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Research Article

Promoting Self-Directed Learning in the Context of Natural Science Education in Preschool

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ABSTRACT

We live in a world of rapid social and economic change, which requires regular renewal and improvement of knowledge, skills, and attitudes. Therefore, in the context of lifelong learning, the ability to learn and manage one's learning is particularly important. The promotion of self-directed learning should be given attention from the pre-school age. Self-directed learning is an approach to learning in which children are actively involved in their learning, taking responsibility for various aspects of their learning. As various technologies are introduced and used more and more nowadays, one of the possibilities to diversify the learning process and promote the development of self-directed learning skills in children is to use educational technologies. In the research, the theoretical regularities of self-directed learning have been investigated, play activities have been developed and approved in the field of natural science education, using the programmable floor robot. Research methods are analysis of scientific and methodical literature, observation of children's activities and assessment of play activities, and data processing in the SPSS program. The research has been applied to the promotion of self-directed learning in the field of natural science in the second age stage of preschool children. Integrating educational technologies into the learning process creates an effective learning experience for children, and strengthens their curiosity and joy of science. Promoting self-directed learning in natural science learning in preschool is an essential aspect that helps children actively engage in the learning process and develop their knowledge and skills in the field of natural science. Such an approach gives children the opportunity to explore the world around them by themselves, promoting curiosity and interest in nature and its processes.

Keywords: Educational Technologies, Play Activities, Programmable Floor Robot, Self-Directed Learning

INTRODUCTION

Educational sciences discuss how to prepare children for today's changing world, where technology is developing rapidly and it is necessary to react and adapt to changes (McLeod, 2024; Khrystyuk, Mykhailova, 2022; Aboltina, 2021; Andreas et al., 2020). A child's first conscious learning experience is acquired in preschool, which forms the basis for further development and the learning process. Preschool plays an essential role in the development of a child's personality and the formation of learning experiences because whether a child learns with pleasure affects his desire to explore the world, phenomena, and connections.

Self-directed learning in preschool is an approach to learning in which children are given the freedom and support to be actively involved in their learning. This approach encourages children to take initiative, choose topics, explore issues of interest, and engage in activities that are based on their interests and understanding of the world around them.

The accent of self-directed learning is focused on the child's ability to act independently, to independently choose his behavior or response in specific situations. A person is very versatile and like all other individuals in the surrounding environment, he forms his human core by developing and improving in this way (Helminga, 2006). According to A.Vanaga and L.Rutka, one of the main tasks of self-directed learning is to promote the child's ability to perceive change as an opportunity and, realizing the set goals, to look for a solution with the available resources, as well as to promote the ability to control one's emotions, to find solutions to unexpected situations

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(Vanaga, Rutka, 2014).

Self-directed learning skills for preschool children promote all-round development, providing a favorable foundation

for their future education and life. These skills stimulate children's curiosity, self-motivation, and the ability to take initiative in their learning, which is necessary for successful and sustainable development. The development of self-directed learning provides a foundation for children's intellectual, emotional, and social development, promoting the ability to learn, understand, and solve problems.

Education in general is a self-evident and natural process that a child can develop on his own. The task of the teacher is to be there, guide the child's activities, set up an appropriate learning environment, and offer and provide diverse learning materials, work tools, and auxiliary tools, motivating children to express themselves creatively and gain experience (Montesori, 2019).

Self-directed learning of a preschool child takes place under the supervision of teachers, as they are the people who help by being around, guiding children's activities, and introducing them to the learning of new topics and skills. The development of self-directed learning brings great benefits to children in their future lives, as they become independent personalities who, with the support they need, can complete many tasks based on what they have experienced and felt before.

The preschool teacher's competence is to diversify the children's daily life in the preschool educational institution and to help them learn the achievable results of the necessary learning areas in the context of the children's interest in acting on their own.

The development of self-directed learning stimulates the child's independence and promotes self-confidence, supporting his ability to think for himself, analyze information, and find solutions. At this age, children are very interested in the world around them, and self-directed learning skills can help them take an active role in their education, ask questions, and seek answers.

Previous research (Aboltina, 2021) shows that preschool teachers lack a common understanding of children's self-directed learning. Teachers are often challenged to promote the development of children's self-directed learning skills (Todd, Douglas, 2012; Grava, Pole, 2021). This indicates the need to study the theoretical aspects of promoting self-directed learning and to develop and approve solutions for the development of self-directed learning skills in preschool children.

As various technologies are introduced and used more and more nowadays, one of the possibilities to diversify the learning process is to use educational technologies. The introduction of educational technologies in preschool is a step forward in improving the learning process, however, it requires a thoughtful and careful approach to guarantee the appropriateness of technology and its integration into the learning process. Such an approach, combining the possibilities of educational technology with a pedagogical vision, can create an effective learning experience that strengthens children's curiosity and joy for natural science from an early age. Promoting self-directed learning in natural science learning in preschool is an essential aspect that helps children actively engage in the learning process and develop their knowledge and skills in the field of natural science. Such an approach gives children the opportunity to explore the world around them by themselves, promoting curiosity and interest in nature and its processes.

In the research, the theoretical regularities of self-directed learning have been investigated, play activities have been developed and approved in the field of natural science education, using the programmable floor robot. The research has been applied to the promotion of self-directed learning in the field of natural science in the second preschool age for children from three to four years old.

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The aim of the research: is to analyze the theoretical aspects of self-directed learning, and to develop and approve play activities with the use of programmable floor robots in the natural science teaching process for the development of self-directed learning for preschool children. Research methods: analysis of scientific and methodical literature, observation of children's activities and evaluation of play activities, and data processing in the SPSS program.

LITERATURE REVIEW

Development of Self-Directed Learning in Preschool

At preschool age, children learn the basics to be able to manage their learning and to be able to get quality education. Self-directed learning as one of the cross-cutting skills allows you to acquire real and at the same time problem-solving skills (Çakır, Yalçın, 2022). Today, preschool educational institutions emphasize the development of self-directed learning skills for children, because teachers create the learning process in such a way that the child knows how to do everything on his own - freely choose his actions, connect his experience with current situations and build cooperation and interaction with others.

Self-directed learning is the freedom that is given to children and when experiencing difficulties, children themselves limit their freedom, thus maintaining a sense of security. The freedom of self-directed learning means that the child is not afraid of his actions and the expected result, nor is he afraid to be different and try new things. The child does

not lose heart and realizes himself. Freedom in the learning process is an integral criterion for self-realization, but at the same time, one must learn to respect the opinions of others, and the actions of others, and be able to rejoice in the achievements and successes of other children (Helminga, 2006). During self-directed learning, the child is constantly in the process of developing, improving, and acquiring knowledge, besides, not everything is learned at once, some knowledge and skills need a longer time to develop (Menzendorfa et al., 2020), and the preschool pedagogue is the one who organizes an appropriate pedagogical environment, manages the learning process and makes constructive conclusions.

Self-directed learning as a cross-cutting skill is defined as setting the child's development goals, implementing them, analyzing actions and thoughts, managing the ongoing sensations, feelings, and thoughts, and, of course, learning from unsuccessful actions in which a mistake has been made (Skola2030, 2019).

Self-directed learning is also described as gathering experiences and drawing conclusions. The child compares situations and looks for similar moments experienced. Realizing that the actions are repeated, the child memorizes this situation and what he has learned, and tries to apply it the next time. Repetition of such lessons or actions creates awareness of the need to remember them. In this way, situation analysis, forecasting, action planning, and evaluation are practiced (Namsone et al., 2018).

In self-directed learning, the child learns and learns on his own because it is his initiative to act. Educators and other adults can partially facilitate the formation of self-directed learning skills - by placing the materials, tools, instruments, and other means necessary for the learning of learning areas in the child's environment, with the help of which the child will create his own experience. Educators guide the child, observe, and help if there is such a requirement, but do not teach according to a certain plan and rules. The child must be allowed to act on his own, to make choices between actions, things, and ways of acting, and to realize his goals.

Integrated learning, which is based on the integration of several learning areas, combining them around a main learning idea, can be used for successful learning of learning areas. Learning material should be designed in such

a way that the child can see the connection between the learning process and life situations. Learning areas of study through play creates both intellectual and emotional upliftment for the child. By creating a connection between the already experienced and the new, the child comes up with new ideas, new applications, and how to diversify the activity.

The child himself is the main leader in the learning of the field of study because preschool children are great explorers, inquisitive, and learn very quickly. In such learning, the teacher is a fellow human being, without whom the child cannot fulfill all his wishes and needs, but the teacher is also an observer when the child is in his world and acts self-directed. The teacher is important, because it is he who prepares the environment for children, which is safe, maintains order in it, and ensures the introduction of new learning materials in the learning process. During self-directed learning, the child perceives everything through what he has experienced, so the teacher cannot limit himself to explaining the theoretical learning content only (Helminga, 2006).

Currently, in many countries of the world, attention is paid to the findings of Montessori pedagogy, when education is described as a natural process in which children learn according to their developmental needs and individual speed when it is ensured that curiosity, analysis, creativity, cooperation, problem solving, responsibility to learn are developed and critical thinking (Çakır, Yalçın, 2022).

Based on Montessori pedagogy, the child, guided by his initiative and desire to do something, forms his personality and shows his character. Every person, including a small child, has to live his own life, therefore, the child must have a supporter and observer by his side, who helps him adapt and is by his side in critical situations - these days, these are preschool teachers. In preschool, the child gains the experience of functioning, communicating, and interacting, as it grows and develops fully (Helminga, 2006).

In Montessori pedagogy, there is equal interaction between the child himself, the adult, and the learning environment in which they are located. The child is the main leader of this process, the others are supporters. These three structural units interact with each other. An adult can intervene in the research process to help, but not for a long time - later the child is left alone again in his cognitive world (Deivisa, 2020).

Today, children develop very quickly and adapt to the world of new technologies. Allowing learning and expressing themselves in a self-directed way, children get used to new skills such as thinking ahead, being aware of possible obstacles, and predicting what the result will be in a given situation. Children learn the skill of self-evaluation, during which they must determine their actions and conclude whether these actions could have been done differently. Children learn to perceive loss as an integral part of life experience - they learn to identify and describe it, putting forward proposals for improving the activity (Skola2030, 2019).

As a result of the theoretical analysis, self-directed learning development content units were proposed (Figure 1). It is important to organize the learning process so that the child gets positive emotions because self-directed learning is an emotional process (Rager, 2009). During self-directed learning, a child must learn the skill to manage and regulate his emotions and actions, to regulate his behavior, and to achieve a goal, he must learn to motivate himself (Schweder, Raufelder, 2019; Skola 2030, 2019). Researchers (Veenman et al., 2014; Azevedo, Aleven, 2013) indicate that a child has good self-directed learning skills if he can motivate himself to learn, manage his emotions, plan, analyze, and evaluate his learning results. Self-directed learning is also based on thinking and action-planning processes (Grava, Pole, 2021). This means that the child, using reflection and memory, can connect his actions. Self-management requires a lot of attention, as actions may vary in the flow of emotions. It is concluded that self-directed learning depends on the child himself, on how he motivates himself, what goals he sets for himself, and what actions he uses to achieve all this.

Self-directed learning is related to the development of a preschool child's personality, as it includes setting real and practical goals, making decisions, and achieving goals in any sphere of activity - social, emotional, cognitive, etc. (Grava, Pole, 2021).

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Analyzing the information, methods for building meaningful self-directed learning skills were identified. One of the main methods of skill building is the application and observance of "sensitive periods". As a child grows and develops, there is a certain time over time when he/she is more prone to learning a skill. It is important to comply with it in time and properly guide and support the child. Self-directed learning skills development methods are based on attention and phonemic perception of a certain object, phenomenon, or being in the learning of learning areas. Memory and experience play an important role in a child's life, it forms a reflection on what has been seen, heard, and felt - for the child it is like an auxiliary tool that he uses in the realization and achievement of future activities.

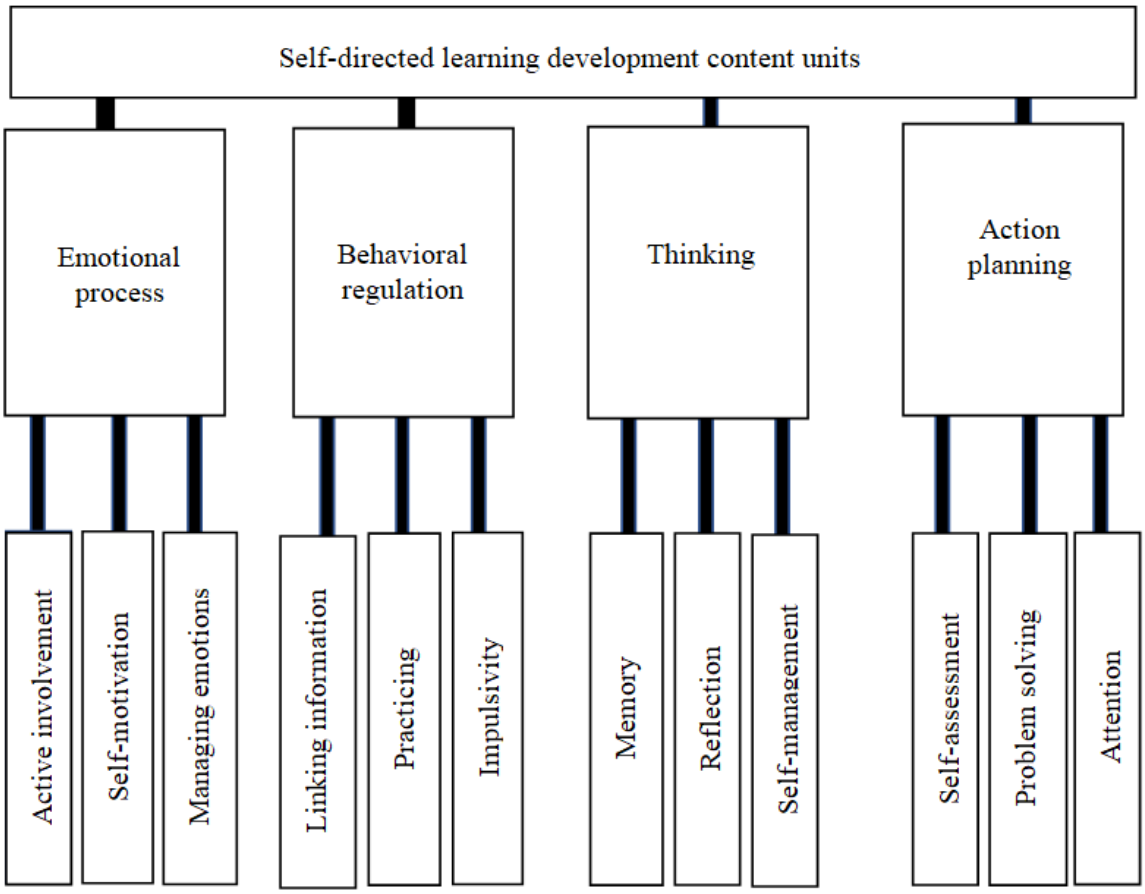

Figure 1: Self-directed learning development content units

By studying and analyzing self-directed learning skills development methods, it is concluded that the development and improvement of a child requires a long time, patience, and knowledge. The task of peers is to introduce children to the learning process and allow them to find out the information they need on their own. Based on the methods of building these skills, the child will become persistent in the future, show empathy, and devote time to self-improvement and achieving goals.

By integrating the development of cross-cutting skills in the learning process, the child learns to plan his activities with a certain goal, so that what he does during the activity gives him understanding and knowledge about a certain topic. On the other hand, the pedagogue, setting the achievable results for the learning process, plans the child's daily life in the educational institution (Namsone et al., 2021).

A teacher is a person who is aware of skill-building methods and applies them in his professional activity, using

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various means, researching learning factors, and performing analysis to improve and develop children's learning (Namsone et al., 2018).
Self-directed learning skills are present in every child, but the degree of their development varies. One child may spend a long time independently playing, exploring, and exploring, while another child needs the involvement, support, and help of an adult. The pedagogue in the preschool educational institution has to direct the children to independent activity and in this, he is helped by various methods and means that contribute to the development of self-directed learning skills.

Educational Technologies in the Learning Process in Preschool

In the learning process, the educational institution must use methods and means that contribute to the achievement of the child's achievable results. Nowadays, various technologies are increasingly being created, implemented, and used, which are also used in preschools as auxiliary tools for learning subjects. Various technologies are used in the preschool, such as interactive whiteboards, tablets, and interactive toys. One such auxiliary tool is the programmable floor robot, which has already been successfully integrated into the learning processes of many preschool educational institutions - learning different fields of study, different topics, learning new information, thus promoting children's self-directed learning, thinking, and also developing skills in using educational technologies.

Children in the modern world must be able to work with various technological devices, moreover, if they are used in the learning process, it is a double investment in the child's future - fun, interactive work in the learning process and new skills in working with educational technologies (Tamsone, 2021).

Educational technologies - robots are very diverse, as some devices can move with several legs, others move on wheels, and some fly at a certain or variable height. Robots differ in what they are designed for, they differ in size, structure, and color. Robots are created machines that are controlled by a person - with speech or language, coding, programming, reflexes, and remote control - and the robot performs tasks at the request of a person (Guizzo, 2023; Papadakis, 2020).

By teaching children coding and programming at an early age, the child is prepared for the world of modern technologies (Marinu set al., 2018; Eteokleous, 2019). Self-directed learning is one of the skills, how a child learns to do an activity by himself - by planning it himself, choosing the most suitable actions, performing a task and analyzing it, and also the child learns to be responsible for his actions.

Making mistakes in programming or other ways using educational technologies is significant for young children - this is how they learn, use logical thinking, and come up with new ways to do differently what failed, and look for new solutions. It is important to allow children to make mistakes and try to analyze their own mistakes and offer solutions for their elimination. Mistakes in the use of technology teach, build understanding, develop skills, and help to strengthen character qualities - patience and perseverance so that the goal is finally achieved (Bonfligo, 2022).

Integrating technology into the learning process allows preschool teachers to turn lessons into fun, educational games in which children participate as participants learn new topics and gain new knowledge while playing (Bers, et al., 2014).

Each device should have a set period during which the child can operate it. Likewise, the use of educational technologies in the learning process does not replace the importance of other learning areas - educational technologies improve understanding of topics, skill development, and visual perception (Tamsone, 2021).

Interaction with educational technology takes place only if the thing, subject, or device is used usefully and meaningfully. The use of educational technologies in an educational institution should be based on the achievable

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results of the learning areas, the children's age, and the development period. All conditions are reviewed by the teacher, who plans methods and techniques for effectively conducting play lessons for children in the respective age group.

The use of educational technologies also requires additional materials created by both teachers and children themselves, such as task cards with drawings, numbers, and pictures, as well as various interactive games in which the teacher includes the main aspects of the subject to be learned. Tasks must be appropriate for the age and development period, as well as contain information about the subject to be learned and with its help achieve the results of the field of study.

Educational technologies, which are used for information acquisition, cognition, and processing, are considered very versatile tools. Based on the fact that in the last ten years, educational technology has developed very rapidly and taken over the whole world with various innovations, the classical teaching method of the fields of study has become outdated and children are not so interested in the learning process. However, by using the integration of educational technology in the learning process, this can be prevented and learning can be made an interesting and modern activity for children (Pavlovs, 2004; Papadakis, 2020).

Today, children are developing very quickly and their skills in working with technology are very broad. Children understand well both the basic meaning of technology and also know how to work with it - manage, and program. However, the teacher must be able to create a balanced learning process, which includes the acquisition of technologies and theoretical information, as well as practical activities.

Characterization of the Developed Play Activities in the Field of Natural Science Education

Based on the achievable results of the field of natural science in preschool second age groups and their connection with self-directed learning, play lessons were created, the learning of which was connected with educational technologies - TTS BeeBot programmable floor robot 2.0.

Learning the field of natural science is based on getting to know nature and the surrounding environment, the territory and the ability to navigate in it, sensory development, language development, as well as working with various objects, materials, and tools (Līduma, 2014).

Group work with the programmable floor robot bit is offered relatively rarely to children of the second age stage, therefore children are allowed to play the game "Meet the robot bits" at the beginning of the lesson. During the game, one gets to know the robot bee itself, learns skills in working with it and learns about the basic principles of robot programming and its control.

As part of the study, four play activities were developed, which include nature themes and work with the programmable floor robot bit, which helps children learn the content of the science curriculum and develop self-directed learning skills:

1. "Living and inanimate nature around me";
2. "Water in nature";
3. "What lives in water?"
4. "What grows from the seed."

Play activities with robot bits were created so that the child, by participating in them, develops and perfects logical thinking, develops and perfects the already acquired knowledge in the field of natural science, performs self-directed actions, and finds independently invented solutions for various situations created in the learning process. The play activities that used robot bees, floor bases, or mats were designed, which depict the educational material corresponding to the topic, which the child gets to know.

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Play activity "Meet the robot bees" - children are offered a floor mat on which the bee can operate on the corresponding squares of the mat. Children are told that the robot bee on the floor moves one square forward with one press of the 'forward' button, marked with an arrow, the 'right' and 'left' buttons, also marked with corresponding arrows, allow the bee to turn, but it does not move forward. The robot bee also has a clear button to restart the programming in case a mistake is made or the wrong arrow is pressed. In this play activity, children try to reach the finish line using various maps created by the teacher with the respective route, thus getting to know the capabilities of the robot bee.

When the children have become familiar with the possibilities and the course of operation of the robot bee, then the first topic of the natural science field of study "Living and non-living nature around me" is explored. In the beginning, the teacher invites the children to present their thoughts on how they think these two concepts are characterized, later pictures are presented, which must be classified according to their essence and divided into two parts, where one is living nature and the other is non-living nature. After grouping the picture cards, the children divide themselves into two teams and choose which group of picture cards they want to work with and go to the floor mats on which various objects, things, and beings are depicted. The children's task is to program the robot bit so that it can reach its end point from the starting position according to the picture card. By learning the topic, children improve their skills in group work, cooperation, logical thinking, and programming, as well as develop self-directed learning skills.

Learning about living and non-living nature, it is concluded that living nature needs water, therefore the second theme is "Water in nature". Within this topic, children get to know the importance of water in the life of both animals and plants, as well as people, as well as the properties of water and ways of obtaining it.

In addition to the theme of water, children are also talked about what lives in water. Therefore, the children's knowledge about living beings, organisms, and various animals that live in and on water, the place of residence, and the characteristic features of the inhabitants are supplemented. Children learn the necessity of living nature in our lives and how we can take care of living nature, living beings, and organisms that are in and live in water.

The closing theme of the month is "What grows from a seed?". Within this theme, children get to know the growth process as such, the growth process of specific plants. Children are invited to design their floor mats for the robot bee, depicting the different phases of the growth process in a jumbled way. The children's task is to show their knowledge in the field of natural science, the acquired knowledge about the growth process of a bean, the actions that help the seed to grow, as well as to introduce the skills of the expert-observer, by working with the floor robot bees themselves, thus demonstrating the skill of self-directed learning.

RESEARCH METHODOLOGY

The research on the use of educational technologies in the learning of natural science was conducted in the second age group of a preschool educational institution. As part of the study, children were introduced to educational technology - TTS BeeBot programmable floor robot 2.0. For data collection, five play activities were created, during which children worked with programmable floor robots and were evaluated according to twelve criteria corresponding to such content units as emotional process, behavior regulation tools, thinking, and action planning. The evaluators in the study were the group teacher and an expert, who is a teacher and methodologist of a preschool educational institution. The expert's experience in working with educational technology - the programmable floor robot - is two years. Children's performance was evaluated with points from one to five:

5 – active involvement, operation;
4 – engages only in cooperation with others (children/adults);
3 – shows interest only in a topic/situation/process known to him;
2 – participates as an observer, not a participant;

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1 – does not show interest, does not get involved in the process.

11 children aged 3-4 years were involved in the study. The difference in age makes it possible to examine children's skills, emotional development, and interest in using educational technologies more widely.

The SPSS program was used to process the research data, performing Cronbach's alpha test, Kolmagorov-Smirnov test, Mann-Whitney U-test, and Kendall's correlation test.

At the beginning of the study, an ascertaining play activity was implemented, during which the children got to know the programmable floor robot and the evaluators could assess the children's skills in operating it. After the establishing play activity, three play activities followed, during which the children actively worked together with the teacher of the group - exploring the field of natural science with the floor mats developed by the teacher and the relevant tasks. At the end of the study, a play activity was implemented, in which the children demonstrated their skills in operating the programmable floor robot, applying cross-cutting skills, and achieving the achievable results set by the field of natural science. After processing the results obtained in the study, conclusions were formulated.

RESEARCH RESULTS

An evaluation table containing twelve criteria was developed for the evaluation of children's performance with the programmable floor robots. The scoring table criteria were coded.

Cronbach's alpha test was performed to ascertain the internal consistency of the scoring table criteria. The obtained result (p=.905) shows a good internal consistency of the evaluation table criteria.

The results obtained in the Kolmogorov-Smirnov test (p<.05) show that the data do not correspond to the normal distribution, therefore non-parametric tests were used in the analysis.

To determine the distribution of answers, a frequency test (frequency test) was performed for the three criteria of the evaluation table of play lessons (Table 1)

Table 1: Results of the frequency test for three evaluation criteria of play activities

Criterion	Average value		
	1st play activity	2nd play activity	3rd play activity
1. Active involvement in the process	3,64	4,55	4,73
2. Self-motivation to act	3,55	4,45	4,73
3. Managing, controlling one's emotions	3,64	4,64	4,91
4. Integration of information with the operational process	4,45	4,82	4,82
5. Repetition, practice of actions	3,73	4,64	4,82
6. Taking initiative	3,64	4,09	4,27
7. Memorization of information, its application in action	4,64	4,82	4,82
8. Reflecting on what has been done	4,55	4,18	4,45
9. Self-directed operation	4,73	4,73	4,91
10. Self-assessment	4,09	4,45	4,36
11. Engaging in problem solving	3,45	4,45	4,73
12. Staying focused throughout the process	3,73	4,82	4,73

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The highest average value in the first play activity is the criterion of self-directed activity – 4.73. This means that the children actively engaged and worked with the programmable floor robot, and it was also a benefit of great interest because the children had a great desire to operate and get to know the new educational technology used in the learning process.

The lowest average value in the first play activity is for the criterion of involvement in problem-solving – 3.45. During the first play activity, children's involvement in problem-solving was observed only in a topic known to them, which indicates that the children have not yet mastered the skills of working with the programmable floor robot, and do not know how to fix the problems that have arisen (for example, programming the wrong direction).

In the second play activity, the highest average value is for the criteria linking information with the action process, memorizing information, applying it in action, and maintaining attention during the entire process. It can be interpreted as the children's interest in the topic to be learned and the application of the acquired knowledge in working with the programmable floor robot, as well as the children's desire to get involved in the work process - to cooperate with other children and to work independently.

The lowest mean value in the second play activity is for the criterion of taking the initiative. During the activity, it could be observed that children work more in cooperation with others, and prefer to wait until someone else takes the initiative. This shows that children are afraid to make mistakes and take responsibility for their actions.

The third play activity has the highest average value for the criteria of managing, controlling, and self-directed emotions. This rating is explained by the fact that the children, working with the programmable floor robot for a month, have learned and developed various skills, and have also become independent in their actions. Children know how to wait their turn, know how to accept help and also help others, as well as know how to tell about their achievements or mistakes and make constructive conclusions about their work.

The lowest average value in the third play activity is for the criterion of taking the initiative. This means that children do not want to start work first, because the toy robot is already a part of their daily life, with which they spend time in the learning process, and there is no surprise effect for them, as it was in the first play activities.

Evaluating all the results that were obtained by evaluating the children's activity process in play activities according to twelve criteria, it is concluded that the children's self-directed learning skills are applied in working with the programmable floor robot, which manifests as managing their actions, the ability to control their emotions, cooperation with other children and reflecting on the work done. By working with the programmable floor robot, not only the basic skills were learned, but also the achievable results in the field of natural science were achieved both by looking at the big topic of the month and also by looking at the topic of each week. It is very important for children to act both practically and to know the topic theoretically, but to understand the need for technology during the learning process, interaction must take place.

Within the framework of the study, it was found whether there are statistically significant differences depending on the measurements of the group teacher and the expert. According to the result of the Mann-Whitney U-test, it is concluded that, in general, no statistically significant differences were found in the results ($p>.05$).

The results obtained in the study from the ascertaining play activity and the final play activity were compared with each other (Table 2) to be able to see how the children's skills changed at the beginning and at the end of the study, as well as to conclude whether the use of educational technology in the learning process promotes children's self-directed learning.

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Table 2: Comparing the results of play activities

Criterion	Average value		p
	Ascertaining play activity	Final play activity	
1. Active involvement in the process	4,32	4,86	,535
2. Self-motivation to act	4,14	4,68	,399
3. Managing, controlling one's emotions	5,00	5,00	1,000
4. Integration of information with the operational process	4,09	4,77	,104
5. Repetition, practice of actions	4,05	4,95	,775
6. Taking initiative	3,82	4,50	,005
7. Memorization of information, its application in action	4,00	4,82	,003
8. Reflecting on what has been done	3,95	4,77	,738
9. Self-directed operation	3,91	4,86	,577
10. Self-assessment	4,50	4,86	,430
11. Engaging in problem solving	4,00	4,82	1,000
12. Staying focused throughout the process	4,64	4,95	,801

Kendall's correlation test showed significant correlations. The correlations were such criteria as self-motivation to act (r=.872) and connecting information with the process of action (r=.841), which shows that children motivate themselves to act with the information they have obtained, which they want to apply in action, to show the acquired knowledge practically. There were also correlations for such criteria as self-directed functioning (r=.786) and involvement in problem-solving (r=.786), which indicates that children engage in problem-solving on their initiative, independently engage in conversations with others, and seek compromises. Correlations indicate that almost all criteria are closely related and derive from each other. Self-directed learning is the basis for all the child's actions, which he learns in the learning process and his daily life. The results of the evaluation table criteria analysis tests agree with the theoretical findings, and the results also indicate that by using the programmable floor robot and the play activities developed by the teacher, the self-directed learning skills of the second-age children are improved.

CONCLUSIONS

The idea of self-directed learning is to give the child freedom in his actions, thus allowing him to understand the world around him with his senses, to connect with experiences, achievements, and failures, because the child is inherently able to lead himself and this is given to him by nature.

The skill of self-directed learning promotes children's ability to manage their learning process, take initiative, actively engage in learning activities, and stimulate their curiosity, critical thinking, and the development of practical skills, which are essential in learning natural science. Natural science play activities are particularly suitable for developing self-directed learning skills for the following reasons:

• Hands-on experience, active exploration, and experimentation: In natural science play activities, children often have the opportunity to do hands-on work, experiment, observe, and explore. The skill of self-directed learning in this context allows children to actively engage in these processes, choose topics that interest them and design experiments, gain hands-on experience, and understand scientific principles based on their interests.

• Fostering curiosity and understanding observations: In natural science, it is important to foster the development of curiosity and the ability to understand the world around us. Self-directed learning through play activities allows children to explore natural phenomena and make observations that stimulate their curiosity and help them understand the laws of nature.

• Development of critical thinking: In natural science play activities, children are invited to analyze, think

sequentially, and draw conclusions about what they have observed or experienced. The skill of self-directed learning encourages this critical thinking because children must decide how to solve problems and how to explain their observations.

By using the play activities developed by the pedagogue with thematic tasks, preschool children of the second age stage successfully improve their self-directed learning skills, as well as achieve the set achievable results for the teaching field of natural science. Educational technologies used in play activities – programmable floor robots – help children understand the essence of the topic, become independent and responsible for their actions, and also teach them not to be afraid to make mistakes, analyze mistakes, and find successful solutions to achieve the goal. Play activities that use educational technologies are becoming more modern, more exploratory, and more exciting. The child learns not only the achievable results of the field of study but also develops the skills to work with modern devices.

For the learning of self-directed learning skills to be successfully realized, preschool children must be given freedom in the learning process - in actions, self-improvement, expressing opinions, and forming cooperation with others.

ETHICAL STATEMENT

An official application for conducting the research was submitted to the administration of the preschool educational institution and ethical permissions were obtained. The children's parents were also informed about the conduct of the research, and parental consent was obtained for the children's participation in the research. Data confidentiality and anonymity were ensured throughout data collection and evaluation.

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