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The impact of extracurricular activities on the fostering of learners' research skills

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Abstract

This study examines students' research skills and how extracurricular activities influence the fostering of students' research skills. A mixed-methods approach was used before and after the test. The experiment included 160 participants. The study revealed that research skills were developed formally among the learners through extracurricular activities. The author created and implemented an extracurricular activity programme in the context of experimental manipulation to help the students improve their research skills. A set of measures was carried out to develop research skills through extracurricular activities to support and encourage the students' research search. This study found that extracurricular activities have an impact on students' development of research skills by providing them access to new perspectives and scientific knowledge in the field of problem-solving research, as well as by applying that knowledge in practical settings to support research skills in extracurricular activities.

Keywords: Development, Extracurricular activities, Impact, Primary school, Research abilities, School children.

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Contents

Contribution of this paper to the literature
This study adds to the existing literature by examining students' research skills and how extracurricular activities influence the development of students' research skills.

1. Introduction

Modern education in Kazakhstan aims to create an environment conducive to the growth and self-improvement of students, with the formation of educational and research motivation being one of the most important means to achieve this goal. This requires the creation of specific conditions in educational practice for the inclusion of younger students in active cognitive activities, particularly research activities.

The issue of developing research skills among students has become especially relevant these days, although it should be noted that it attracted the attention of researchers in earlier times (Cicekci & Sadik, 2019; Swider-Cios, Vermeij, & Sitskoorn, 2023). According to Aktepe and Ulu (2023), children begin to develop analytical skills in the first grade when they learn behavioral standards and rules, solve emerging problems and gain personal experience. Vieno, Rogers, and Campbell (2022) investigate the characteristics of research behavior and educational activities. According to the research of Blumberg et al. (2019), a child's cognitive and research activity as they explore how the world around them functions becomes clear by the time they are in preschool. Gizzonio et al. (2022) identified the criterion-level characteristics of research skills in primary students and analyzed data on junior students' creative abilities. Castillo-Martínez and Ramírez-Montoya (2021) explore the potential of extracurricular activities, including individual principles, work approaches, and their role in the school system.

In educational institutions, children in elementary school have been observed to participate in research activities. However, an examination of organizing scientific research activities reveals that it is inadequately focused on younger students and does not provide practical educational resources to solve research problems (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2020). Öcek et al. (2021), Yeboah, Abonyi, and Luguterah (2019) and Obiyo and Inyama (2019) identified challenges in developing students' interest in science include insufficient preparation time, inadequate resources for experiments, and limited curriculum scope. The most obvious issue is that students' research activities are purely empirical, consisting of taking measurements and making observations without understanding the theoretical foundations. The theory within which the research is carried out is, for objective reasons, inaccessible to the students' understanding. Therefore, this task is difficult to implement in a classroom-based teaching system (Edry, Sasson, & Dori, 2023).

Rational research planning involves employing various methods with varying degrees of generality, and a cognitive task posed as a research task is open (containing multiple acceptable solutions and outcomes). In this regard, the emphasis is on developing deep and lasting knowledge of students, as well as general educational skills such as universal learning activities, functional literacy, and research activities (Yespolova, Irodakhon, Bekzod, Rabiga, & Zhupat, 2023; Zhakupova, Kyakbaeva, Karimova, & Omarova, 2022). However, the organization of learning in our country frequently mirrors the Soviet educational system. This system was founded on a knowledge paradigm and instructional methods that contradicted the stated goals of modernizing education (Nagima et al., 2023). In laboratory workshops, "recommendations" and "instructions" for performing experiments are compiled in such a way that they provide the student with specific and complete guidelines for performing almost all actions. This eliminates the possibility of the student engaging in independent, irrational, and incorrect behavior. This is one of the reasons why students' research skills and, in general, cognitive competencies have not developed adequately. In some cases, the desire to offer an objective novelty has negative consequences. At the same time, the independent development of projects by students requires a significant investment of training time.

Finally, the most important aspect of fostering research abilities is the impact of extracurricular activities on students' research skills. However, the main question is whether the use of extracurricular activities promotes research skills and improves research activities. If that is the case, how does it occur? Unfortunately, the existing literature has not adequately addressed the issue of fostering students' research abilities through extracurricular activities, despite acknowledging the potential of extracurricular activities in enhancing students' research skills and engagement in research. The methodology for organizing students' research skills in elementary school extracurricular activities, particularly in Kazakhstan, is still in its early stages. This study attempted to address the following research question:

1.1. Research Question

Q1: Do extracurricular activities have a significant effect on fostering students' research skills?

1.2. Objectives

The present study examines students' research skills (RS) and how extracurricular activities influence the development of students' research skills.

The research hypothesis is that extracurricular activities will significantly improve students' research skills as a prerequisite for shaping research abilities and overall cognitive competence.

1.3. Significance of the Study

This study is significant because it addresses the pressing problem of fostering students' research skills through extracurricular activities. The research issue represents the conflict between the need to organize students' research activities and the insufficient focus on developing research skills in junior students through extracurricular activities. The traditional educational process is ineffective in developing research skills in primary students through classroom activities. This study adds to the existing literature by investigating whether extracurricular activities have a significant impact on developing students' research skills. During the research process, the following were developed: diagnostic tools that allow teachers to assess junior students' research skills, content, forms, and methods of fostering research skills in extracurricular activities in primary schools. During the research process, the following were developed: diagnostic tools enabling teachers to assess the research skills of junior students; content for the

development of students' research competencies; and forms and methods for fostering these skills through extracurricular activities in primary schools.

2. Literature Review

Most researchers' main subject matter interest has been studying how research skills improve over a long period of time, especially in younger students (Ibrahim & Lede, 2018; OECD, 2019a). In the opinion of Kirchhoff and Keller (2021) and Nasheeda, Abdullah, Krauss, and Ahmed (2019), the education of children's special knowledge as well as the development of their universal skills and abilities is one of the practical tasks of modern education. Polat and Kutlu (2022) argued that effective pedagogical innovations to develop students' creative abilities activate cognitive search activity. Gregory et al. (2021), Christensen, Taylor, Hancock, and Zubrick (2022), and Sørlie, Hagen, and Nordahl (2021) emphasize the importance of early involvement in the exploratory process for developing research skills.

Rodríguez, Pérez, Núñez, Baños, and Carrió (2019) identify several types of research skills. Böttcher and Thiel (2018) believed that the category "research skills" was defined after considering various approaches to defining the category "skill." Ricciardi et al. (2021) compared "research skills" with "research behavior," "research activity" and "educational and research activity." Miller and Kehl (2019), Duncan, Duncan, Stanley, Aguilar, and Halfon (2020) believe that using these categories with the following provisions is the best. Human research in its phenomenology is based on research behavior, which is a child's basic need. Search activity is the foundation of both research behavior and research activity. Fanchini, Jongbloed, and Dirani (2019) and Bezerra, Alves, and Azoni (2022) examined the characteristics of junior students research skills at three levels: adaptive, productive and creative. However, according to Pérez-Suay, García-Bayona, Van Vaerenbergh, and Pascual-Venteo (2023), the researchers' attempt to classify the research skills of junior high school students does not take into account their age characteristics or didactic capabilities. Many researchers have serious doubts about teachers' ability to achieve these goals despite understanding the importance of research ability and sharing ideas about the concept of research activity development (Albalawi & Johnson, 2022; Van Leeuwen & Janssen, 2019).

The concept of stage-by-stage (planned) formation of mental actions should be considered an important regulation in the formation of research activities since it presents all the necessary stages of the formation of actions performed in educational research. Hazrati, Hashemi, Gholtash, and Machinist (2021) found that research activities include individual knowledge, skills, and abilities as well as the willingness to learn new ways and techniques of activity based on the general formulation of research abilities.

Assimilation and development of the toolkit of experimental activity occur when the student experiences a real need to use certain means to carry out this activity. Barroga and Matanguihan (2022), El-Hamamsy et al. (2022) and Nugteren, Jarodzka, Kester, and Van Merriënboer (2018) believe that a student's research activity includes forecasting (building hypotheses), modeling, and implementing one's future, proposed actions as well as correcting research behavior. Educational and research activities for students require significant motivational, methodological, organizational to a lesser extent, informational support from the teacher regardless of the form of organization or the number of participants (individual, group, or performed in front of the entire class).

According to Munir and Zaheer (2021), the specifics of extracurricular activities are best revealed through their principles: free choice (student's choice of direction, type of activity, degree of participation in collective affairs), objective uniqueness, interactions (partnerships between participants in joint activities to develop a strategy to achieve the desired result), and psychological comfort (empathic communication between an adult and a child, removing all stress). Oberle et al. (2019) found that extracurricular activities may enable learners to seek new modes of research action and methods of presenting research results, as well as build the teacher's cognitive trajectory of the child based on his personal experience. This highlights the essence of student extracurricular activities. Students can complete research projects throughout many courses, often for up to six months, through extracurricular activities in addition to short-term tasks designed for one or two classes. However, Bapanova, Orekhova, Kadirsizova, Kasbayeva, and Sholpankulova (2025) believed that despite this diversity of different studies, there appears to be agreement on (1) the need for developing country researchers to build on international research findings, and (2) the directions that new research in developing countries should take. Therefore, more research is needed to explore the potential of extracurricular activities and how extracurricular activities influence the development of student research skills.

3. Method

3.1. Research Methods

We chose the quantitative and qualitative methods of the study that were carried out simultaneously to conduct the research. A mixed strategy provides additional data and offers the opportunity to examine the phenomenon from different perspectives.

3.2. Research Sample

The experimental group (EG) consisted of 80 fourth-grade students from Secondary School No. 39 (Shymkent, Kazakhstan), while the control group (CG) consisted of 80 fourth-grade students from E. Izzatullaev Elementary School (Turkestan, Kazakhstan). The average age of the participants (N = 160) was 9-10 years, as the study was conducted among elementary school students in grade 4.

3.3. Measures

General sociometric indicators such as gender, age, school and classroom were collected from study participants (see Table 1).

Table 1. Descriptive information provided by the respondents

Descriptive information about a respondent's		Quantity	Sample
Gender	Female	86	100%
	Male	74	100%
Age	9-10 years	160	100%
Class at school	4	160	100%
EG	Secondary school no. 39	80	50%
	Male	38	36%
	Female	42	64%
CG	E. Izzatullaev Elementary School	80	50%
	Male	36	46%
	Female	44	54%

3.4. Designing Experiments and Evaluating Performance

3.4.1. Experimental Setting

The experimental site for this experiment is the elementary school named after E. Izzatullaev (Turkestan, Kazakhstan) and Secondary School No. 39 (Shymkent, Kazakhstan). The specific location is the fourth-grade classrooms in an elementary school. Their age, gender, number, and learning ability are all relatively similar, laying the foundation for the smooth progression of the experiment. The specific time frame is September 2023 to December 2023, with a total of 32 class hours. The program lasted 16 weeks, and the specific learning period was Tuesday and Thursday from 14:00 to 16:45, with 45-minute classes. Subject areas include "Mathematics" and "The World Around Us." The experiment focused on the following subject areas: "Mathematics" and "The World Around Us." This experiment intends to use EG and CG to conduct teaching experiments. Diagnostic assessments of the results of the participants in the two groups are administered before and after the experiment begins and ends, respectively, and the specific classroom conditions of the groups of participants studied during the experiment are documented. The experimental group receives additional instruction in the extracurricular activities program "Young Researcher" (see Figure 1), whereas the control group is taught in a traditional elementary school program.

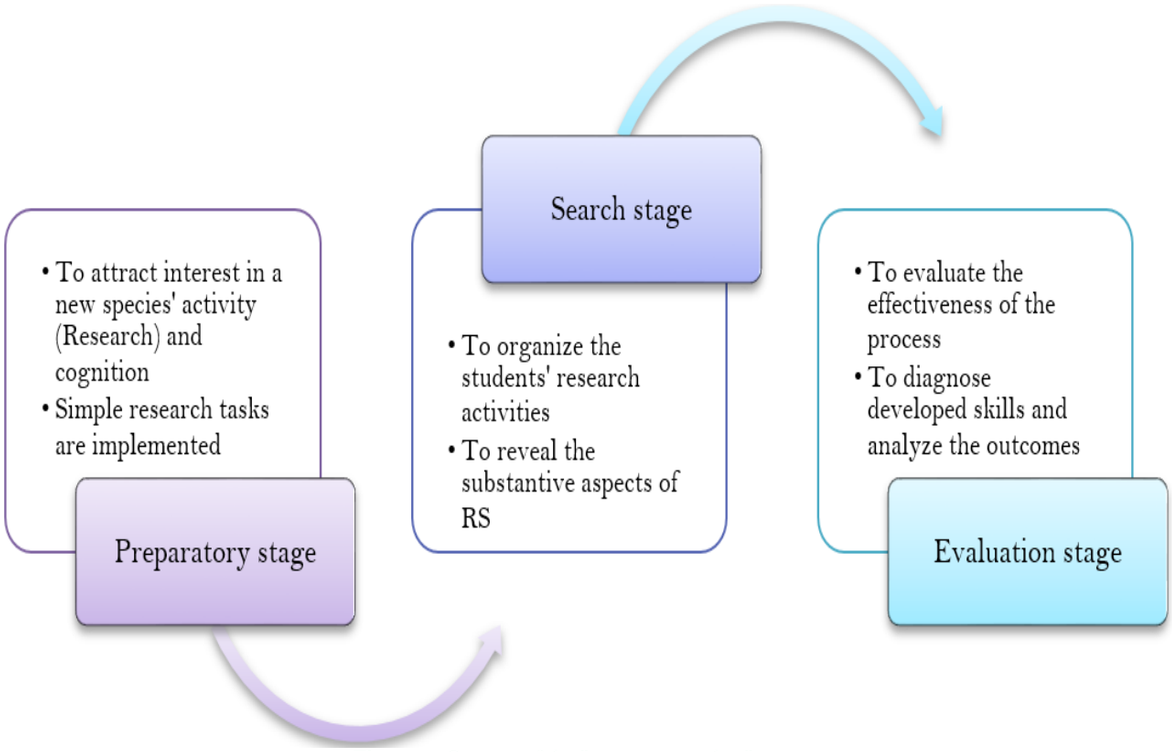

Figure 1. Content of the "young researcher" program

3.4.1.1. Preparatory Stage

The goal of the stage is to attract the interest of EG participants towards a new activity (research) and cognition. The tasks are: (1) to foster the development of the ability to observe objects in the surrounding world to obtain information. (2) To demonstrate the value of research skills. (3) To involve students in the solution of research problems.

At this point, the teacher's primary responsibilities are to pique participants' interest and activity in seeking information to support and encourage any signs of initiative and independence in students, and to strengthen and develop students' emotionally positive attitudes towards research.

3.4.1.2. Search Stage

The goal of the second stage was to organize student activities to develop basic research skills. The tasks are: (1) developing initial ideas about the researcher's activities. (2) disclosing the substantive aspects of research skills using available material (analyze, compare, pose questions, make assumptions, transform the initial state of objects, draw conclusions, evaluate, and present research results).

Presently, the teacher's primary responsibilities are to organize cooperative search activities and to support and encourage the students' research endeavors.

3.4.1.3. Evaluation Stage

The third stage aimed to assess the efficacy of the process of developing students' research skills through extracurricular activities. The tasks are: (1) to determine the levels of development of participants' research skills; (2) to assess the impact of extracurricular activities on participants' EG ability to independently transfer research skills to another type of activity (educational).

The teacher's main functions at this stage are to create problem situations, diagnose developed skills, analyze the results, and formulate conclusions and recommendations.

Methods: The case method, problem-based learning, project method, didactic game technique, research, and explanatory and illustrative methods are some of the methods used in this study.

Forms of organizing research activities: lessons; research assignments, exercises, research lessons, educational games, research projects, etc.

Tools: electronic educational resources, visual materials, educational instruments, scientific and educational literature, portfolios, etc.

3.4.2. Instructional Design

The primary tool for developing research skills in education is research training. The inclusion of children in specially organized research allows them to master techniques of scientific thinking in the process of understanding the surrounding reality. During the 16 weeks of the experiment, EG participants acquired research skills in stages, followed by increasing the complexity of activities, expanding the operational actions performed when solving educational and research problems, and increasing the share of independence in research and the discovery of new things. The inclusion of students in research activities was flexible and varied depending on the characteristics of the individual research experience of the participant.

The following parameters were identified for the development of research abilities based on the characteristics of students' research activities: curiosity, a tendency to experiment, a tendency to observe, originality, flexibility, the development of convergent and divergent thinking, independence, criticality, persistence, and high concentration of attention. The combination of these parameters allows us to trace the dynamics of the development of research skills in young children.

We have identified five levels of development of research skills in junior students based on the parameters indicated.

A high level is distinguished by pronounced curiosity, a proclivity for experimentation and observation, a high level of convergent thinking, independence, perseverance, a high concentration of attention even when performing monotonous work, and a diverse set of interests.

The above-average level is characterized by a sufficient development of curiosity, a penchant for experimentation, the manifestation of interest and the need for observation, possession of sufficiently developed convergent thinking, manifestation of creativity in many types of activities, manifestation of independence, perseverance, criticality, and a high concentration of attention when performing work that is interesting for a primary school student.

The average level is characterized by the situational manifestation of search activity, interest in observations, an average level of convergent thinking, and the unstable manifestation of independence, criticality, perseverance, and attention development.

A level below average is characterized by insufficient development of curiosity, unstable interest in observation, insufficient level of convergent thinking, manifestation of difficulties in solving open-ended, divergent problems, low ability to overcome difficulties, independence, and insufficient development of attention.

A low level is distinguished by a lack of curiosity, an interest in observations, a low level of convergent thinking, an inability to solve open-ended, divergent problems, the inertia of thought, a lack of independence, a lack of criticality, an inability to overcome difficulties, and a low level of attention.

3.5. Research Instrument

A series of diagnostic methods was created to determine the initial level of research skills and the dynamics of their development. These methods included: (1) a test for diagnosing divergent thinking; (2) a test for diagnosing convergent nonverbal thinking; (3) a technique "Simple analogies"; (4) a technique "Elimination of the unnecessary"; (5) an observation.

3.6. Data Analysis

Statistical data were processed using the SPSS Statistics program (version 26.0 for Windows). The mean values were compared using the Student's t-test to determine the statistical significance of the findings. Spearman's rank correlation coefficient was used to identify a statistical relationship between convergent (verbal and non-verbal) thinking and exploratory behavior.

4. Results

Analysis of the results revealed that in the EG, a more pronounced dynamic of research skill development was achieved (see Table 2).

Table 2. Level of research skill development among participants

Stages	Parameters	Levels									
		High level (%)		Above average level (%)		Average level (%)		Level below average (%)		Low level (%)	
Initial		EG	CG	EG	CG	EG	CG	EG	CG	EG	CG
	Curiosity	-	-	9.6	-	66.8	57.4	24.2	43.8	-	-
	Tendency to experiment	-	-	9.6	-	43.2	38.6	24.2	48.5	24.2	15.3
	Tendency to observe	-	-	9.6	-	58.2	58.2	29.6	39.5	5.2	5.2
	Originality	-	-	-	-	38.6	38.6	53.4	39.5	9.9	24.2
	Flexibility			4.8	-	23.6	33.2	53.4	39.5	20	29.2
	Productivity	-	-	-	4.8	38.6	33.2	39.2	43.5	24.6	20
	Elaboration	-	-	9.6	-	33.4	38.6	34.6	48.3	24.6	15.3
	Verbal thinking	-	-	-	-	-	-	53.4	67.7	48.3	29.3
	Non-verbal thinking	-	-	14.4	-	39	41.6	24	43.9	24	15.4
	Independence	-	-	-	-	72.3	38.6	15.3	48.7	15.3	9.6
	Criticality	-	-	9.6	-	53.2	20	20	58.2	20	24.7
	Persistence	-	-	-	-	57.4	42.9	39.7	53.4	5.6	5.6
	Attention	-	-	4.8	-	72.3	33.2	-24.6	58.2	-	9.6
Final	Curiosity	62.8	4.8	15.2	9.8	24.2	78.6	-	4.8	-	-
	Tendency to experiment	47.8	-	15.2	24.2	29.3	58.2	5.6	20	-	-
	Tendency to observe	58.4	-	4.8	15.4	29.3	84.7	15.6	-	-	-
	Originality	34.6	-	34.2	14.7	24.7	77.2	9.6	9.6	-	-
	Flexibility	29.7	-	29.2	28.6	34.3	48.5	9.6	24.7	-	-
	Productivity	39	4.8	24.6	14.7	29.4	77.2	9.6	5.2	-	-
	Elaboration	48.4	-	24.6	20	24.6	62.3	5.2	20	-	-
	Verbal thinking	20	-	9.8	9.8	29.4	24	43.8	53.5	-	14.8
	Non-verbal thinking	24	-	18	13.7	43.6	43.6	9.6	34.4	-	9.6
	Independence	24.6	-	43.2	20	20	62.4	15.3	20	-	-
	Criticality	5.2	-	53.4	-	23.9	86.4	15.3	15.3	-	5.2
	Persistence	43.4	-	15.6	9.8	33.7	66.8	9.6	24.5	-	
	Attention	43.6	-	20	-	29.7	72.3	9.6	29.4	-	

The mean values of the main research skills parameters in CG and EG were compared using students' t-test to assess the validity of the findings. Table 3 compares the initial and dynamic states of the main parameters in EG and CG.

Table 3. Average values of the main parameters

Parameters	Average values			
	Initial stage		Final stage	
	EG	CG	EG	CG
Curiosity	10.3	9.5	14.6*	11
Tendency to experiment	8.7	8.4	13.6*	10.2
Tendency to observe	8.2	8	10.3*	8.7
Originality	6.7	6.7	8.8	6.9
Flexibility	46.5	46.5	56.6*	46.4
Productivity	49.3	49.4	53.4	52
Elaboration	35	34.8	50.07*	38.3
Verbal thinking	18.4	19.2	27.43*	22.4
Non-verbal thinking	9.8	8.6	12.9*	10.4
Independence	9	8.6	12.4*	9.8
Criticality	9.3	8.6	13.7*	9.8
Persistence	9.8	9.7	14.7*	11.6
Attention	9.6	9.5	13.9*	9.6

Note: The * sign indicates statistically significant coefficient values (p=0.05).

According to Table 4, the EG outperformed the control group statistically.

During the final stage, a correlation study was conducted to determine a statistical relationship between the level of development of convergent thinking (verbal and nonverbal) and the research behavior of the participants, using Spearman's rank correlation coefficient (see Table 4).

Table 4. Results of the correlation analysis of convergence thinking and research behavior of participants in the final stage

Correlating variables	Verbal thinking (curiosity)	Nonverbal thinking (curiosity)	Verbal thinking (tendency to experiment)	Non-verbal thinking (tendency to experiment)	Verbal thinking (tendency to observe)	Non-verbal thinking (tendency to observe)
EG	0.926*	0.749*	0.954*	0.814*	0.960*	0.857*
CG	0.314	0.450	0.341	0.285	0.265	0.226

Note: The * sign indicates statistically significant coefficient values (p=0.05).

Analysis of the data obtained during the correlation study showed that in the final stage of the EG participants, there was a positive relationship between convergent thinking and exploratory behavior. Thus, the results obtained prove that extracurricular activities have a significant impact on fostering learners' research skills and confirm the hypothesis put forward.

5. Discussion

The findings of the current study support the research question that extracurricular activities improve students' inquiry skills, which are critical for the development of their experimental skills and overall cognitive competence. The first step in developing research skills in junior school students was to create a programme called "Research Activities in Primary General Education," which was based on the lessons "The World Around Us" and "Mathematics" in the classroom. During the 16-week study period, students participated in extracurricular activities based on the programme "Young Explorer," which assisted in further improving their research skills.

The EG participants acquired research skills in stages, followed by increasing the complexity of activities, expanding the operational actions performed when solving educational and research problems, and increasing the share of independence in research and the discovery of new things. The use of a heuristic and explanatory-illustrative method to organize research activities allowed the demonstration of experiments, presentation materials, action algorithms, etc. Problematic situations were generated using the problem method. The research method enabled the study of a specific subject or object. The project method facilitated the achievement of a didactic goal through detailed problem development (technology), resulting in a real and practical outcome. The didactic game method allowed the EG participants to be in a psychologically comfortable and emotionally positive environment while performing research activities. Using the case method, research scenarios were created in which experiment participants determined the essence of the problem, proposed potential solutions, and selected the best solutions. These methods have been used in various forms of organizing research activities by participants in EG, including lesson research, educational games, research projects, conferences, etc., utilizing modern information and communication technologies. Therefore, the inclusion of participants in research activities was flexible and differentiated based on the characteristics of their individual research experience. Students applied the skills they learned in extracurricular activities to educational activities, as evidenced by the learning outcomes: the ability to work with a book as a source of information; quick adaptation to the process of learning to read; and positive dynamics in students' cognitive activity.

Observations of student activities during training sessions revealed that participants in the experimental group were more confident in engaging in dialogue with the teacher and classmates, completing educational tasks independently, and evaluating their own and their classmates' work. When performing creative tasks, the variability in how students in the EG present the results of their work outperforms the quality and effectiveness of performing a similar task among participants in the CG. These findings conclude that extracurricular activities aimed at developing participants' EG research skills allow them to demonstrate their research abilities while also providing an opportunity for creative activity and research independence. Research has shown that the potential and ability of a primary school student for creative, out-of-the-box thinking are most visible and successfully developed in a variety of extracurricular activities with a research focus (Dickinson, Griffiths, & Bredice, 2021; Uysal, 2023). According to Meadows (2019), extracurricular research activities for elementary schoolchildren allow them to demonstrate their abilities, contribute to the formation of psychological and practical readiness for research work, and develop research skills. Mkude and Mubofu (2022), Lyoba and Mwila (2022) and Kennewell, Curtis, Maher, Luddy, and Virgara (2022) argued that extracurricular activities allow students to choose the direction of their activity and independently search for new methods of action, enabling them to construct an individual cognitive trajectory based on their subjective personal experiences. Therefore, the potential to use extracurricular activities as a special type of joint research activity between students and teachers has been demonstrated, allowing students to direct their search for new ways of conducting research activities.

6. Conclusion

This study examined students' research skills and how extracurricular activities influence the development of students' research skills. The study revealed that research skills were developed in a formal way among learners. This study demonstrates that significant advances in students' research skills have occurred following the introduction and testing of the author's academic program with EG participants to develop research skills in extracurricular activities. Our findings from a sample of study participants indicate that participating in extracurricular activities is an effective way to improve research skills. Thus, according to the study's findings, participation in extracurricular activities improves students' research skills, which are necessary for the development of their experimental skills and overall cognitive competence.

7. Suggestions and Implications for Further Research

This study provided novel information on the use of extracurricular activities, which offer the most opportunities to foster students' research skills. Although we thoroughly examined the effectiveness of the teaching strategy by actively incorporating extracurricular activities to train students in research skills, several gaps remain related to our findings and where additional research can be helpful. We propose the following suggestions for future research:

1. Future research could reveal the conditions necessary for developing research skills in young students while they are in class and participating in extracurricular activities.

2. Additional methodological work is required to master the content of the subject by organizing the independent actions of young children using heuristic cognitive methods.

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