, student's confidence in science, the usefulness of science lessons [2], and parent's perceptions of their child's school.

Class-level variables. The class-level variables can be further split into 1) those pertaining to the teacher's characteristics and 2) those which relate to the teacher's perceptions of the school environment or the circumstances in which they taught their class of students.

The first subgroup of teacher-level variables included years of teaching, teacher gender, teacher education level, teacher supports students' active engagement, homework frequency, different science assessment variables, and professional development in teaching science in the past two years. The second subgroup of teacher-level variables included the teacher's school emphasis on academic success, safe and orderly school, teacher's job satisfaction, teaching limited by students not being ready, access to computers, and students taught life and earth science topics.

School-level variables. The school-level variables included 1) those pertaining to relatively more objective school characteristics such as location and resources and 2) those related to the school principal's perceptions of the school environment or resources.

The first subgroup of school-level variables included principal's estimation of population in the city, town, or area, number of computers that the school has, whether or not the school has a science laboratory, whether or not the teachers have science laboratory assistance when performing science experiments, whether or not the school has an online system for learning management, whether the library size is greater or smaller than 2,000 books, and whether or not the school provides access to digital sources of knowledge. The second subgroup of school-level variables included principal's opinion on whether or not the instruction is affected by science resource shortages, school emphasis on academic success, school discipline, and literacy and numeracy readiness for school.

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2 Data available upon request from the national TIMSS 2019 center: timss2019serbia@gmail.com.

Data Analysis

Data analysis was performed in R (R Core Team, 2020). The models were fitted using the lmer() function from the lme4package (Bates *et al*., 2015). We first tested whether there was sufficient variation at class and school levels to warrant using HLMs. For this purpose, we created a model which included only random intercepts at the class and school level and compared it to models which did not include these random intercepts, using the anova() function (R Core Team, 2020). Furthermore, if there was sufficient unexplained variance between different classes or different schools expressed through the value of interclass correlation (ICC; see Hayes, 2006) then the calculation of a nested statistical model was indeed warranted.

After confirming that hierarchical linear modeling was warranted (see the Results section for details), we investigated which random slopes should be included in the model using the ffRanefLMER.fnc() function from the LMERConvenienceFunctions package (Tremblay & Ransijn, 2020). We used a forward-fitting procedure to test the inclusion of random slopes for all of the predictor variables listed in the Instruments and variables subsection. The random slopes were tested separately for the school and for the class grouping level. No interactions between the random intercepts and random slopes were included (our attempts led to singular models and convergence issues).

After specifying the initial structure of the random effects, we used a backward-fitting procedure to test the contribution of the grand-mean centered predictors using the step() function from the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2017). This procedure eliminates all random and fixed effects that do not contribute to a better model fit. Afterward, we manually removed all the random slopes for the fixed effects that were removed in the step() procedure. Finally, we carried out model criticism by observing the distribution of the residuals in the model created after applying the step() function. Model criticism includes trimming all cases with residuals that deviate by more than 2.5 SD and recreating the hierarchical linear model on the trimmed data. We used this trimmed model as the final hierarchical linear model. Throughout the model fitting procedure, we corrected the few occurrences of model singularity by excluding the predictor causing the model to have a singular fit.

RESULTS

In the present report, we only focus on the output of the final hierarchical linear model, but we also describe the important points of the model fitting procedure. The descriptive statistics for all the predictors and the R code detailing the procedure can be found in the supplementary material.[3]

The model including random intercepts at the class and school level was significantly better than the models which only included a random intercept for one of the two grouping variables, as tested by the anova() function (R Core Team, 2020). The values of the interclass correlation coefficients (ICC) indicated that 8.16% of the variance in the environmental awareness scores can be explained by a by-class random intercept, i.e., through differences in the intercept values between classes. The random intercepts at the school level explained an additional 10.85% of the variance in the student scores on the dependent variable. These values of ICC indicated that applying a hierarchical linear model (as opposed to using, for example, a multiple linear regression at the student level) is warranted (Hayes, 2006).

We then followed the procedure described in the data analysis subsection to achieve the final model. Model trimming removed 51 additional cases (1.38%). The final, trimmed model is presented in Table 1. The right-hand side of Table 1 describes the retained random effects, where blank cells indicate a non-significant (i.e., excluded) random effect. The final model includes a random intercept at the class level only, indicating that the differences in environmental awareness observed between schools can be explained by the existing structure of random and fixed effects. At the class level, there are still inter-class differences in environmental awareness (8.99% variance) which are not explained through the present random and fixed effects structure of the model. In addition to the random intercept at the class level, the model also includes random slopes for three predictors. The predictors with included random slopes for different schools are student-level variables *expected student education level*, *home resources for learning*, and the *usefulness of science lessons*. Random slopes for different classes were included only for the predictor *expected student education level*. In other words, the statistical model takes into account that the slope representing the effect for these variables is different for different schools and/or classes.

3 Additional material is available from the first author of the article.

Table 1: Summary of the effects on environmental awareness in the final hierarchical linear model

	Fixed effects					Random effects	
						By class	By school
Parameters	Estimate	*SE*	95% CI	t	p	SD	SD
(Intercept)	532.02	1.94	[528.21, 535.83]	273.92	<.001	20.93	
Expected student education level	18.71	1.45	[15.87, 21.54]	12.94	<.001	6.25	8.17
Home resources for learning	14.18	1.16	[11.90, 16.46]	12.18	<.001		7.66
Usefulness of Science lessons	16.96	2.02	[12.99, 20.92]	8.39	<.001		9.34
Literacy and numeracy readiness for school	6.48	0.65	[5.20, 7.76]	9.91	<.001		
Students confident in science	6.39	0.65	[5.11, 7.67]	9.80	<.001		
Parents' perceptions of their child's school	-3.13	0.63	[-4.36, -1.90]	-4.98	<.001		

Note. The P-values are calculated using Satterthwaite's method. 95% *CI* were approximated using the Wald method. Empty cells indicate nonsignificant effects which were excluded in the model fitting procedure.

The left-hand side of Table 1 presents the retained fixed effects. The scores on the first plausible value of the EAS can be predicted by six variables which all vary at the level of the individual student: higher scores are related to higher *home resources for learning* (b = 14.18; s.e. = 1.16; p < .01), higher *literacy and numeracy readiness for school* (b = 6.48; s.e. = 0.65; p < .01), higher *expected student education level* (b = 18.71; s.e. = 1.45; p < .01), higher scores on the *student confident in science* (b = 6.39; s.e. = 0.65; p < .01), and higher scores on the *usefulness of science lessons* (b = 16.96; s.e. = 2.02; p < .01). Somewhat lower scores on the EAS are related to higher scores on the *parents' perceptions of their child's school* (b = -3.13; s.e. = 0.63; p < .01).

DISCUSSION

Our study shows that individual student characteristics, rather than (considered) class or school characteristics, presently shape the development of students' environmental awareness. The first significant predictor of students' environmental awareness is home resources for learning. The students whose families provide better learning resources have higher environmental awareness. Thus, the children who come from families with a greater number of books and children's books in the home, as well as access to electronic devices, and whose parents had a higher educational and professional status had a greater chance of developing higher environmental awareness. Such families tend to be more adept at preparing their children for school so that they are able to read, write, and count before starting school. The ability to solve literacy and numeracy tasks when beginning primary school facilitates students' learning and represents the basis for developing scientific literacy, within which environmental literacy is also developed.

The results of our study are in accordance with those of numerous studies on the effects of cultural capital and habitus on children's learning and academic achievements, such as better conditions for learning and the greater engagement of highly educated parents and parents involved in more complex and creative tasks related to their children's education (Jošić, Teodorović, & Jakšić, 2021; Martin, Mullis, & Foy, 2008; Marks & McMillan, 2003; Radulović & Gundogan, 2021; Radulović, Malinić, & Gundogan, 2017). Parents with a higher educational and professional status show greater sensitivity for the education of their children and are more ready and able to support their curiosity, interests, love of books, and acquisition of basic literacy (Džinović, Đerić, & Malinić, 2021; Kohl, Lengua, & McMahon, 2000). All families want the best for their children, although it is known from many studies that social reproduction occurs nevertheless (Ball, Bowe, & Gewirtz, 1995; Crozier, 1997; Erikson & Jonsson, 1998; Jaeger, 2009). Further investigations of the relationship between the level of education and environmental awareness of parents and the development of environmental awareness of their children are needed.

Those students whose parents had higher educational aspirations for their child showed higher environmental awareness. Parental aspirations determine how they will behave in relation to their child's school learning, what they will support, what they will insist on, and how persistent and determined they will be in providing incentives that lead to the desired level of education. In earlier research, it was shown that parental aspirations for their children's educational attainment were related to children's academic performance (Spera, Wentzel, & Matto, 2009). We assume that this concerns the general effect of parents' educational aspirations on the school achievement of students and that environmental knowledge forms part of the knowledge which contributes to students' school achievement. It is precisely the aspirations of parents which can be linked to the effects of parent's perceptions of their child's school on environmental awareness.

Students' confidence in science, which is based on achieved success and the students' beliefs that they can easily and quickly learn science, is an important predictor of environmental awareness. It is reasonable to assume that greater scientific self-confidence among students is the basis for a higher level of environmental awareness. Students who have more self-confidence in science will be motivated to learn more about nature, to invest more effort, and to better organize and remember what they have learned so that this knowledge becomes an integral part of them. In turn, they will act in accordance with such knowledge, which is the ultimate goal of environmental education. Students' scientific self-confidence helps the development of their environmental awareness so that they gain a better understanding of environmental issues and are more prepared to deal with them (Marušić Jablanović & Blagdanić, 2019).

The next predictor of environmental awareness is students' perceptions of the applicability and usefulness of what is learned in science. Students' opinions about the possibility of using knowledge from the field of science in solving everyday life challenges encourage the development of their environmental awareness. Knowledge takes on a personal meaning when students can relate the learning content to their real-life experiences. Environmental awareness develops through experience in contact with nature, through learning about natural phenomena, changes, and dangers. Achieving the goal of environmental education not only comprises acquiring knowledge but also developing a value system in which nature has a key role. Environmental education should focus on developing feelings of belonging to nature, with love and respect for nature as a whole, of which mankind is a part (Stanišić & Marušić Jablanović, 2020).

Parent's perceptions of their child's school appear as a predictor which has a negative relationship with the student's achievement on the environmental awareness scale, which is an unexpected result. The correlation between parental perceptions of a school and their child's achievement on the EAS indicates a complex relationship between these variables. Among the students whose parents perceive the school positively, there are both students who achieve high results and those with low results on the EAS. On the other hand, students whose parents have a very negative perception of what the school offers their child do not form part of the group with the lowest scores on the EAS. It could be said that a number of parents with negative perceptions of the school have relatively successful children in terms of EAS and that this is the reason for the negative correlation between these two variables. It is known that schools are more focused on unsuccessful students, so support and more frequent contact with their parents could be a consequence of that (Milošević, 2002).

The finding on the connection between the students' environmental awareness and their parents' attitudes towards the school differs from the results of earlier studies, which indicate a positive relationship between parental attitudes and students' school achievement (Phillipson & Phillipson, 2012; Slijepčević, Zuković, & Kopunović, 2017; Yamamoto & Holloway, 2010). It is necessary to find ways to improve the school's collaboration with the students' parents so that parents begin to perceive the school environment as an important place where their children's environmental awareness develops. Before that, it should be ensured that the parents value pro-environmental behavior and realize how important the development of environmental awareness among young people is for survival on a global level. Broader actions are needed to raise the environmental awareness of citizens so that the world can survive in its diversity and interdependence. These relationships would certainly need to be examined in future research.

A large number of teacher and school characteristics examined in our study did not prove to be significant predictors of students' environmental awareness. There was only one exception related to the environmental awareness of students from different school classes. It remains unknown why students in certain classes differ from those in others. These differences can be assumed to be the consequence of the specific experiences of students in a particular class due to the quality of the teacher's work. The teacher could have been doing something that the questions did not take into account, which led to specific experiences and created differences between classes. For example, the students of one class were able to participate in some environmental events and activities (such as festivals and competitions), programs, and projects as a group, thanks to the enthusiasm and special involvement of their teachers, parents, and many others from the local community.

It is not surprising that all school- and class-level variables were not significant for predicting student achievement on the EAS, considering previous studies on the predictive power of contextual variables for students' achievement in tests. Similar findings were reported in a study investigating the connection between student achievement in a science test and the characteristics of teaching and learning, where it was determined that higher-level variables were not so useful in explaining the patterns in the results (Jošić, Teodorović, & Jakšić, 2021; Teodorović *et al.*, 2021).

Knowing that the school- and class-level variables did not make a significant contribution to the development of the students' environmental awareness raises the question of whether and to what extent students' environmental awareness develops at school. We hope that some general conclusions can be drawn about conditions for the development of environmental awareness at school.

The educational implications of the study results regarding the predictors of elementary school students' environmental awareness indicate the need to promote students' self-confidence in the domain of science and to develop beliefs about the usefulness of science classes. Students' self-confidence could be stimulated by creating learning opportunities in which they feel competent when the syllabus seems manageable to them. What happens in school empowers them to persevere in learning, thus directing them towards further learning. Teaching should encourage the creativity of students and teachers, bearing in mind that humanity does not know which environmental problems it will face in the future, much less how they can be solved. It is necessary to educate people who will think in a flexible way, individuals who are effective in communicating with others, as well as individuals who are able to see problems from multiple perspectives (Stanišić, 2015).

Contemporary living conditions require the development of critical and divergent thinking, which implies changing teaching and learning methods (Maksić, 2021). Students are more interested in learning if they are active in class, when the learning content is close to their own experience, when they see the topics they learn about in class as being relevant to their everyday lives, and when they can express their opinions (Stanišić, 2015). The application of an integrative and interdisciplinary approach which enables students to research and analyze, discuss problems, and observe certain issues from different perspectives, is very fruitful for students' environmental awareness. Teachers have to practice effective pedagogy which is focused on developing higher-order thinking and metacognition, using dialogue and questioning (Handrianto *et al.*, 2021).

In addition, classroom activities have limited capacity to support the development of environmental awareness because they are mostly associated with improving environmental knowledge (Duerden & Witt, 2010). Experiences gained in nature influence the development of pro-environmental attitudes, which encourage students' pro-environmental behavior (Skelly & Zajicek, 1998). For this reason, it is essential to highlight the necessity of teaching outside, where students will be in direct contact with nature. The organization of outdoor activities is very demanding, requiring different and flexible organization by the school. However, it is the way in which the school can contribute to the development of environmental awareness among young people.

The main contribution of this study is the construction of a predictor model of environmental awareness among primary school students that shows the dominant participation of early learning (home resources for learning and literacy and numeracy readiness for school) in the development of environmental awareness. The obtained findings are in accordance with the findings of previous research, leaving the question of how to increase the school's contribution to the development of environmental awareness remaining pertinent. The role of parents' cooperation with the school, which could be more complex than a linear relationship, requires special attention in future studies. Even more intriguing are the class-level effects. Further analyses could reveal specific aspects of the class structure and microclimate, and teaching perspectives that stimulate the development of students' environmental awareness. As the model of predictors of environmental awareness was developed according to data collected in a wider international examination, it could be further tested through comparative studies of different environments.

Further research is needed on the contribution of the educational setting to the development of students' environmental awareness. It should be borne in mind that although the predictors of students' environmental awareness included in our study were numerous, there are still many others to explore. For a more complete understanding of the development of environmental awareness among young people, research is needed which would take into account the predictive capacities of factors such as peer groups and "significant others" (idols, YouTubers, influencers, etc.), as well as media effects. Schools seem to be losing the battle to influence, primarily because of their rigid structure and slowness in following all rapid societal changes. In order to alleviate such limitations, schools should cooperate with institutions of informal education and recognize other social institutions and organizations as partners in achieving the goals of environmental education.

CONCLUSION

Based on this investigation of environmental awareness, we can conclude that for the development of the environmental awareness of students who are at the end of the first cycle of basic education, their individual characteristics are the most significant. This study confirms the contribution of early learning to the development of students' environmental awareness and shows that further research is needed on the characteristics of the educational setting that would make the school a significant factor in the development of environmental awareness among young people. Taking into account that this concerns data obtained in an international survey, it would be useful to research and compare data for students from different countries and entities. If the data from another country were to show the greater predictability of school and classroom characteristics, an analysis of the education system of that country could provide the answer to the question of what kind of school and school setting would serve to promote environmental awareness to a greater extent.

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APPENDIX 1

Appendix 1: Ecological awareness predictors

Student-level variables		
Variable code	**Variable name**	**Additional information**
ASBG01	Sex of student	categorical predictor
ASBGHRL	Home resources for learning	https://timss2019.org/reports/home-resources-for-learning-4/
ASBGSSB	Students Sense of School Belonging/SCL	as reported by the student https://timss2019.org/reports/students-sense-of-school-belonging/
ASBGSB	Student Bullying/SCL	as reported by the student https://timss2019.org/reports/student-bullying/
ASBS06	SCI\HOW OFTEN CONDUCT EXPERIMENTS	the frequency of scientific experiments in sciences conducted by the teacher, as reported by the student
ASBGSLS	Students Like Learning Science/SCL	as reported by the student https://timss2019.org/reports/students-like-learning-mathematics-and-science/
ASBGICS	Instructional Clarity in Science Lessons/SCL	as reported by the student, rating the teacher https://timss2019.org/reports/instructional-clarity-in-science-lessons/
ASBGSCS	Students Confident in Science/SCL	as reported by the student https://timss2019.org/reports/students-confident-in-mathematics-and-science/
ASXMA11mean	Science lessons usefulness	calculated as the average of three variables administered on the national level (ASXMA11A-ASXMA11C) pertaining to the importance, applicability and usefulness of what is learned in science classes, as reported by the student
ASBHELN	Early Literacy and Numeracy Activities Before School/SCL	as reported by the parent https://timss2019.org/reports/literacy-and-numeracy-activities-before-primary-school/

ASBH04B	preschool program length in years	regardless of program type; parent report
ASBHLNT	Literacy and numeracy readiness for school /SCL	as reported by the parent https://timss2019.org/reports/could-do-literacy-and-numeracy-tasks-when-beginning-primary-school/
ASBHPSP	Parents Perceptions of Their Child School/SCL	parent estimate https://timss2019.org/reports/parents-perceptions-of-the-school/
ASBH16	expected student education level	as expected by the parent
	Class/Teacher – level variables	
ATBG01	Years been teaching	
ATBG02	Sex of teacher	categorical predictor
ATBG04	Education level	Derived as a categorical predictor from variable ATBG04 1, 2, 3, 4 = no university-level education 5, 6 = university-level and higher
ATBGEAS	School Emphasis on Academic Success-Teacher/SCL	as reported by the teacher https://timss2019.org/reports/school-emphasis-on-academic-success/
ATBGSOS	Safe and Orderly Schools-Teacher/SCL	as reported by the teacher https://timss2019.org/reports/safe-and-orderly-school/
ATBGTJS	Teachers Job Satisfaction/SCL	as reported by the teacher https://timss2019.org/reports/teachers-job-satisfaction/
ATBGLSN	Teaching Limited by Student not Ready/SCL	as reported by the teacher https://timss2019.org/reports/classroom-teaching-limited-by-students-not-ready-for-instruction/
ATBS02mean	teacher supports students' active engagement	calculated as the mean of variables ATBS02A-M
ATBS03A	Computer tablet availability	categorical predictor
ATDSLIF	Pct Students Taught Life Science Topics	as reported by the teacher https://timss2019.org/reports/students-taught-timss-science-topics/

ATDSEAR	Pct Students Taught Earth Science Topics	as reported by the teacher https://timss2019.org/reports/students-taught-timss-science-topics/
ATBS05A	HOW OFTEN SCIENCE HOMEWORK ASSIGNED	categorical predictor
ATBS06A-E	Importance of assessment strategies	all included separately in the models
ATBS08Asum	Prof development past	sum of "yes" answers to variables ATBS08AA-AH
	School-level variables	
ACBG05A	How many people live in area	
ACBG07	Total number of computers	as reported by the principal
ACBG08A	Existing science laboratory	as reported by the principal; categorical predictor
ACBG08B	Assistance available	as reported by the principal; categorical predictor
ACBG09	Online learning management system	as reported by the principal; categorical predictor
ACBG10A ACBG10B	Existence and size of school library	categorical predictor derived from AC-BG10A and ACBG10B; one group are schools with 2,000 books or fewer (or no library) and second group are schools with more than 2,000 boks
ACBG12	Access to digital learning resources	categorical predictor
ACBGSRS	Instruction Affected by Science Resource Shortage/SCL	as reported by the principal https://timss2019.org/reports/science-resource-shortages/
ACBGEAS	School Emphasis on Academic Success-Principal/SCL	as reported by the principal https://timss2019.org/reports/school-emphasis-on-academic-success/
ACBGDAS	School Discipline-Principal/SCL	as reported by the principal https://timss2019.org/reports/school-discipline/
ACBGLNS	Students Enter with Litteracy and Numeracy Skills/SCL	as reported by the principal https://timss2019.org/reports/students-enter-primary-school-with-literacy-and-numeracy-skills/