Ilkogretim Online - Elementary Education Online, Year; Vol 20 (Issue 4): pp. 264-271
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.04.29

STEM EDUCATION OF STUDENTS AT CHILDREN'S UNIVERSITY

Damekova Saule Kairollovna, Candidate of Pedagogical Sciences, Head of the Department of Physics and Mathematics of Sh. Uvalikhanov Kokshetau University, Kazakhstan, 020000, Akmola region , Kokshetau, 76 Abay street, Damekova_S@mail.ru
Nurmuhanbetova Nurgul Nurkenivna, Candidate of Chemistry Sciences, Head of the Department of chemistry and biotechnology of Sh. Uvalikhanov Kokshetau University, Kazakhstan, 020000, Akmola region, Kokshetau, 76 Abay street, nn_nurgul@mail.ru
Durmekbayeva Shynar Nurlybekovna, Associate Professor, Candidate of candidate of biological sciences , Head of the Department of Bology and Biology teaching methods of Sh. Uvalikhanov Kokshetau University. 020000, Kazakhstan, Akmola Region, Kokshetau, Abaya Str. 76, durmekbaeva@mail.ru,
Khamitova Aina Sultanseitovna, Associate Professor, Candidate of Chemistry Sciences, Dean of the Faculty of Natural Sciences of Sh. Uvalikhanov Kokshetau University**,** Akmola region, Kazakhstan, 020000,
Kokshetau, 76 Abay Street, aina-hamitova@mail.ru
Fakhrudenova Idiya Bolatovna, Sh. Uvalikhanov Kokshetau University Candidate of Biological Sciences, Head of the Department of Geography, Ecology and Tourism, Kazakhstan, 020000, Akmola region, Kokshetau, 76 Abay Street, agrokgu@mail.ru
Shayakhmetova Aisulu Alkeshovna, Associate Professor, Candidate of Philology, Head of the Department of Social and Pedagogy Sh. Uvalikhanov Kokshetau University. 020000, Kazakhstan, Akmola region, Kokshetau, Abaya str. 76. aisulu_sh@mail.ru

Abstract- The article describes the STEM education projects presented on the educational platform of the Children's University, created on the basis of Sh. Ualikhanov Kokshetau University, in the context of traditional and distance learning.
The article aims at studying the activities of the Children's University and identify indicators that arouse interest among primary school students in STEM education. The study involved children from 8 to 12 years old in the amount of 250 students from schools in the city of Kokshetau (Kazakhstan).
Methods: A mixed method, questionnaire and semi-structured interviews of children were used.
The Likert scale questions allowed for the analysis using descriptive statistics. Open-ended questions and data from the interviews were classified using content analysis and analytically interpreted through the theory of the development of cognitive interest in children.
Results: the study identified a new factor influencing children's interest in STEM education at the Children's University – future teachers-students.
Five important indicators proposed in previous studies were checked: the topic of classes, the learning environment, the spectacularity of the classes, training, the role of the family in face-to-face meetings and distance learning at the Children's University.
Conclusions: the study highlighted a new factor that arouses the interest of primary school students in STEM education when visiting Children's University, of interest to all parties involved in STEM education in non-formal learning.

Keywords: Children's University, virtual 3D laboratory Labster, STEM, students – future teachers.

I. INTRODUCTION

The relevance of the research issue.
The purpose of creating a Children's University is to identify and study the indicators of extracurricular activities in STEM education, as well as to demonstrate the successful performance of university students and school students through the use of entertaining forms of education that were developed by future tutors and university teachers. Discussion of learning outcomes is conducted under the guidance of teachers based on the use of the theory of the development of cognitive interests of younger students [1].
The basis for STEM education at the Children's University was the creation of an informal learning environment that stimulates interest in science; research on the activities of the Children's University was carried out in the work of Susanne Walan, Niklas Gericke, 2019 [2]. There are many ways to stimulate interest in the exact sciences, in our research we offer several: first, voluntary participation in these activities (Potvin and Hasni) [3]; secondly, non-judgmental activity; third, the interactivity of the classes (Shabi, Assaraf) [4]; fourth, the use of 3D game virtual laboratory work.
The format of the Children's University in the pedagogical environment is not new, so the European Children's Universities Network has been created in Europe [5]. The activities of teachers and students involved in the Children's University of the Sh. Uvalikhanov Kokshetau University are focused on creating

new learning platforms, expanding the educational space and implementing joint pedagogical and didactic research. The format of the Children's University captures not only the creativity of the use of teaching approaches, but also the active involvement of student youth in the education of students, when the boundaries of communication are erased and interest in serious academic subjects arises, both on the part of students and on the part of students. Such meetings became possible thanks to the Children's University, which became the main one in the strategy of mutual cooperation of teachers, parents, students and tutors of the Akmola region [6].

According to Krishnamurti and co-authors [7], studies of interest in STEM in informal contexts lag significantly behind studies of interest in STEM in school learning.

II. MATERIALS AND METHODS

Among various psychological phenomena that are taken as an incentive to activity (including research), much attention is paid to interest. The diversity of views on interest can be noted in the works of many famous psychologists: A.N. Leontyev, S.L. Rubinstein, S.L. Vygotsky, and others [8]. Interest as a focus of attention, as a motive for activity, as a source of personality development, etc. is considered on the sequential implementation of the stages of cognitive interest [1], which starts from initiation in certain situations (evoked situational interest) and ends with the formation of a well-developed individual interest. In our study, the first stage, the initiation of interest, was the focus. Cognitive interest arising in the learning process intensifies mental activity not only at the moment, but directs it to the subsequent solution of various intellectual problems.

In this regard, when forming cognitive interest in the system of non-formal education, it is necessary to take into account the psychological factors of its formation. According to L.S. Vygotsky, cognitive interest from a psychological point of view is a "natural engine of children's behavior", and is "a true expression of instinctive striving; an indication that the child's activities coincide with his organic needs" [9].

It is generally accepted that not all academic subjects are of interest, and when the content of research affects the daily life of a person, interest arises among students [2]. Likewise, in this study, the authors conducted 4 sessions, and then asked the students to choose the topics they were most interested in. It should be noted that the popularity of chemistry, biology and programming was observed among students.

This research was also aimed at studying the role of the family in the choice of subject areas of interest; often, parents influence the future careers of children, since they believe that a scientific career is the best choice for their children [2].

The second objective aspect of the activities of the Children's University is the participation of students who, like a litmus test, pass all the moods of children, the interest and motivation of students in STEM education through themselves. In such an informal educational environment, students and teachers began to develop a new strategy for the inclusion of children, students, parents, teachers and teachers in extracurricular activities, which requires further study.

The system of additional education, which has been conceptually introduced in Kazakhstan since 2019 [10]; it is considered as the most important component of the educational space, and it is not just an element of the existing system of general education, but an independent source of education that contributes to the achievement of key competencies in various spheres of the child's life self-determination. In the Republic of Kazakhstan, the system of additional education for students requires the availability of qualified pedagogical personnel with basic training in the field of additional education and capable of introducing interesting and modern educational programs.

Children's University at the Sh. Uvalikhanov Kokshetau University makes a significant contribution to the system of additional education in Kazakhstan. The aim of the Children's university is to stimulate the scientific interest of children aged 8-12 in STEM. Since 2016, the Children's University has been working to expand the horizons of students, deepen scientific knowledge in a number of natural sciences, as well as form an active life position for children.

Students of the city's schools are offered eight classes that are held every month during the academic year at the university. Students of the 3rd year of pedagogical specialties of the Faculty of Natural Sciences, under the guidance of methodologists, conduct practical classes and laboratory experiments in physics, chemistry, biology, mathematics, computer science, geography and talk about their applied features of application in human life.

In terms of time, classes last about 2 hours, as a rule, these are morning hours, for example from 10.00 to 12.00 with 10 minute psychological trainings or musical warm-up activities every 20 minutes. In the context of a pandemic in 2020, the lessons of the Children's University were held in a distance format.

Training under the program of the Children's University, developed and successfully implemented by the teaching staff of the departments of the Faculty of Natural Sciences and aimed at deepening knowledge in biology, chemistry, physics, mathematics, computer science, geography. The summer camp allowed

uniting children with an interest in research work in order to organize their interaction with peers, with university teachers in the context of joint creative, research activities.
The main strategy of the University's activities is for children to meet with researchers, visit the university laboratories and be able to independently conduct simple experiments. To date, about 250 children have attended Children's University, not counting those students who have re-enrolled in our classes. All participants of the Children's University receive certificates for success in research activities, gifts that are prepared by students and presented in a festive atmosphere with the participation of parents and school representatives.
The main goal of the Children's University is to identify and research indicators that arouse interest in science, exact STEM technologies in primary school children in non-formal learning.
The study set the following objectives: 1 (Q1): does attendance at Children's University increase children's interest in STEM?; 2 (Q2): What indicators of the activity of the Children's University do the children themselves find interesting?
The use of a mixed method, including both questionnaires and semi-structured interviews, was developed specifically for the Children's University in order to determine the growth of interest in STEM, their general interest in science. The closed elements of the Likert scale [11] in the questionnaire were used to test whether pupils report increased interest due to participation in extracurricular activities at Children's University (Q1). The ratings were: 1 = not interesting at all, 2 = not very interesting, 3 = no opinion, 4 = interesting and 5 = very interesting. The open-ended questionnaire items were used to inform the second research question (Q2). However, these questions were few and far between, and the authors know from earlier experience that young children are not shy about expressing their thoughts in writing. Therefore, additional interviews were conducted with some of the children in order to collect more children's opinions in order to answer the second research question.
In summer vacation period 2019 and 2020 semi-structured interviews with 60 children were conducted during the classes of the Children's University. The children volunteered to participate in interviews and parental consent was obtained. Interviews were conducted in focus groups of four to six students to stimulate discussion and enable children to be more talkative. These interviews were conducted after the Children's University classes, when the season was closed, and were conducted in parallel by all researchers (authors of the article). Each of the interviews was audio recorded and lasted about 8-10 minutes.
The Likert style questions in the questionnaire were analyzed on the basis of descriptive statistics to highlight the characteristics of the change in interest (Q1). The open items of the questionnaire were analyzed using content analysis as described in the 2007 studies by Cohen, L., L. Manion, and K. Morrison [12]. Audio recordings from interviews were transcribed verbatim and also analyzed using content analysis; transcripts (from open items of the questionnaire and interview transcripts) were read repeatedly. The second research question was to use appropriate words with a positive meaning of increasing interest in STEM: "like", "best", "interesting", "cool", words associated with the object of interest, for example, "I liked the physical devices", "Labster is cool", "I like interacting with students at the university", "It is interesting to study".
These keywords and sentences were grouped into categories that allowed identification under the guidance of the researchers and then under the editorship of a second researcher. Some of the children's responses can be interpreted as falling into two categories; in those cases they were placed in both.
The children who participated in the study were coded as I = interview, Q = questionnaire, B or G for a boy or girl, the number of the respondent, for example, IG4 means an interview with a girl who was identified as the fourth among all respondents.

Research results

In the second half of the 2016-2017 academic years at the Children's University, all children who attended classes in the second semester were offered a questionnaire. 100 percent of children answered (40 responses in total). The questionnaire was presented on paper after class, the adults who accompanied the children were informed about the questionnaire and we asked to help the children if there were any questions that they did not understand. Most of the children who responded to the questionnaire were students from the same grade (see Table 1).

Table 1. Survey of respondents, methods of data collection and number of visits to Children's University by respondents over the years

№	Respondents	Academic year	Data collection methods	Number of classes at Children's university
1	40 children of schools in Kokshetau, Akmola region	2016-2017	questionnaire	8
2	150 children of schools in Kokshetau, Akmola region	2017-2018	questionnaire	8

3	40 children of schools in Kokshetau, Akmola region	2018-2019	survey	8
4	20 children of schools in Kokshetau, Akmola region	2019-2020	survey	8

To the question "How does attendance at Children's University affect children's interest in STEM?" the following answers were received (see Figure 1).

Figure 1 Children's interest in science before attending Children's University

About 42 percent (105 children) **rated science as interesting**, and 28 percent (70 children) rated science as very interesting before attending Children's University. In this question, the answers can be ranked from not very interesting to very interesting; hence, the responses can be viewed as ranked on the Likert scale points, with the most positive response. The average was 3.6 out of 5.0 for the total number of responses.

Diagram 2. Interest of children while attending Children's University

Regarding the question of whether the interest changed after attending the Children's University, the children found the science as interesting as before the visit (120 children, 48%), or even more interesting (110 children, 44%) (Figure 3). This can be considered as a three-point Likert scale, giving an average of 2.4 out of 3.0.

Diagram 3. Interest of children after attending Children's University

During the interview, all 40 children responded that they enjoyed the visit and wanted to return to Children's University. The positive visiting experiences made many children curious and wanted to learn more about other STEM-related issues.

The main interest in this study was in determining what indicators at the Children's University the children themselves identify as interesting: evaluating the topic, evaluating the spectacle, evaluating the learning, evaluating the learning environment, evaluating the student as a future teacher.

The authors compared how the children rated the topics of the Children's University; most of the children from the interviews attended all classes. When asked what was highly rated on the results of the visits, the answers were often related to chemistry and robot programming. Some examples:

Interviewer: What was the best topic in your visit to Children's University?

Chemistry was the best IB16.

Another example related to chemistry was presented by a boy:

I think it was interesting when they made the Pharaoh's Serpents. This made me curious. I want to know how they did it. IB7

I have long wanted to make a robot and here at the Children's University I had such an opportunity IG30.

In setting the topic, the authors tried to ensure that the activities of children at the Children's University were a continuation and deepening of the school curriculum.

The assessment of the spectacularity of classes revolves around those key phrases expressing surprise, that is, words such as "boring", "fun", "cool" were associated with phenomena or ideas (that is, not theoretical content or concepts such as in the previous category) in activities that were intentionally or unintentionally included in order to generate a surprise response. Children who attended chemistry and biology mentioned performing experiments using a microscope and chemical glassware as what they appreciated most from their visit.

I liked it when we studied the structure of the cell in the Labster QG250 virtual laboratory.

I liked it when we dissected the fish and studied its structure. IB17.

I liked the microscopic examination and the sketching of the IB28 penicillin filaments.

I liked the physics experiments carried out by university students: optical effects, temperature measurement with an electronic thermometer and how the data is immediately displayed on the QG212 computer screen.

I liked the entertaining experiments in mathematics that university students conducted: unicursal figures and teleportation through a sheet of paper. It was fun QG200.

Participants of the Children's University summer camp in June 2020 got the opportunity to work in Labster virtual laboratories.

It was a really cool tour of the structure of the cell, seeing atoms and molecules in motion of QB35.

It was interesting and fun. Labster's 3D animation allowed us to teleport from the lab to the sea, to the forest, and back to the lab. It was exciting and really cool QG209.

When children were asked why they enjoyed attending Children's University, many of the responses were about learning. In some cases, children stated that they had learned a lot, they gave examples of what they really learned. In the distance work, the children were greatly helped by the short 10-minute educational videos posted on the You tube channel of the Faculty of Physics and Mathematics of the University [13], which the children used during their virtual laboratory work.

I liked it, I already knew something, but I learned a lot more. For example, about the wavelength in physics and what is the wave spectrum QB15.

Everything was fine, because it was possible to understand adult issues that I did not study in school. For example, what is mitosis and meiosis QG5.
It is very interesting to study in a virtual environment; I learned by what law the light is refracted QB73.
In the responses of the children, it was noted that working in an educational environment with microscopes and physical instruments stimulated their interest. It is the instrument of the nuclear magnetic resonance laboratory that they saw at the university and the virtual research environment Labster [14].
I liked the university; it was nice to just sit in the new scientific chemical physics laboratory IG20.
It was cool there because I have never been to university. I didn't expect it to be such a big IB1.
I think it was interesting to visit preschools, because we see things live there. I watch a lot of films about experiments on YouTube, but it's even more interesting because students are showing a live experiment, and we see it with our own eyes IG40.
I liked the biological museum and the excursion there IB37.
We only presented indicators that the children identified as interesting when they attended Children's University, as that was one of the research questions.
In the course of classes, the mastering of basic knowledge about the subject of activity and the development of techniques for working with real objects and instruments of educational laboratories of the departments of Physics, Chemistry, Biology takes place. The classes not only covered science, but also included aspects from the entire spectrum of STEM.
Any activity is interesting because there is a mandatory feedback, this is the active participation of students, future teachers, who came up with various reflective and relaxation techniques for students so that children do not get tired.
The 3rd year students of the Faculty of Natural Sciences at the Children's University conducted: mass celebrations with elements of intellectual activity, intellectual games and projects, practical exercises with elements of research activities, an excursion to the nuclear magnetic resonance laboratory, individual work with children to carry out research work of different levels.
Each component and the corresponding level of educational work with examples from the practice of the Children's University are considered by the authors.
As a vivid example it is possible to cite the celebration of the New Year for children, the celebration of Nauryz in biology classes (photos and videos on the university website). During the holiday, a special information table was organized, where children received information about the work of the Children's University, colorful advertisements, balloons were distributed, and registration was made for study groups. In this lesson, elements of traditional Kazakh festive culture were used; student groups with concert programs were involved in them. Many children become keen participants of the Children's University after attending such a festive event.
I enjoyed working with LEGO robots, which student Alibek (QB44) helped to build and program.
I enjoy attending Children's University. I want to study at Sh. Ualikhanov University, because there are smart and energetic students (IG13).
I loved how the chemistry students explained the precipitation and why the tube was gassed (IG15).
I liked how Baizhan explains physics, I understood what resistance is when he personally wrote me an answer in the messenger (IG30).
I got all my questions answered at Children's University (IG11).
In addition to students and teachers, adults, teachers and parents also took part in the work of the Children's University. Children attended these events with their teachers or relatives until 2020. The high degree of interaction between children and adults at Children's University can be explained by the fact that children are aware of the importance of their families during the COVID-19 pandemic. The work is carried out in close contact with the parents, who acted as consultants during the first virtual laboratory work and strongly supported the children. The children, answering the questionnaire, noted the high activity and emotionality of adults. Reviews of parents are posted on the website of the Children's University of KU [6].

III. Discussion

From the interviews with children who attended classes, the authors found that topics that are particularly interesting for them and piqued their curiosity were related to chemistry experiments and robot programming. However, it is impossible to generalize these findings, and earlier research also found that children tend to have different preferences and interest in different topics. Baram-Tsabari and Yarden 2005; [15] Jones, Howe, and Rua 2000 [16], Holbrook 2008; [17] Newton 1998 [18] argue that the relevance of a topic is essential in order to motivate students and interest them in scientific disciplines. Since most of the children in this study rated the proposed topics as interesting, it can be concluded that the choice of different topics at the Children's university stimulates interest in STEM. The fact that lectures on chemistry were popular among children was connected not so much with the assessment of this topic,

but with the assessment of the organization of the experiments, because they were impressive, there were experiments with color change, combustion of substances. Interest in experiments was indicated by previous researchers S. Agranovich and B.Z. Assaraf (2013) [19]. The results of this research should be seriously considered when planning future extracurricular activities.

Early research by Susanne Walan, Niklas Gericke 2019 [2] noted the importance of impressive, spectacular activities in extracurricular activities. Spectacular laser shows and chemical experiments can only be seen on university equipment or experimental equipment of university scientists, which cannot be provided by teachers in primary schools. The authors used virtual laboratory work of the Labster Company in remote work of the Children's university, which aroused great interest of children and parents, inclusive, the experience of working with which had not been previously studied. It is important to note here that the complexity of mastering a new software interface is manifested in the first lesson with virtual laboratories. But the 3D effect, animation and playful presentation of scientific material motivates children to quickly get acquainted with the Labster program.

Another indicator that children noted in this study was that they value learning and found learning more enjoyable than school classes. As shown in the earlier research of Tal 2012 [20], , L.J. Rennie 2007 [21], learning in an informal context or outside of school is a good addition when it comes to stimulating the study of STEM subjects. Moreover, science teaching is often considered positive among children in extracurricular activities.

Activities in a different environment, in this case at the university, became more interesting for many children; most of the children had never attended university before. Previous studies of the learning environment have shown that the focus has often been on typical artifacts such as physical and chemical devices, as well as the environmentally friendly area in the university premises. In this study, children talked about the STEM learning environment Labster. The Labster online laboratory allows you to engage in science, it provides access to complex experiments and scientific discoveries from any corner of the world. At the same time, students at Labster do not study haphazardly, but according to pre-prepared lessons in a playful way. This means that in the laboratory they do not just experiment and have fun, but really learn to work with laboratory equipment and learn real physical, chemical, biological laws. Kids found Labster jobs exciting and fun, often describing them as really cool.

The factor that was discussed by the children was students - future teachers as role models or identity creators. Creative students with high academic and research achievements were allowed to prepare and conduct classes. The children talked a lot about the researchers - the students who taught the classes. When children were asked questions about the researchers represented at Children's University, they had positive comments. The children noted that there were many students at the Children's University and, unlike one teacher for the whole class, this is very good. The participation of students in the activities of the Children's University allows individualizing the learning process, this is clearly not enough for children at school. Parents talked about the need to accompany the research and creative activities of children, which can also be realized with the help of students. The activities of the Children's University are related to the field of non-formal education, related to the individual development of the child in culture, which he chooses in accordance with his desires and needs [10]. This is a key area for future research, as well as an area where there is room for improvement in the preparation of future teachers at the university.

The authors were interested in what happened after the visits, in the cultures where children spend their time (at home and at school). The children were asked if they subsequently discussed the lectures with their classmates, teachers and relatives. All students stated that after the visit there were discussions in their classes. Children told their parents about their visit to the Children's University and we received feedback from parents via the messenger. Therefore, it is also an important area for improvement that the children's university needs to develop, that is, cooperation with schools, teachers, with relatives in order to improve preparation and integration into school activities in order to create a common culture of science teaching.

IV. CONCLUSIONS AND OFFERS

Extracurricular activities in science are important factors in helping students make future choices when it comes to STEM studies and careers. However, along with other activities and hopefully good teaching in school, attending extracurricular STEM activities like Children's University can serve as a trigger for developing interests.

As shown in this study, when organizing extracurricular activities, it is important that students experience something of their normal learning. First of all, the place is important, that is, the learning environment, the out-of-school environment.

Topics must be chosen with the potential to surprise the children, the class must be entertaining, and ultimately the program must be aimed at the cognitive level of the activity as children expect to learn something.

The results of this study highlight the metrics that children actually ranked after attending Children's University, which may also be of interest for various STEM activities to generate interest in learning these subjects. Having the opportunity to learn new things in an environment conducive to learning, under the guidance of energetic student lecturers, in an eco-friendly environment or in a virtual 3D lab is essential for children.

Consequently, subjects planning extracurricular activities should consider these factors when designing their activities. Moreover, although this has been emphasized by previous researchers, we believe that the possibility of practical experiments, including virtual ones, is appreciated by many children and, therefore, should be included, as already happens in many STEM events.

In this study, the authors used effective research methods, i.e. questionnaires and interviews in which the children's own experience and perceptions are investigated. These methods have limitations, and children of this age (8-12 years) may not be able to express and verbalize all the important indicators. Therefore, in the future, our research should be complemented by research using action approaches such as observation and interaction research.

The research focused on what is of interest, not how it develops. Therefore, for future research, the authors would suggest studying how it changes over time as students get older. How do they change over time for the same students?

REFERENCES

1. Shchukina G.I. Pedagogical problems of the formation of the cognitive interest of students. - M .: Education. – 2005, 280 p.
2. Susanne Walan, Niklas Gericke Factors from informal learning contributing to the children's interest in STEM – experiences from the out-of-school activity called Children's University, Research in Science & Technological Education, DOI:10.1080/02635143.2019.1667321
3. Potvin, P., and A. Hasni. 2014. "Interest, Motivation, and Attitude Towards Science and Technology at K-12 Levels: A Systematic Review of 12 Years of Educational Research." Studies in Science Education 50 (1): 85–129. doi:10.1080/03057267.2014.881626.
4. Shaby, N., O.B. Assaraf, and T.J. Tal. 2017. "The Particular Aspects of Science Museum Exhibits that Encourage Students' Engagement." Journal of Science Education and Technology 26: 253–268. doi:10.1007/s10956-016-9676-7.
5. European Children's Universities Network https://eucu.net/
6. Website of the Sh. Uvalikhanov Kokshetau University https://www.kgu.kz/detski_universitet
7. Krishnamurthi, A., B. Bevan, J. Rinehart, and V. R. Coulon. 2013. "What Afterschool STEM Does Best: How Stakeholders Describe Youth Learning Outcomes." Afterschool Matters 18: 42–49.
8. General pedagogy: a textbook for university students enrolled in pedagogical specialties / Ed. A.M. Stolyarenko. - M .: Unity-Dano, 2012. - 479 p.
9. Vygotsky L.S. Psychology of human development. - M .: Publishing House of Meaning; Publishing house Eksmo, 2005 .-- 1136 p.
10. Conceptual approaches to the development of additional education for children in the Republic of Kazakhstan. https://www.ziyatker.org/legislation
11. Volkova N.V. Likert and Rush scales: comparative analysis of results // Modern methods of data mining in economic, humanitarian and natural science research. - Pyatigorsk: Publishing house of the Russian
12. Cohen, L., L. Manion, and K. Morrison. 2007. Research Methods in Education. New York, NY: Routledge.
13. K. Morrison. 2007. Research Methods in Education. New York, NY: Routledge.
14. YouTube channel of the Department of Physics and Mathematics of the Sh. Uvalikhanov Kokshetau University https://www.youtube.com/channel/UCBc-ICBg0cUGLBXzqAgUQGA
15. Official website of Labster https://www.labster.com/
16. Baram-Tsabari, A., and A. Yarden. 2005. "Characterizing Children's Spontaneous Interests in Science and Technology." International Journal of Science Education 2 (7): 803–826. doi:10.1080/09500690500038389.
17. Jones, M.G., A. Howe, and M.J. Rua. 2000. "Gender Differences in Students' Experiences, Interests, and Attitudes toward Science and Scientists." Science Education 84: 180–192. doi:10.1002/(SICI)1098-237X(200003)84:2<>1.0.CO;2-2.
18. Holbrook, J. 2008. "Introduction to the Special Issue of Science Education International Devoted to PARSEL." Science Education International 19 (3): 257–266.
19. Newton, D.P. 1988. Making Science Education Relevant. London, England: Kogan Page.
20. Agranovich, S., and B. B. Z. Assaraf. 2013. "What Makes Children like Learning Science? An Examination of the Attitudes of Primary School Students Towards Science Lessons." Journal of Education and Learning 2 (1): 55–69. doi:10.5539/jel.v2n1p55.

21. Tal, T. 2012. “Out-of-school: Learning Experiences, Teaching and Students’ Learning.” In Second International Handbook of Science Education, edited by B. Fraser, K. Tobin, and C. J. McRobbie, 1109–1122. Netherlands: Springer.
22. Rennie, L. J. 2007. “Learning Science outside of School.” In Handbook of Research on Science Education, edited by S. K. Abell and N. G. Lederman, 125–167. Mahwah, NJ: Lawrence: Erlbaum