Vol 12(1) (2023): 89-97
DOI: http://dx.doi.org/10.24235/sc.educatia.v12i1.13891

SCIENTIAE EDUCATIA: JURNAL PENDIDIKAN SAINS

http://www.syekhnurjati.ac.id/jurnal/index.php/sceducatia

How is Kamishibai are able to Construct Students' Environment Literacy?

Irvan Permana[a], Annisa Nurramadhani[b*], Najla Nurul Amalia[b]

[a] Science Education Study Program, Postgraduate School, Pakuan University, Indonesia
[b] Science Education Study Program, FKIP Pakuan University, Indonesia

[*]Corresponding author: Jl. Pakuan No.38, Tegallega, Kecamatan Bogor Tengah, Kota Bogor, Jawa Barat, 16129. E-mail address: annisanurramadhani@unpak.ac.id

article info

Article history:
Received: 04 April 2023
Received in revised form: 20 May 2023
Accepted: 10 June 2023
Available online: 30 June 2023

Keywords:
STEM learning
Kamishibai
Environmental literacy
Pre-service teacher

abstract

The purpose of this study is to analyze how students' environmental literacy in STEM-based learning with Kamishibai learning media. The method that is used is Qualitative study. The location of this research is located in the Science Education study program at Pakuan University Postgraduate School, Bogor. The research subjects in this study were postgraduate students of the science education program. with a total of 20 students divided into 4 groups. Each group makes a kamishibai project by determining environmental problems first, then thinking about what is the best solution to overcome these environmental problems. The data that has been obtained will then be analyzed, processed using the RASCH Model and quantitative description. Environmental literacy will be analyzed based on indicators of each dimension of environmental literacy (competence, knowledge, and attitude). From this research is that students' environmental literacy tends to be good and in a positive direction, both in terms of their competence or knowledge related to the environment, as well as related to their attitudes towards the environment through learning using Kamishibai media and the STEM (Science, Technology, Engineering, and Mathematics) approach.

1. Introduction

The global issue that is being discussed at this time is environmental damage, both in the form of air, water and soil pollution, as well as land and intentional damage. Environmental damage today is not only about pollution, but increased carbon emissions that can cause an increase in earth's temperature and ecosystem imbalance due to global warming (Rauland, et al. 2019). Actions to prevent environmental damage have been taken, one of which is by conserving the environment, implementing the 3Rs (Reduce, Reuse, Recylce) with a plastic bag diet, laws on the use of electric vehicles, and improving the quality of vehicle fuel (octane) to reduce the amount of carbon emissions exposed to the wild so that there can be sustainable environmental development, so that future generations can still enjoy and utilize the natural resources around them. Environmental damage today is not only about pollution, but the increase in carbon emissions that can cause an increase in earth's temperature and ecosystem imbalance due to global warming.

Sustainable environmental development in Indonesia today has only explored the legislation, economic and manufacturing stages. Meanwhile, in education, it is still limited to Environmental education subjects with material that has not been updated on current issues and is only limited to material that is explained by measuring cognitive evaluation alone. Meanwhile, what is needed for sustainable environmental development is literacy from students and college students so that it can be implemented in their daily lives. One of the effective solutions to tackle environmental problems is through educational programs, including at the university level (Farwati, et al. 2018). Student literacy is very important to be explored so that their understanding of something, especially the environment, can be passed on and implemented to their students at school later and in the surrounding environment, considering that students are agents of change.

Literacy itself is a person's ability to identify, understand, interpret, communicate, create, and implement their knowledge in various contexts (OECD, 2018). Literacy in education already has evaluation results as stated in the PISA test which is an OECD international assessment program for 15-year-old students by measuring reading, mathematics, and science literacy, both in knowledge and skills. The results of reading literacy, math, and science in the 2018 PISA test, Indonesia ranked 69 out of 79 participating countries (OECD, 2018). This proves that the literacy of Indonesian students still needs improvement. Likewise with environmental literacy, the results of which have not seen a significant increase (Nasution, 2016).

STEM learning has been widely adapted and implemented in learning, especially science. STEM has also been included in the learning curriculum from kindergarten to college. STEM in science learning has many forms of approaches such as PJBL (Project Based learning) (Kristian, et al. 2017), PBL (Problem Based Learning) (Putri, et al. 2020), and DBL (Design Based Learning) (Bozkurt Altan, & Tan, 2020). In addition to approaches, there are also media and teaching materials such as STEM-based E-modules that can improve student learning performance (Nurramadhani, et al. 2020). Based on these approaches and media in science learning, there are measurable results, namely better student learning outcomes (Meyric, 2011), students' critical thinking skills that are increasingly formed (Mutakinati, et al. 2018) and student questioning skills that have a slight increase (Nurramadhani, & Permana, 2020) In addition to the skills that can be honed with STEM learning, there are also student literacy that increases when STEM learning is applied, such as STEM literacy (Aninda, et. al. 2019) and science literacy (Kusumastuti, et al. 2019). Based on the results of the above research, it can be seen that by implementing STEM learning in science learning, it can foster several essential skills such as critical thinking skills, and other high-level skills, and can foster student literacy.

Commented [A1]: et al

According to (Nasution,2016), changes in literacy, especially environmental literacy, are largely influenced by classroom learning. The learning provided by teachers in terms of materials, methods, models, and learning media greatly affects students' environmental literacy. There are already several ways of learning outlined in the results of research to improve environmental literacy, such as: 1) using practicum method (Harness & Drossman, 2011); 2) using project-based model (Farida, et al. 2017); 3) using discussion method (Sephard, et al. 2014); and 4) using one-way media such as videos and movies (Kostova, & Vladimirova,2018). However, no one has used kamishibai learning media in the STEM approach to explore students' environmental literacy. Kamishibai itself is a traditional paper puppet art in the form of theater and stories originating from Japan. Kamishibai has been used in some learning besides science, such as language learning. The use of kamishibai is generally intended for children. The purpose of this research is to analyze how students' environmental literacy in STEM-based learning by making Kamishibai learning media.

2. Method

Kamishibai is a paper puppet medium that originated in Japan. Initially, this media was intended as propaganda for World War II. However, as time changed, this media was used to provide understanding and new concepts related to the surrounding life, social, and others to children by telling stories based on the pictures made. The relevance of this research to kamishiabai media is that environmental literacy can be introduced in various ways, not only by providing material, but also through stories or fairy tales that are not only favored by children but adolescents and adults. Kamishibai media is also made by students by determining environmental problems first, then packaging them on the media. Making kamishibai media in learning is included in project-based learning with a STEM approach. They still make the stage, script, pictures, with precise size calculations, then the technology they use is when making pictures, some of them use digital applications, engineering is done by them when making the kamishibai stage itself, and science is done by them as the basis of the story material in it related to the environment. The kamishibai media that they have made is displayed and can also be used by them during teaching practice at school with their students later.

The location of this research is located in the Science Education study program at Pakuan University Postgraduate School, Bogor. The research subjects in this study were postgraduate students of the science education program. with a total of 20 students divided into 4 groups. Each group makes a kamishibai project by determining environmental problems first, then thinking about what is the best solution to overcome these environmental problems. Then, in this study, students were given a google form containing environmental literacy instruments that they had to do after displaying kamishibai. This research design uses a qualitative research method with a descriptive design (Astalin,2013). That is, explaining in detail and clearly about a phenomenon related to research. Usually this method is used to find out the initial conditions as a preliminary study for subsequent research, in order to determine the right treatment so that certain skills can increase. Data collection techniques and instruments in this study will be described in the table below.

Table 1. Data collection techniques and research instruments

Data	Data Collection Technique	Instumens
Engineering Desain Product (STEM)	Observation	Observation sheets and Students video recording
Environmental Knowledge	Multiple choices Questions	Questions about environmental concept
Environmental Attitude	Likert Scale	Likert Scale Questionnaire

The data that has been obtained will then be analyzed, processed using the RASCH Model and quantitative description. Environmental literacy will be analyzed based on indicators of each dimension of environmental literacy (competence, knowledge, and attitude) based on an instrument adapted from (Farwati, et al. 2018).

3. Result and Discussion

The results of the research obtained for students' understanding of environmental literacy, based on the results of the analysis using the RASCH model approach, show that the reliability or consistency of students' answers is still weak with a person meassure value of 0.42, while the reliability of the quality of the questions is in sufficient criteria with a meassure item value of 0.76. Overall, the instrument developed has sufficient reliability consistency with a value of 0.75. As shown in figure 1.

SUMMARY OF 20 MEASURED PERSON

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	6.1	12.0	-.01	.69	.98	-.03	1.08	.15
SEM	.5	.0	.21	.01	.05	.18	.13	.22
P.SD	2.0	.0	.90	.04	.23	.79	.57	.96
S.SD	2.1	.0	.93	.04	.23	.81	.58	.99
MAX.	9.0	12.0	1.35	.82	1.39	1.22	2.94	2.56
MIN.	2.0	12.0	-1.96	.65	.55	-1.94	.47	-1.57
REAL RMSE	.72	TRUE SD	.55	SEPARATION	.77	PERSON RELIABILITY		.37
MODEL RMSE	.69	TRUE SD	.59	SEPARATION	.86	PERSON RELIABILITY		.42
S.E. OF PERSON MEAN = .21								

PERSON RAW SCORE-TO-MEASURE CORRELATION = 1.00 (approximate due to missing data)
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .42 SEM = 1.53 (approximate due to missing data)
STANDARDIZED (50 ITEM) RELIABILITY = .75

SUMMARY OF 12 MEASURED ITEM

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	10.1	20.0	.00	.54	.99	-.08	1.08	.01
SEM	1.2	.0	.34	.02	.07	.32	.14	.36
P.SD	4.1	.0	1.12	.07	.22	1.06	.46	1.18
S.SD	4.3	.0	1.17	.08	.23	1.11	.48	1.24
MAX.	16.0	20.0	2.47	.76	1.44	2.07	2.01	2.66
MIN.	2.0	20.0	-1.62	.49	.64	-2.18	.58	-1.92
REAL RMSE	.57	TRUE SD	.97	SEPARATION	1.70	ITEM RELIABILITY		.74
MODEL RMSE	.55	TRUE SD	.98	SEPARATION	1.80	ITEM RELIABILITY		.76
S.E. OF ITEM MEAN = .34								

ITEM RAW SCORE-TO-MEASURE CORRELATION = -1.00 (approximate due to missing data)
Global statistics: please see Table 44.
UMEAN=.0000 USCALE=1.0000

Figure 1. Summary statistic of student's environmental literacy

According to students' abilities and the level of difficulty of the items, it can be explained that for students' understanding of environmental literacy, students 12P and 9P (female) have the highest ability or ability to answer questions. Meanwhile, student 4L (male) has the lowest ability in answering questions because it is outside the lower limit of standard deviation. This is strengthening by the observations results that the female students is the most active and take their initiative during the lesson by using STEM approach to make kamishibai project from the beginning, determine the topic until making the project based on environmental topics. Female students more focus to concept, science, story related to the environmental cases, and design. While the male students more focus to how build the stage of kamishibai, digitalize the performance, and calculate the measurement of kamishibai stages. So, this is similar with others research that female students are not to interested and have difficulties in technical, calculating, and spatial which means in STEM, there are mathematics, engineering, and technology (Bottia, et al. 2015; Kulturel-Konak, et al. 2011; Daniela, et al. 2022). In the item test, it is shown that question Q4 is a very difficult question, because none of the students can answer the question correctly. Problem Q2 is the easiest problem. As shown in the results of Figure 2. From the overall results, that students can answer the questions and understand related to environmental concepts. That means learning by using kamishibai project with STEM approach could construct students' environmental concept and understanding. Because, STEM asked them to do the project with several steps that make the students engaged with the learning itself. Kamishibai also as a new project that students ever done. Environmental topics and cases are constructed as theatrical story which is fun, challenging, and dynamics learning. So, this is in a line with several previous research that said demonstrated

learning or something new way in the learning can improve students understanding, because they are motivated and refreshment in their learning (Muhlisin, 2019; Novak, 2003; Triepels, 2020).

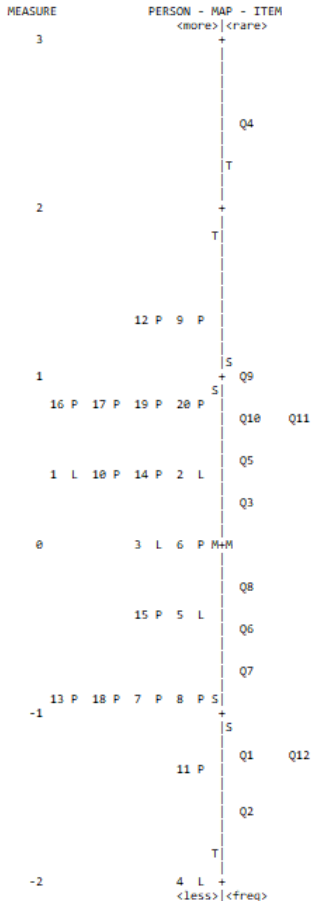


Figure 2. Wright map of students' environmental literacy understanding

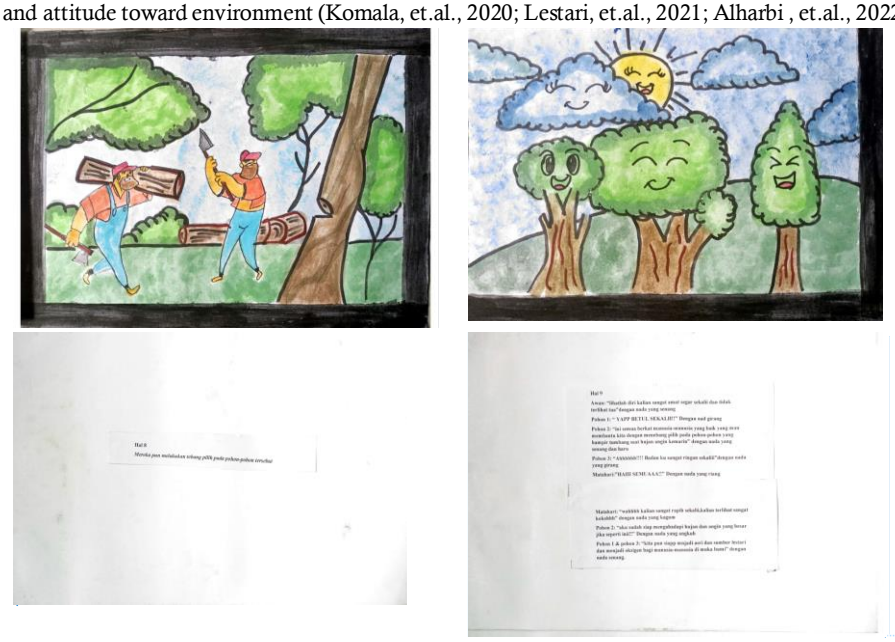
Based on students' attitudes data towards the environment, the students are positive about the environment generally. However, there are some deviations in answering statements in the likert questionnaire related to environmental literacy, namely students tend to avoid extreme choices such as always and never if the statement they do not understand. For example, statement Q14 related to "Riding a motorcycle with high acceleration to get to the destination quickly" almost most of students answered the middle option, namely sometimes. This is because students do not understand the concept of integration between acceleration and fuel usage. The faster the vehicle is driven, the more fuel is wasted. The data can be seen in the scalogram diagram in Figure 3.

```
GUTTMAN SCALOGRAM OF ORIGINAL RESPONSES:
PERSON |ITEM
       |   1 1 1   11 1
       |192240835675134
       |---------------
    12 +333333222322223  12 P
    14 +333333332222222  14 P
    16 +333322332322223  16 P
     3 +333333322222222  3  L
     8 +333333332122321  8  P
    20 +333333322222222  20 P
     5 +333333322221222  5  L
     6 +332323322322222  6  P
     9 +333323222133222  9  P
    15 +333322232233122  15 P
    17 +333333222222222  17 P
     7 +333332332211222  7  P
     4 +333323322122221  4  L
    10 +333233222122222  10 P
     1 +333332222311131  1  L
    19 +333323232122112  19 P
     2 +331333331113211  2  L
    18 +333231312311222  18 P
    11 +322222222232212  11 P
    13 +222133312222211  13 P
       |---------------
       |   1 1 1   11 1
       |192240835675134
```

Figure 3. Scalogram of student attitude toward the environment scale

Based on the students' attitude toward environment data, students have a positive attitude toward the environment, one of which is due to several factors, namely student awareness built by environmental learning using kamishibai through the STEM approach. So far, environmental learning has only been done by learning as in general, for instance discussion, making posters, and presentations (Ichsan, et al. 2019; Lai, 2018). Based on the results of interviews with students, they are very happy to do learning by using kamishibai through STEM. Before making the kamishibai media, they were asked to collaboratively identify environmental problems around them. Then, they were asked to critically think about what solutions are suitable for the problem. Then, students creatively designed the kamishibai media as a medium to convey the environmental problems raised and their solutions, so that other students understand and increase their awareness of the environmental problems raised. Kamishibai is a visual and audio communication medium that can improve student communication. As described in figure 4 that students' make figure and script for kamishibai perform about one of the environmental topics that is chosen by their group. They tried to make it and perform in front of their friends to know the awareness of environmental problem. They made it as creative as they can for their students at school. Awareness and attitude towards the environment can be formed if students have an understanding and motivation related to the environment. A good learning environment is a physical or virtual space that supports the process of acquiring, developing, and applying knowledge. The main characteristics of a good learning environment are designed to be engaging and provides opportunities for learners to engage in meaningful and active interactions with one another. Environmental learning is an act of communication. So, this research learning is appropriate by using kamishibai that emphasis communications and through STEM approaches which is engaged students higher order thinking skills such as critical thinking, creativity, communications, and collaborations. This is in a line with

other research that shows all the learning material, teaching learning media that is not higher order thinking skills based are not develop students environmental concept understanding and attitude (Ichsan, et.al., 2019; Garcia, 2015), so it is appropriate while teaching learning science by using higher order thinking skills-based material and learning media to develop students' understanding and attitude toward environment (Komala, et.al., 2020; Lestari, et.al., 2021; Alharbi , et.al., 2022).



Commented [A2]: what is the meaning of this picture? What does it contribute to the discussion?

Figure 4. Students' Kamishibai script for environmental learning

4. Conclusion

The conclusion of this research is that students' environmental literacy tends to be good and in a positive direction, both in terms of their competence or knowledge related to the environment, as well as related to their attitudes towards the environment through learning using Kamishibai media and the STEM (Science, Technology, Engineering, and Mathematics) approach. They environmental understanding and attitudes are developed by the learning process that higher order thinking skills-based in material, process, and also media. The higher order thinking that are implemented in this learning are critical thinking, creativity, communications, and collaborations. Thos skills are covered in environmental learning process by using kamishibai learning media through STEM approaches.

References

Alharbi, S. M., Elfeky, A. I., & Ahmed, E. S. (2022). The effect of e-collaborative learning environment on development of critical thinking and higher order thinking skills. *Journal of Positive School Psychology,* 6848-6854.

Aninda, A., Permanasari, A., & Ardianto, D. (2020). Implementasi pembelajaran berbasis proyek pada materi pencemaran lingkungan untuk meningkatkan literasi stem siswa sma. *JSEP (Journal of Science Education and Practice)*, *3*(2), 1-16.

Astalin, P. K. (2013). Qualitative research designs: A conceptual framework. *International Journal of Soceial Science & Interdiciplinary Research, 2*(1), 118-124

Bottia, M. C., Stearns, E., Mickelson, R. A., Moller, S., & Parler, A. D. (2015). The relationships among high school STEM learning experiences and students' intent to declare and declaration of a STEM major in college. *Teachers College Record, 117*(3), 1-46.

Bozkurt Altan, E., & Tan, S. (2020). Concepts of creativity in design based learning in STEM education. *International Journal of Technology and Design Education*. DOI:10.1007/s10798-020-09569-y

Daniela, L., Kristapsone, S., Kraģe, G., Belogrudova, L., Vorobjovs, A., & Krone, I. (2022). Searching for pedagogical answers to support STEM learning: Gender perspective. *Sustainability, 14*(21), 14598.

Farida, I., Hadiansah, Mahmud, Munandar, A. (2017). Project-based learning design for internalization of environmental literacy with Islamic Value. *Jurnal Pendidikan IPA Indonesia, 6*(2), 277-284.

Farwati, R., Permanasari, A., Firman, H., & Suhery, T. (2018). Pengembangan dan validasi instrumen evaluasi literasi lingkungan. *Jurnal Penelitian Pendidikan Kimia: Kajian Hasil Penelitan Pendidikan Kimia, 5*(1).

Garcia, L. C. (2015). Environmental science issues for higher-order thinking skills (hots) development: A case study in the Philippines. In Biology Education and Research in a Changing Planet: Selected Papers from the 25th Biennial Asian Association for Biology Education Conference (pp. 45-54). Springer Singapore.

Harness & Drossman. (2011). The environmental education through filmmaking project. *Environmental Eductional Research, 17*(6), 829-849

Ichsan, I. Z., Sigit, D. V., & Miarsyah, M. (2019). Environmental learning based on higher order thinking skills: a needs assessment. *International Journal for Educational and Vocational Studies, 1*(1), 21-24.

Komala, R., Lestari, D. P., & Ichsan, I. Z. (2020). Group investigation model in environmental learning: An effect for students' higher order thinking skills. *Universal Journal of Educational Research, 8*(4A), 9-14.

Kostova, Z., & Vladimirova, E. (2010). Development of environmental literacy by interactive didactic strategies. *Chemistry, 19*(3), 50-70.

Kristiani, K. D., Mayasari, T., & Kurniadi, E. (2017). Pengaruh pembelajaran STEM-PjBL terhadap Keterampilan Berpikir Kreatif.Seminar Nasional Pendidikan Fisika III.

Kulturel-Konak, S., D'Allegro, M. L., & Dickinson, S. (2011). Review of gender differences in learning styles: Suggestions for STEM education. *Contemporary Issues in Education Research (CIER), 4*(3), 9-18.

Kusumastuti, F. A., Rombot, O., & Ariesta, F. W. (2019). The effect of stem integration on primary school students' scientific literacy. *International Journal of Scientific & Technology Research, 8*(12), 1551-1553

Lai, C. S. (2018). A study of fifth graders' environmental learning outcomes in Taipei. *International Journal of Research in Education and Science, 4*(1), 252-262.

Lestari, N. A., Ambarsari, R., Prahani, B. K., Jauhariyah, M. N. R., Yantidewi, M., & Deta, U. A. (2021). A preliminary study of environmental learning to improve students' higher order thinking skills in physics. In Journal of Physics: Conference Series (Vol. 1805, No. 1, p. 012033). IOP Publishing.

Meyric, K. M. (2011). How STEM education improves student learning Meridian K-12 School *Computer Technologies Journal, 4*(1).

Muhlisin, A. (2019). Reading, mind mapping, and sharing (rms): innovation of new learning model on science lecture to improve understanding concepts. *Journal for the Education of Gifted Young Scientists, 7*(2), 323-340.

Mutakinati, L., Anwari, I., & Kumano, Y. (2018). Analysis of students' critical thinking skill of midddle school through STEM education project-based learning. *Jurnal Pendidikan IPA Indonesia, 7*(1), 54-65

Nasution, R. (2016). Analisis kemampuan literasi lingkungan siswa SMA Kelas X. *Proceeding Biology Education Conference, 13*(1), 352-358.

Novak, J. D. (2003). The promise of new ideas and new technology for improving teaching and learning. *Cell biology education, 2*(2), 122-132.s

Nurramadhani, A., & Permana, I. (2020). Students' generated question quality through stem based project learning in science activity. *Journal of Humanities and Social Studies, 4*(2), 86-90

Nurramadhani, A., Lathifah, S. S., Permana, I. (2020). Students' generated questions quality by developing stem-based e-module in science learning. *Scientiae Educatia: Jurnal Pendidikan Sains, 9*(2), 134-152

Organization for Economic Co-operation and Development. (2018). Indonesia student performance (PISA 2018). [Online]: Retrieved from https://gpseducation.oecd.org/CountryProfile?primaryCountry=IDN&treshold=10&topic=PI

Putri, C. D., Pursitasari, I. D., & Rubini, B. (2020). Problem based learning terintegrasi STEM di era pandemi Covid-19 untuk meningkatkan keterampilan berpikir kritis siswa. *JIPI (Jurnal IPA dan Pembelajaran IPA), 4*(2), 193-204

Rauland, V., Caruso, C., Perry, B., & Kashima, Y. (2019). Low carbon, high performance schools: national survey results on attitudes toward the role of the built environment and sustainability on learning outcomes.

Shephard, K., Harraway, J., Lovelock, B., Skeaff, S., Slooten, L., Strack, M., ... & Jowett, T. (2014). Is the environmental literacy of university students measurable?. *Environmental Education Research*, *20*(4), 476-495.

Triepels, C. P., Smeets, C. F., Notten, K. J., Kruitwagen, R. F., Futterer, J. J., Vergeldt, T. F., & Van Kuijk, S. M. (2020). Does three-dimensional anatomy improve student understanding?. *Clinical Anatomy, 33*(1), 25-33.