IMPACT OF SHORT-TERM EDUCATIONAL ACTIVITIES ON PUPILS' ATTITUDES TOWARDS WASTE IN DISTANCE EDUCATION

[a]IVAN IĽKO, [b]VIERA PETERKOVÁ, [c]ROMANA MARTINCOVÁ, [d]KARIN PREINEROVÁ

[a,b] Department of Biology, Trnava University in Trnava, Priemyselná 4, Trnava 918 43, Slovakia.
[b] Department of Educational Studies, Trnava University in Trnava, Priemyselná 4, Trnava 918 43, Slovakia.
[c] Department of Inorganic Chemistry, Slovak University of Technology, Radlinského 9, 812 37 Bratislava, Slovakia.

email: [a]ivan.ilko@truni.sk; [b]viera.peterkova@truni.sk; [c]romana.martincova@truni.sk; [d]karin.preinerova@stuba.sk.

The study was supported by the Trnava University grant No. 5/TU/2021.

Abstract: The aim of the work was to apply short-term educational activities to primary school pupils and to find out their influence on pupils' attitudes, compared to the traditional way of teaching. We observed differences between the cumulative mean scores of girls (x = 2,1) and boys (x = 2,4). We showed no difference in the cumulative mean scores of 7th and 8th graders. The pre-test data were at the level of statistical significance (p = 0,0521), with the experimental group (E) performing worse on mean score (x = 2,61) than the control group (K) (x = 2,31). The values correlated with the end-of-year grade in the biology and chemistry subjects. A paired t test revealed a statistically significant difference in the experimental group between the cumulative means of the pre-test and post-test (p = 0,0419) and the pre-test and retention test (p = 0,0354). A statistically significant difference was also observed in the individual dimensions (separation, recycling and production). In the control group, there was no statistically significant difference between the individual tests and dimensions. We have demonstrated the effective use of inquiry-based learning during the Covid-19 pandemic.

Keywords: inquiry-based learning, waste, environmental education, primary school, Covid-19

1 Introduction

The constructivist model or approach in teaching is based on the creation or construction of knowledge and one's own reality by students. Situations induced during the classroom activate pupils, continuously requiring them to engage in activities and problem solving (Tomengová, 2012). Svobodova (2013) states that pupils find science subjects unpopular and uninteresting. These findings may be related to the heavy emphasis on rote memorization in contemporary schooling. It further states that pupils possess knowledge but cannot apply it in practice. To motivate pupils, to apply knowledge in practice and to acquire competencies, changing the role of the pupil to that of a scientist may be helpful. The shift from traditional deductive to inductive-exploratory teaching requires pupils to take initiative in measuring, experimenting, observing, analysing, hypothesising, modelling and verifying. Such an oriented teaching promotes motivation, self-confidence and collegiality (Holec et al., 2010). The application of inquiry-oriented teaching requires a change in the mindset of both the students and the teacher (Stuchlíková, 2010). According to the Centre for Inquiry-based Learning, inquiry-oriented teaching is a multifaceted approach in teaching, for the acquisition of knowledge, skills and competencies. Furthermore, it is a tool for students' active work in the classroom, a tool for defining and solving problems, and a simulation of scientific and research work (Dyasi, 2000). The process of research requires the involvement of all the senses, at the same time, its essential part is the search for information, interpretation and analysis of data (Janoušková et al., 2008). Wenning (2005) developed a table that includes the exploratory level of the pupil and the intellectual difficulty of the tasks. According to Eastwell (2009), there are different ways of exploration: confirmatory, structured, directed and open-ended exploration. In our work, we used confirmatory and structured exploration. Vybiralova et al. (2005) define waste as an unnecessary product or substances that we do not want or for certain reasons cannot be used anymore. Waste threatens all biotic and abiotic components of the environment (e.g. water, soil or air) (Chmielewská et al., 2011). According to Bočková (2004), the first step in solving the waste problem is to prevent its generation. Next comes reuse, recycling and composting, incineration (i.e. its energy recovery) and lastly landfilling. According to Milova et al. (2011), despite the replacement of the subject curriculum of environmental education by its cross-cutting theme, the application of this cross-cutting theme is insufficient. Chmielewska et al. (2011) state that increasing the interest of pupils and teachers in environmental education by alternating organizational forms and methods in the classroom can contribute to improving this situation. Also Šimonovičová et al. (2011) cite teacher preparation as one of the important tasks in environmental education. Eliašová and Eliáš (2009) consider environmental education in primary schools in Slovakia to be the least satisfactory. These authors further state that traditional verbal knowledge acquisition prevails over creative knowledge acquisition in primary schools. The aim of our research was to apply an inquiry-based model of teaching in the cross-curricular topic of environmental education for 7th and 8th grade primary schools and to find out its impact on all components of pupils' attitudes in comparison with the traditional way of teaching. Another aim was to test the effect of short-term educational activities on attitudes of primary school students and to determine the difference between grades and gender, and to validate the inquiry-based model of teaching during the Covid-19 pandemic in distance education. The aim of the research was to determine the difference in scores obtained between the experimental and control groups and to compare different teaching methods in practice.

1.1 Methods

The pedagogical experiment took place at the BESST Primary School, Limbová 3, 917 02 Trnava. Before the experiment we prepared a model of an inquiry-oriented lesson and a model of a traditional lesson. Both of these models are based on one of the most well-known environmental problems of today, the topic of waste. We implemented both lesson models in 8th and 7th grade of primary school. We selected four classes of 7th and 8th grade. There were 121 respondents, pupils, represented in the research, due to the non-participation of pupils throughout the research, some respondents were excluded. We evaluated data from 45 respondents, 22 of whom were girls and 23 of whom were boys. There were 21 pupils in the experimental group with a representation of 12 boys and 9 girls. The control group consisted of 24 pupils with a representation of 11 boys and 13 girls (Table 1).

Table 1. Characteristics of the research sample.

group	total number	gender		year in school	
		girls	boys	7	8
experimental	21	9	12	8	13
control	24	11	13	12	8
use respondents	45	22	23		
respondents contacted	121				

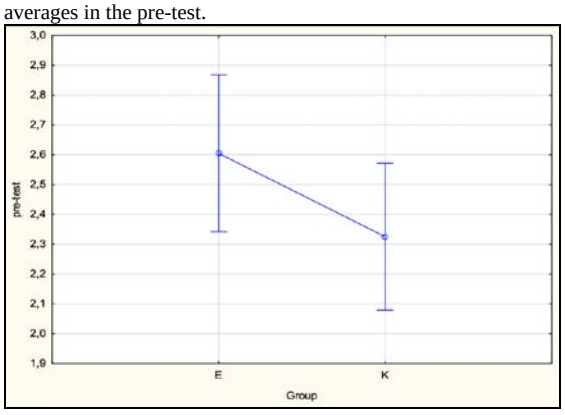
According to Bartlett et al. (2001), a sufficient number of respondents to determine differences is 118. Salkind (1997), states that respondent losses during research can account for 40-90% of the original size, so it is important to increase the research sample. Both groups followed the same procedure in the SPP. The students of both groups were used to the traditional way of teaching with the use of explanation, innovative methods in teaching and the use of information and communication technology during the lessons. Their motivation to think for themselves was positive, dominated by logical reasoning. Due to the small number of respondents, it is not possible to generalize the data obtained to the whole population. Our research is of a recommendatory nature; the issues outlined and their implementation in practice require further experimental scrutiny. In the experimental group, we implemented teaching through an inquiry-oriented model of the lesson while in the control group,

traditional teaching was carried out using the teaching method of interpretation. The teaching was conducted during one week in all the classes based on the timetable of each class. To test the effectiveness of inquiry-based teaching in the process of primary school education, we used a questionnaire that was made available to the pupils before the experiment in the form of a pre-test, after the experiment in the form of a post-test and one month after the experiment in the form of a retention test. The questionnaires were completed anonymously by the pupils under a code number provided by the school. The numerical code was verified by the teacher, a member of staff at the school where the experiment was conducted. The teacher ensured that the same code for the pre-test, post-test and retention test was always given to the same pupil. The list of codes and names was destroyed after the experiment. The questionnaire consisted of 32 Likert scale questions, with choices (strongly agree, agree, have no strong opinion, disagree, strongly disagree). The research instrument contained cognitive (questions 2, 3, 4, 7, 10, 11, 12, 25, 30 and 32), affective (questions 5, 8, 9, 13, 15, 19, 22, 23, 26, 28 and 31) and conative attitude components (questions 1, 6, 14, 16, 17, 18, 20, 21, 24, 27 and 29). After the experimental part of the research, we focused on students' evaluation of inquiry-oriented and traditional teaching. We administered attitudinal questionnaires to both experimental and control group pupils. Out of 45 respondents, 35 reported that their school also implements similar activities, while 10 respondents reported that they do not implement similar activities at school or are not aware of it. We based the evaluation of the instrument on the scale levels (1- very significant, 2-significant, 3-somewhat significant, 4-significant, 5-significant not at all significant).

1.2 Results

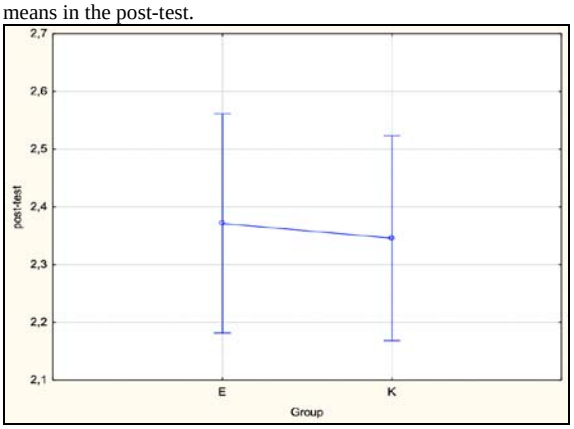
The measured data were subjected to statistical analysis using Statistika 12 and Microsoft Excel Version 16.49/2021. The students' ratings of the individual lesson models reached the mean (x= 2,5) in the control group and the mean (x= 2,1) in the experimental group. This shows that the experimental group evaluated the teaching process more positively than the control group. We conducted a normality test using the Shapiro-Wilk test. Further, we compared the mean scores of the answers obtained in the pretest, posttest, and retention test, between the experimental and control groups. The dependent variable was the test scores obtained. The cumulative mean score of girls was higher (x= 2,1), compared to the cumulative mean score of boys (x= 2,4). There was no difference in the cumulative mean scores of 7th and 8th graders. The pre-test data were compared at the level of statistical significance (p= 0,0521), with the experimental group (E) performing worse on the mean score (x= 2,61) than the control group (K) (x= 2,31) (Figure 1).

Figure 1. Comparison of experimental (E) and control (K) group averages in the pre-test.



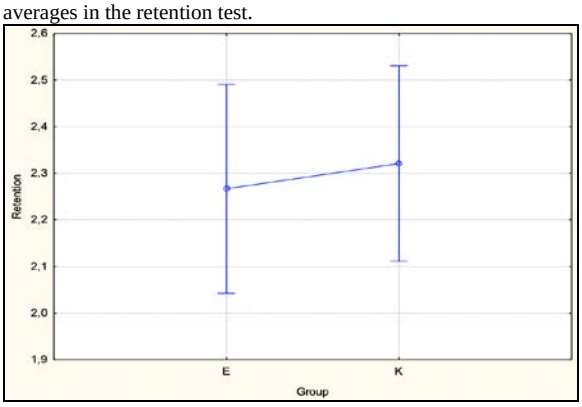
These values correlate with the end-of-year grades in biology and chemistry, with the experimental group's mean grade in biology and chemistry being (x= 1,23) and (x= 1,41), respectively. The control group's mean grade in the subject biology was (x= 1,09) and in the subject chemistry was (x= 1,08). The post-test data were not at the level of statistical significance (p= 0,8437), with the experimental group achieving comparable mean cumulative scores (x= 2,37) to the control group (x= 2,35) (Figure 2).

Figure 2. Comparison of experimental (E) and control (K) group means in the post-test.



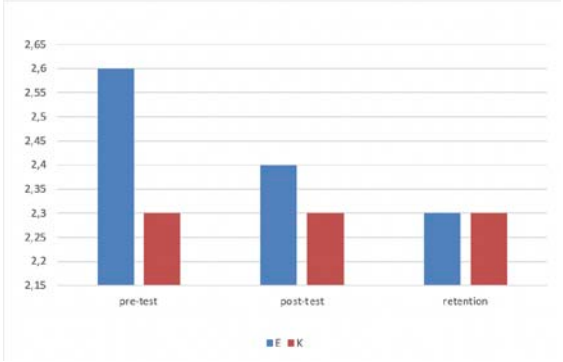
The retention test data were not at the level of statistical significance (p= 0,7235), with the experimental group achieving comparable mean cumulative scores (x= 2,31) to the control group (x= 2,25) (Figure 3).

Figure 3. Comparison of experimental (E) and control (K) group averages in the retention test.



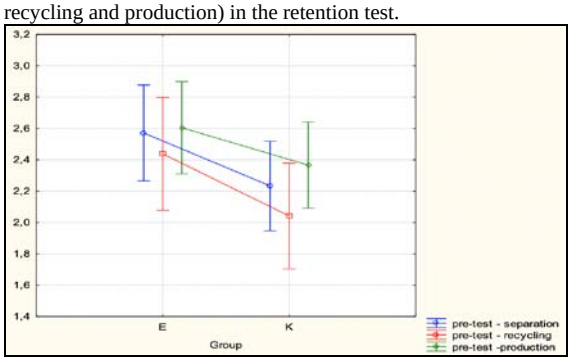
In Figure 4, we present a comparison of the cumulative scores between the experimental and control groups.

Figure 4. Comparison of cumulative mean scores between experimental (E) and control (K) group.



We used measurement tools to identify students' attitudes along three dimensions (separation, recycling and production) (Figure 5).

Figure 5. Students' attitudes in the three dimensions (separation, recycling and production) in the retention test.



The pre-test data between the experimental and control groups were not statistically significantly different (Table 2).

Table 2. Students' attitudes in the three dimensions (separation, recycling and production) in the post-test.

separation	recyclation	production
p= 0,1107	p= 0,1121	p= 0,2406
F= 2,6523	F= 2,6309	F= 1,4158

We implemented the same procedure in the post-test (Figure 6). The post-test data were not statistically significantly different either (Table 3).

Figure 6. Students' attitudes in the three dimensions (separation, recycling and production) in the post-test.

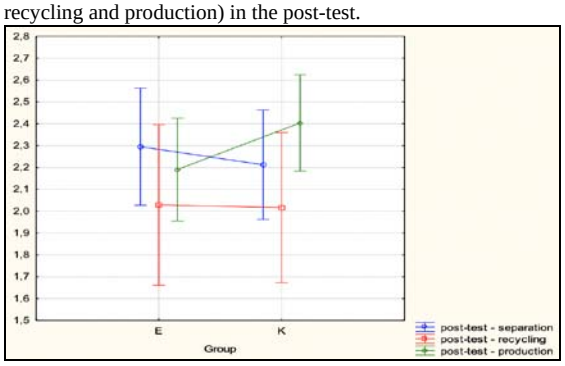


Table 3. Students' attitudes in the three dimensions (separation, recycling and production) in the post-test.

separation	recycling	production
p= 0,6517	p= 0,9621	p= 0,1883
F= 0,2066	F= 0,0023	F= 1,7868

We implemented the same procedure for the retention test (Figure 7). We did not find a statistically significant difference in the retention test either (Table 4).

Figure 7. Students‘ attitudes in the three dimensions (separation, recycling and production) in the retention test.

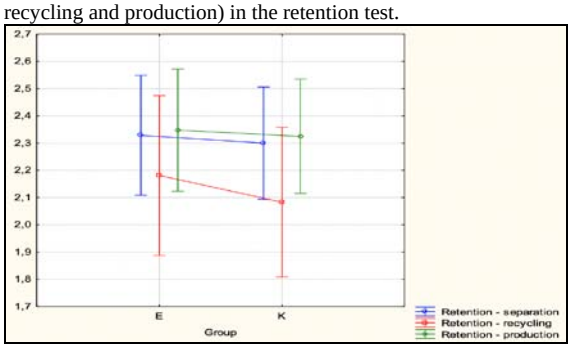


Table 4. Students‘ attitudes in the three dimensions (separation, recycling and production) in the retention test.

separation	recycling	production
p= 0,8491	p= 0,6265	p= 0,8825
F= 0,0366	F= 0,2402	F= 0,022

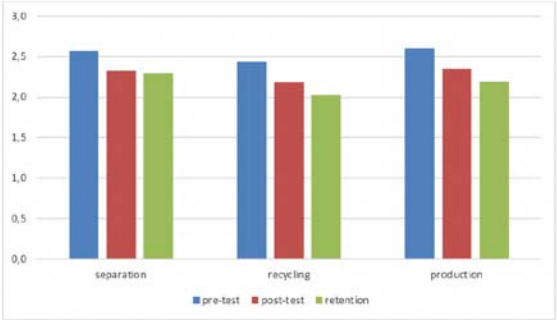
The obtained data were further processed by a paired sample t-test to verify the effectiveness of the implemented activities, comparing the cumulative means between the tests and dimensions (Table 5).

Table 5. Paired t-test comparison.

Experimental group	p- value
pre-test vs. post-test	0,041959
pre-test vs. retention	0,035426
post-test vs. retention	0,941554
pre-test - separation vs. post-test - separation	0,034063
pre-test - recycling vs. post-test - recycling	0,057116
pre-test - production vs. post-test - production	0,054638
post-test - separation vs. retention - separation	0,587338
post-test - recycling vs. retention - recycling	0,453705
post-test - production vs. retention - production	0,375093
Control group	
pre-test vs. post-test	0,979690
pre-test vs. retention	0,095448
post-test vs. retention	0,100461
pre-test - separation vs. post-test - separation	0,392797
pre-test - recycling vs. post-test - recycling	0,323256
pre-test - production vs. post-test - production	0,799532
post-test - separation vs. retention - separation	0,152678
post-test - recycling vs. retention - recycling	0,193700
post-test - production vs. retention - production	0,266877

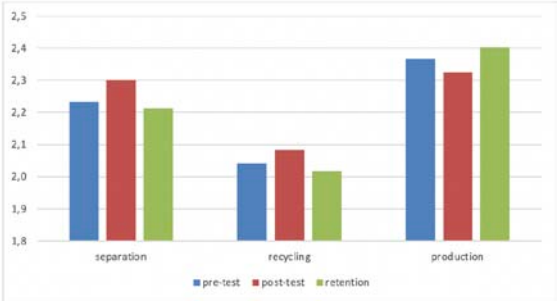
There was a statistically significant difference in the experimental group between the cumulative means of the pre-test and post-test (p= 0,0419) and the pre-test and retention test (p= 0,0354). There was no statistically significant difference between the cumulative means of the post-test and retention test (p= 0,9415). A statistically significant difference was also observed in the individual dimensions. There was a significant difference between pre-test and post-test in the separation dimension (p= 0,0340), pre-test and post-test in the recycling dimension (p= 0,0571) and pre-test and post-test in the production dimension (p= 0,0546) (Figure 8).

Figure 8. Comparison of mean scores of the observed dimensions in the experimental group.



In the control group, there was no statistically significant difference between the tests and dimensions (Figure 9).

Figure 9. Comparison of mean scores of the observed dimensions in the control group.



2 Discussion

In this study, we found a positive effect of a 1-day learning activity on cognitive, affective, and conative components of attitudes in 7th and 8th grade students. Our data correlate with the teaching method in the experimental group. The pre-test data between the experimental and control groups were at the level of statistical significance (p = 0.0521), with the experimental group (E) scoring worse on average (x = 2.61) than the control group (K) (x = 2.31). These values correlated with the end-of-year grades in biology and chemistry, with the experimental group's mean grade in biology and chemistry being (x = 1.23) and (x = 1.41), respectively. The control group's mean grade in the subject biology was (x = 1.09) and in the subject chemistry was (x = 1.08). The post-test data were not at the level of statistical significance (p = 0.8437) between the experimental and control groups, with the experimental group achieving comparable mean cumulative scores (x = 2.37) to the control group (x = 2.35). The retention test data between the experimental and control groups were not at the level of statistical significance (p = 0.7235), the experimental group achieved comparable mean cumulative scores (x = 2.31), as the control group (x = 2.25). The data obtained were further processed by a paired sample t-test, and we observed a statistically significant difference in the experimental group between the cumulative means of the pre-test and post-test (p = 0.0419) and the pre-test and retention test (p = 0.0354). There was no statistically significant difference between the cumulative means of the post-test and retention test (p = 0.9415). A statistically significant difference was also observed in the individual dimensions. There was a significant difference between the pre-test and post-test in the separation dimension (p = 0.0340), the pre-test and post-test in the recycling dimension (p = 0.0571), and the pre-test and post-test in the production dimension (p = 0.0546). In the control group, there was no statistically significant difference between the tests and dimensions. Based on the data obtained, we conclude that the significant improvement in scores in the experimental group between the pre-test and post-test indicates an improvement in attitudes and a positive effect of the validated teaching method in the experimental group. The positive impact of inquiry-based teaching with a scaled questionnaire was also demonstrated by Sotáková (2018), who found an increase in the cognitive and conative components of attitudes in students at both levels of primary school. The positive impact of short-term teaching was also confirmed by Kvasničák et al. (2013) who found a positive impact of a 5-day short-term course on pupils' knowledge, Easton and Gilburn (2012) who found a positive impact of a 10-day course on pupils' knowledge and attitudes, and Knox et al. (2003) who found a positive effect of a 14-day course on pupils' knowledge and attitudes. From the measured data, we further note the durability of the changes in the attitudes of the pupils in the experimental group, as indicated by the retention test data obtained with a time lag of 1 month after the post-test. We did not observe a statistically significant difference between the post-test and the retention test in the experimental group. Similar conclusions were reached by Kvasničák et al. (2013), Kvasničák et al. (2005) and Prokop (2007). We found a more positive evaluation of the teaching method in the experimental group by means of an evaluation questionnaire. The cumulative mean was higher in the control group (x = 2.5) than in the experimental group (x = 2.1). Many authors have addressed the evaluation of the teaching process by pupils through questionnaire (Schreiner & Sjoberg, 2007; Ambusaidi & Beggs, 2006; Awan et al. 2011). Sotáková (2018) evaluated structured interviews with teachers and pupils after completing an inquiry-oriented lesson. Her results show an increase in teachers' and pupils' positive attitudes towards inquiry-oriented teaching. Karolčík (2020) evaluated pupils' perceptions of inquiry-oriented teaching in geography teaching, and the results show positive perceptions of the reported method in primary schools, especially in the areas of cooperation among classmates and pupils' individuality. The positive impact of pupils' active work, linking theory with practice and the importance of informal teaching was also confirmed by Prokop (2007). When analysing the impact of short-term exploratory activity of pupils compared to the traditional model of teaching, we found that the cumulative mean score of girls was higher (x = 2.1), compared to the cumulative mean score of boys (x = 2.4). Zeidan (2010) and Jones et al. (2000), find that girls have higher preferences for the subject of biology compared to boys, which may be related to the values we measured. They further note that girls tend to be more inclined towards biology and humanities subjects and boys with a technical subject. We showed no difference in the cumulative mean scores of 7th and 8th graders. Cheung (2009), Mandíková (2009), Kaya and Böyük (2011), and Barnes et al. (2005) reached similar conclusions when examining students' attitudes. (2005). Galková and Kotuľáková (2019), in their research involving Year 7 pupils (24 in the experimental group and 24 in the control group), demonstrated the positive impact of inquiry-oriented teaching on science literacy. The results showed an improvement in science process skills among low-performing students in the experimental group, which is consistent with our results. Further, Sandika and Fitrihidajati (2018) addressed the enhancement of skills and scientific approach through inquiry-oriented teaching in primary schools. The result of the research showed an increase in students' positive attitudes and improvement in students' scientific skills in the subject of biology. It can also be concluded that the research conducted demonstrated the effective use of inquiry-oriented teaching during the Covid-19 pandemic, with the lesson model used in the experimental group positively impacting all three components of students' attitudes despite distance learning. Our findings are supported by the work of Kurniawan et al. (2021). Appropriately chosen teaching methods in schools that are prepared for distance education can effectively influence pupils' attitudes during a pandemic.

3 Conclusion

The present work highlights the impact of short-term educational activities focused on waste on the knowledge and attitudes of primary school pupils. Our conclusions are in line with those of the above mentioned works. The main problems we see in the implementation of waste issues in education, within the cross-cutting theme of environmental education, include:

(1) The use of outdated teaching methods in biology classes, the passive reception of information by students, without the possibility of involvement.
(2) Focusing on the cognitive component of students' attitudes, preferably in the area of knowledge of the correct way to sort waste. Absence of waste prevention activities.
(3) Creating misconceptions about how to tackle the increasing amount of waste by sorting it correctly. Lack of depth on the topic in the educational programme and linking theory to practice.

The use of inquiry-based learning is seen as a promising framework for providing active engagement of primary school students in Years 7 and 8 on the topic of waste. At the same time, we consider the validated teaching method to be an effective tool to activate students during the Covid-19 pandemic, and the lesson model used in the experimental group positively influenced all three components of students' attitudes despite distance learning. Appropriately chosen teaching methods in schools, in conjunction with information and communication

technologies, can effectively influence students' attitudes towards waste, during a pandemic.

Literature:

1. Awan, R. U. N., Sarwar, M., Naz, A., & Noreen, G.: Attitudes toward science among school students of different nations: a review study. *Journal of College Teaching & Learning*, 2011, *8*(2), 43-50. https://doi.org/10.19030/tlc.v8i2.3555
2. Barnes, G., Mcinerney, D. M., & Marsh, H. W.: Exploring sex differences in science enrolment intentions: an application of the general model of academic choice. *Australian Educational Researcher, 2005, 32*(2), 1-23. https://doi.org/10.1007/BF03216817
3. Bartlett J. E., Kotrlik J. W., & Higgins C. C.: Organizational research: determining appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal, 2001, 19*(1), 43-50.
4. Bočková, V.: Slovenská agentúra životného prostredia. Hierarchia odpadového hospodárstva [online]. 2004. http://enviroportal.sk/environmentalne-temy/odpady
5. Cheung, A.: Studies' attitudes toward chemistry lessons: The interaction effect between grade level and gender. *Research in Science Education, 2009*, 39(1), 75-91. https://doi.org/10.1007/s11165-007-9075-4
6. Chmielewská, E., Reháčková, T., Fendek, M., Fedor, P., & Bedrna, Z.: *Ochrana a využívanie prírodných zdrojov*. Epos. 2011.
7. Dyasi, H.: What Children Gain by Learning Through Inquiry [online]. *Inquiry. Thoughts, Views, and Strategies for the K-5 Classroom. National Science Foundation, 2000*, 9-14. https://www.nsf.gov/pubs/2000/nsf99148/pdf/nsf99148.pdf.
8. Easton, E., & Gilburn, A.: The field course effect: gains in cognitive learning in undergraduate biology students following a field course. *Journal of Biological Education, 2012, 46*(1), 29–35. https://doi.org/10.1080/00219266.2011.568063
9. Eastwell, P.: Inquiry learning: Elements of confusion and frustration. *The American biology teacher, 2009, 71*(5), 263–266. https://doi.org/10.2307/27669426
10. Eliášová, M., & Eliáš, P.: Environmentálna výchova na základných školách. *Životné prostredie, 2009, 3*, 107. ISSN 0044-4863.
11. Galková, H., & Kotuľáková, K.: Rozvíjanie prírodovednej gramotnosti žiakov v tematickom celku Premeny látok s využitím IBSE. *Biológia, Ekológia, Chémia, 2019, 23*(1), 23-30.
12. Holec, S., Kmeťová J., Spodniaková Pfefferová, M., Raganová, J., & Hruška, M.: Testovanie prírodovednej gramotnosti PISA 2006. *Rozvoj funkčnej gramotnosti v kontexte medzinárodných porovnávacích štúdií PISA a PIRLS, 2010*, 1-11. http://www.kee.fpv.ukf.sk/NarodnaKonferenciaEVVO/EVVO_2018_zbornik.pdf
13. Janoušková, S., Novák, J. & Maršák, J.: Trendy ve výuce přírodovědnych oborů z evropského pohledu. *Acta Facultatis Paedagogicae Universitatis Tyrnaviensis, 2008, 12*(2), 129–132.
14. Jones, M. G., Howe, A., & Rua, M. J.: Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education, 2000, 84*(2), 180-192. https://doi.org/10.1002/(SICI)1098-237X(200003)84:2<180::AID-SCE3>3.0.CO;2-X
15. Karolčík, Š.: Bádateľsky orientované projekty vo vyučovaní geografie. *Geografia, 2020*, 28(1).
16. Kaya, H., & Böyük, U.: Attitude towards physics lessons and physical experiments of the high school students. *European Journal of Physics Education, 2011*, 2(1), 38-49.
17. Kurniawan, R. P., Damopolii, I., & Sirait, S. H. K.: The Correlation Between Biology Teacher Learning Strategies During The Covid-19 Pandemic on Student Motivation. 2021-299-305 p.
18. Kvasničák, R., Prokop, P., & Pištová, Z.: Vplyv krátkodobého neformálneho vyučovania na vedomosti a predstavy žiakov z ekológie. *e-Pedagógium, 2005*, *5*(4), 28-39.
19. Kvasničák, R., Prokop, P., & Pištová, Z.: Krátkodobý vplyv skúsenostného vyučovania v teréne na vedomosti žiakov o ekosystéme. *Pedagogika, 2013, 63*(2), 198- 219.
20. Mandíková, D.: Postoje žáků k přírodním vědám – výsledky výzkumu PISA 2006. *Pedagogika, 2009, 59*(4), 380-395.
21. Milová, S., Medal, R., & Klocovková, J.: Environmentálna výchova a vzdelávanie detí a mládeže – aktuálna situácia na Slovensku [online]. 2011. http://www.iuventa.sk/sk/Vyskum-mladeze/Vyskumy-katalog-dat/2012/Environmentalna-vychova-a-vzdelavanie-deti-a-mladeze-aktualna-situacia-na-Slovensku.alej
22. Murphy, C., Ambusaidi, A., & Beggs, J.: Middle East meets West: vomparing children's attitudes to school science. *International Journal of Science Education, 2006, 28*(4), 405-422. https://doi.org/10.1080/09500690500339696
23. Prokop, P.: Neformálne prírodovedné vzdelávanie. *Acta Facultatis Paedagogicae Universitatis Tyrnaviensis. 2007*. Trnava: Trnavská univerzita.
24. Salkind, N. J.: *Exploring research* (3rd ed.). 1997. Upper Saddle River, NJ: Prentice Hall.
25. Sandika, B., & Fitrihidajati, H.: Improving creative thinking skills and scientific attitude through inquiry-based learning in basic biology lecture toward student of biology education. *Jurnal Pendidikan Biologi Indonesia, 2018, 4*(1), 23-28. https://doi.org/10.22219/jpbi.v4i1.5326
26. Scheerens, J.: The school-level context of instructional effectiveness: accom- parison between school effectiveness and restructuring models. *Tijdschrift voor onderwijsresearch, 1994, 19*(1), 26-38.
27. Sotáková, I.: *Účinnosť bádateľsky orientovanej výučby v téme Chemický dej na základných školách a gymnáziách* [doctoral dissertation]. 2018. Charles University.
28. Stuchlíková, I.: O badatelsky orientovaném vyučováni. 2010. In M. Papáček (ed.). *Didaktika biologie v České republice 2010 a badatelsky orientované vyučování* (DiBi 2010). Zborník príspevkov zo seminára, 25. a 26. marec 2010, PdF JU. 129-135. http://www.pf.jcu.cz/stru/katedry/bi/DiBi2010.pdf
29. Svobodová, J.: *Perspektivy a koncepce přírodovědného vzdelávání*. 2013. European Insitute of Education.
30. Šimonovičová, J., & Kosková, K.: *Ekologická stopa – výchova k trvalo udržateľnému rozvoju. Tréningový manuál pre učiteľov*. 2011. Banská Bystrica: Slovenská agentúra životného prostredia.
31. Tomengová, A.: *Aktívne učenie sa žiakov – stratégie a metódy. 2012*. MPC.
32. Vybíralová, J., Füzyová, Ľ., & Polačko, V. (2005). *Tvorba a ochrana životného prostredia*. Ekonóm.
33. Wenning, C. J.: Levels of inquiry: Hierarchies of pedagogical practices and inquiry processes (revised 2/12). *Journal of Physics Teacher Education Online, 2005, 2*(3). 3-12. http://www2.phy.ilstu.edu/pte/publications/levels_of_inquiry.pdf
34. Zeidan, A.: The Relationship between Grade 11 Palestinian Attitudes toward Biology and Their Perceptions of the Biology Learning Environment. *International Journal of Science and Mathematics Education, 2010, 8*(5), 783-800. https://doi.org/10.1007/s10763-009-9185-8

Primary Paper Section: A

Secondary Paper Section: AM