10.24193/ed21.2023.25.29

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Educatia 21 Journal 25 (2023) – Special issue
Special Issue: Proceedings of 11th International Conference Education, Reflection, Development (ERD 2023)
Educatia 21 Journal, (25) 2023, Art. 29
doi: 10.24193/ed21.2023.25.29
Research article

The Technical-Scientific Circles Within the Children'S Palaces and Clubs, Educational Alternatives in Developing Skills in the Field of Science and Technology

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Abstract

Extracurricular activities serve as a valuable complement to the formal educational system in terms of their goals, content, and practical execution. These activities adopt a student-centric approach, tailoring their content, methodologies, and tools to individual students' abilities and interests. They offer flexibility, remain optional, and rely on voluntary participation, augmenting the formal educational process while nurturing the development of individual personalities, creativity, and essential competencies. Technical-scientific activities place a strong emphasis on the formative aspect of learning by identifying effective methods to structure and guide students' engagements. Through these activities, students amass knowledge, cultivate skills and abilities, and foster attitudes that bridge the gap between theoretical knowledge and its practical application. This questionnaire seeks to investigate the role and significance of technical-scientific activities in skill development. By analyzing the responses, we aim to establish a correlation between students' performance in national assessments and the practical knowledge acquired through extracurricular pursuits. These activities also aid in nurturing students' creativity, problem-solving capabilities, and offer insights into their perspectives on the interactive methodologies employed in organizing extracurricular events. This study was conducted among a cohort of high school students who completed an online questionnaire (N=445). The findings underscore the complementary nature of technical-scientific activities, which, in conjunction with formal education, contribute significantly to the enhancement of competencies in science and technology. The study affords an opportunity to scrutinize the strengths and weaknesses of specialized extracurricular programs, shedding light on students' demands within the realm of science and technology activities and the extent to which these supplementary initiatives can mitigate school dropout rates.

Keywords:
extracurricular activities; creativity; technical-scientific activities; teaching strategies; complementary education; interdisciplinary approach.

Zusammenfasung

Außerschulische Aktivitäten sind eine wertvolle Ergänzung des formalen Bildungssystems in Bezug auf ihre Ziele, Inhalte und praktische Durchführung. Diese Aktivitäten verfolgen einen schülerzentrierten Ansatz und passen ihre Inhalte, Methoden und Werkzeuge an die Fähigkeiten und Interessen der einzelnen Schüler an. Sie bieten Flexibilität, bleiben optional und setzen auf freiwillige Teilnahme, ergänzen den formalen Bildungsprozess und fördern gleichzeitig die Entwicklung individueller Persönlichkeiten, Kreativität und wesentlicher Kompetenzen. Technisch-wissenschaftliche Aktivitäten legen einen starken Schwerpunkt auf den formativen Aspekt des Lernens, indem sie effektive Methoden identifizieren, um das Engagement der Schülerinnen und Schüler zu strukturieren und zu lenken. Durch diese Aktivitäten erwerben die Studierenden Wissen, kultivieren Fähigkeiten und Fertigkeiten und fördern Haltungen, die die Lücke zwischen theoretischem Wissen und seiner praktischen Anwendung schließen. Mit diesem Fragebogen soll die Rolle und Bedeutung technisch-wissenschaftlicher Aktivitäten für die Kompetenzentwicklung untersucht werden. Durch die Analyse der Antworten wollen wir eine Korrelation zwischen den Leistungen der Schülerinnen und Schüler in nationalen Beurteilungen und dem praktischen Wissen, das durch außerschulische Aktivitäten erworben wurde, herstellen. Diese Aktivitäten tragen auch dazu bei, die Kreativität und Problemlösungsfähigkeiten der Schüler zu fördern und bieten Einblicke in ihre Perspektiven auf die interaktiven Methoden, die bei der Organisation von außerschulischen Veranstaltungen eingesetzt werden. Diese Studie wurde unter einer Kohorte von Gymnasiasten durchgeführt, die einen Online-Fragebogen (N=445) ausgefüllt hatten. Die Ergebnisse unterstreichen den komplementären Charakter technisch-wissenschaftlicher Aktivitäten, die in Verbindung mit formaler Bildung wesentlich zur Verbesserung der Kompetenzen in Wissenschaft und Technik beitragen. Die Studie bietet die Möglichkeit, die Stärken und Schwächen spezialisierter außerschulischer Programme zu untersuchen und die Anforderungen der Schülerinnen und Schüler im Bereich der naturwissenschaftlichen und technischen Aktivitäten zu beleuchten und zu untersuchen, inwieweit diese ergänzenden Initiativen die Schulabbrecherquoten senken können.

Schlüsselworte:
außerschulische aktivitäten; kreativität; technisch-wissenschaftliche aktivitäten; unterrichtsstrategien; komplementärpädagogik; interdisziplinärer ansatz.

1. Introduction

Participation in extracurricular technical-scientific activities is essential for new generations and is directly related to academic performance and student's future. By choosing technical-scientific

extracurricular activities, students are given the opportunity to explore their passions, help them develop concentration, creativity, team spirit, but also self-confidence. However, the options are many, formal activities are from morning until 13.00 or 14.00, sometimes together with the "School after school" program students become very busy, so it is important to choose carefully what you receive in return for the time invested. The choice should usually target those activities with a complementary role to the classical teaching-learning hours. Their area is difficult to delineate.

This research delves into the synergy between activities offered within Children's Palaces and Clubs and formal education, while also exploring the factors influencing children's participation in science and technology education.

Extracurricular activities serve a pivotal purpose by enhancing knowledge and fostering competency development, particularly in the realm of science and technology. These activities involve the exploration and rediscovery of natural phenomena through hands-on experiments, cultivating a proclivity for science and technology, nurturing talents in the domains of technology and natural sciences, and bridging the gap between theoretical knowledge and practical, everyday applications.

The technical-scientific circles within Children's Palaces and Clubs play a vital role in achieving this objective, contributing to a more effective translation of theoretical knowledge into practical use (Kerekes, 2022).

These activities place students at the center, employing a didactic design grounded in a results-oriented model, thus creating extracurricular educational offerings that prioritize the development of intended competencies. They delineate the complexity levels of these competencies, correlate them with supportive themes that facilitate their development, create practical learning situations that engage students actively, establish criteria for assessing competency acquisition, and comprehensively evaluate students, often considering academic performance and participation in various competitions (Kerekes, 2018).

Furthermore, through this form of extracurricular education, educators also acquire proficiency in didactic design grounded in a results-oriented model. They revamp the offerings of these circles by aligning them with intended competencies, defining the complexity levels of these competencies, associating them with supportive themes to bolster competency development, creating practical learning scenarios that involve student engagement, setting benchmarks for competency acquisition, and conducting comprehensive assessments.

Central to this approach are the concepts of "interdisciplinarity" and the "application" of acquired knowledge in diverse contexts. Students exhibit higher motivation when topics are approached from various perspectives and grounded in real-life facts (Cucoș, 2017). Moreover, the program's construction should incorporate an interdisciplinary approach. Knowledge is regarded as the information acquired through the educational process, which encompasses formal, non-formal, and informal education (Drăgănescu, 2001).

The unique nature of education within Children's Palaces and Clubs is achieved through the integration of various educational forms, tailored to the needs of the local community and the distinct characteristics of the region. The increasing complexity of the educational process, the interdisciplinary nature of sciences, the adaptability and openness of education, educational research in the field of sciences, globalization, and comparative pedagogy all necessitate the incorporation of an interdisciplinary approach (Albulescu, 2016). Meeting the diverse needs of children and fostering their holistic development can be achieved through the interplay of three educational forms: formal education, non-formal education provided by Children's Palaces and Clubs, and informal education (Bocoș, 2017).

Research on extracurricular activities underscores the significant role of these educational forms in reducing school dropout rates and augmenting the quality of education by nurturing personality development and fostering essential competencies.

Technical-scientific extracurricular activities that are well prepared are attractive at any age. They arouse interest, produce joy, facilitate the accumulation of knowledge, even if they require additional effort. Students develop practical, operational spirit, manuality, giving everyone the opportunity to assert themselves according to their nature. Students discipline themselves by willingly obeying the rules in such activities, assuming responsibilities.

The teacher must be a facilitator, he must have through this type of activity special possibilities to know his students, to direct them, to influence their development, to achieve easier and more beautifully the main objective, preparing the student for life.

2. Statement of problem

The principles advocated by technical-scientific circles, as also stipulated in the regulations governing extracurricular activities in Romania within Children's Palaces and Clubs, emphasize a student-centered approach, facilitating the alignment of non-formal educational processes with the real learning needs of individuals. Another noteworthy attribute is the autonomy of these activities, which adapt to the community and the specific group, all while maintaining a focus on an individualized learning pace (Kerekes, 2022).

The curriculum of extracurricular activities and development programs is structured and organized based on areas of interest rather than rigidly following grade levels or academic disciplines. They are defined by clear learning objectives and create opportunities for abstract thinking by applying knowledge from real-life scenarios. These activities serve as valuable complements to formal education (Bocoș, 2017). The flexible content and shorter timeframes for achieving results, compared to formal education, lead to greater satisfaction among students.

Diversifying and expanding the learning environment, including flexible learning spaces and schedules, falls under the purview of the circle's leader. Meeting the community's demands and motivating students to participate in extracurricular activities alongside other potentially enticing or leisure activities necessitate efficient management and a contemporary pedagogical approach centered on competency-based education, emphasizing the practical application of theoretical knowledge.

Educational games, the flexibility to explore alternative educational methods, and the ability to draw positive or negative comparisons with formal school activities warrant a reconsideration of the locations where these activities occur.

To ensure the effectiveness of these activities, they should complement formal education without running parallel or overlapping with the content of formal educational programs (Albulescu, Catalano, 2019). The quality and efficiency of activities within Children's Palaces and Clubs hinge on adherence to established rules and principles, guided by the development of competencies instilled through formal education.

Extracurricular activities embody educational values that foster a more relaxed and closer teacher-student relationship. Although the teacher facilitates the entire teaching process, students have the freedom to express themselves spontaneously (Kerekes, 2022). Teachers or circle leaders refrain from imposing their viewpoints; instead, they suggest, cooperate, and support students in becoming effective organizers of their own activities. A diverse range of teaching strategies provides students with the opportunity to accumulate life experiences through direct interactions with people, material culture, and spiritual phenomena (Albulescu, 2016).

Evaluation methods such as competitions and model creation, used as feedback mechanisms, mitigate the stress associated with receiving inappropriate assessments. In the event of setbacks, they motivate students to practice more, enhance creativity, and improve problem-solving skills (Stan, 2001). In this dynamic, the student evolves into a valuable resource, a producer, an opinion leader, and an active participant in their own learning journey".

3. Research methodology

The online survey was administered during the period of April to May 2023 in Covasna County, Romania, and included a sample of 445 students from the lower secondary education level who were concurrently enrolled in formal educational programs and various technical-scientific circles. Statistical analysis was conducted using SPSS24 software.

The online questionnaire was thoughtfully structured and comprised 19 questions, each designed to assess various aspects, including the impact of extracurricular technical-scientific activities. Of particular interest were responses to questions aimed at gauging the extent to which these extracurricular activities, conducted within the Children's Palaces and Clubs, contributed to the development of students' problem-solving skills in both theoretical and practical problem situations within the realm of science and technology.

4. Research results

Natural sciences, technology, and technical-scientific circle activities help students see that we have the tools to understand the reality around us.

Students learn mainly through investigation because they face a problem, study the data and causal relationships carefully, and then succeed in finding the best solution. After a few weeks of learning in this style, students become aware of the power of their own minds. This investigative method helps students learn to ask questions about different phenomena, seek

explanations, identify cause-and-effect relationships, and develop their thinking mechanisms (Bocoș, 2017).

Applying the test and processing the data after seven months of activities shows us the effectiveness of the technical-scientific development programs.

The questionnaire had a specific emphasis on evaluating the acquisition of competencies related to structured scientific investigation, primarily through hands-on experimentation, particularly concerning straightforward and observable technological and scientific phenomena.

Figure 1. Comparison of outcomes for the dependent variable V.D.1 between the experimental group and the control group

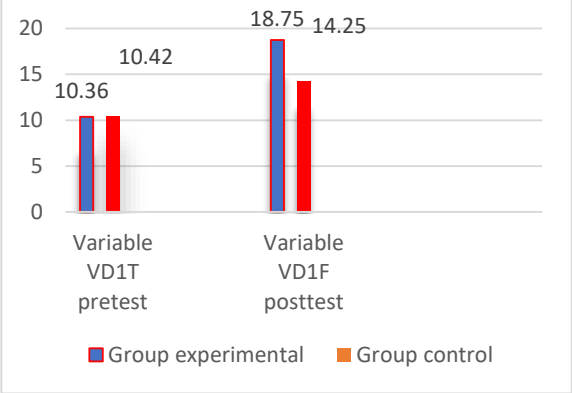

Figure 1 illustrates that both the experimental group and the control group initially exhibited similar levels of competence development in V.D.1, specifically 10.36 and 10.42, respectively. However, after seven months of participating in their respective activities, notable variations between the pretest and post-test results emerged. Specifically, the experimental group demonstrated a significant increase of 8.39 points, while the control group showed a comparatively modest rise of 3.83 points. This discrepancy in results within the experimental group can be attributed to the independent variable, namely the training program conducted within the technical-scientific circles.

To assess the relationship between these variables, two hypotheses were formulated:

H0 – Null Hypothesis: Upon completion of the school programs (control group and experimental group) and the implementation of the intervention program within the experimental group, no statistically significant differences exist in the outcomes related to the dependent variable V.D.1 (VDEF1=VDCF1) between the experimental and control groups.

H1-Research Hypothesis> Following the completion of the school programs (control group and experimental group) and the implementation of the intervention program within the experimental group, there will be a significant difference in the outcomes concerning the dependent variable V.D.1 (VDEF1=VDCF1) between the experimental and control groups.

Table 1. Data, including the average results obtained from conducting a t-test to compare the dependent variable V.D.1 between the experimental group and the control group

	Lot groupe	N	Average	Average difference	Standard error difference
VD_{CT1}	Lot experimental	222	10,363	4,84591	,53210
	Lot control	223	10,422	5,44294	,63895
VD_{CF1}	Lot experimental	222	18,752	4,86410	,53153
	Lot control	223	14,231	5,19634	,62158

Based on the data analysis provided in Table 1, it is evident that students in the experimental group experienced a substantial increase in the average results for the dependent variable V.D.1, with a noteworthy improvement of 4.521 points. In contrast, students in the control group, who solely followed the standard school curriculum encompassing subjects such as chemistry, physics, technological education, and biology, did not exhibit such a pronounced increase.

Based on the information presented in Table 2, it's notable that the Levene test results were non-significant (F=0.363, p=0.517), signifying that rejecting the null hypothesis, which suggests equal variations, would lead to a mistake in approximately 51.7% of cases. Consequently, it can be inferred that the variations between the two groups are indeed equal. Therefore, we can rely on the results obtained from the first row, which assumes equal variances.

The results derived from the t-test ($t(138) = 6.663$, $p = 0.000$) exhibit a p-value that falls below the predefined significance threshold, indicating statistical significance. Based on this statistical analysis, it can be affirmed that students who actively

participated in technical-scientific programs within Children's Palaces and Clubs achieved significantly higher results in terms of their competence in scientific investigation. Consequently, the research hypothesis is substantiated.

Table 2. Data collected from applying the t-test, comparing the dependent variable V.D.1, experimental group and control group

VD_{CT3}	Testul Levene -pentru egalitatea variantelor		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Differ-Ence: Average	Standard error difference	95% Confidence Interval for Differences	
								Reduced	Grown
Equal variances assumed	,005	,924	,031	138	,945	,02447	,74171	-1,434	1,6110
Equal variances not assumed			,031	137,124	,945	,02447	,74171	-1,434	1,6110
Equal variances assumed	,363	,517	6,76	138	,000	5,9532	,73024	4,5126	7,0740
Equal variances not assumed			6,663	144,835	,000	5,9532	,73024	4,51252	7,0740

F=0.363, pF=0.517, t(138)=6.663, p=0.000

Furthermore, an examination of the differences in post-test and pretest results, as depicted in Figure 1 and Table 2, reveals that the dependent variables encompassing the capacity for structured scientific investigation, particularly through hands-on experimentation of simple, observable physical phenomena, which includes exploring the properties and phenomena of physics within basic investigations, utilizing methods for recording and presenting experimental data, formulating straightforward conclusions based on experimental findings, and understanding the implications of technological advancement and environmental consequences, all contribute substantially to the development of competencies in science and technology (Kerekes, 2022).

Notably, these competencies are cultivated to a more significant extent in students actively participating in scientific-technical extracurricular activities compared to their peers who solely engage with school programs, or at most, partake in extracurricular activities.

5. Conclusion

The results obtained are highly credible, given the introduction of school programs for subjects like Physics, Chemistry, and Technological Education with practical applications, starting from the academic year 2017-2018. These programs were explicitly designed to nurture the development of scientific investigation competencies, which hold a pivotal role in the technological education of students. The technical-scientific extracurricular programs, complemented by various activities, have played a vital role in fostering competencies related to investigating phenomena, interpreting data, problem-solving, and effectively addressing complex situations. These competencies bear substantial importance in facilitating students' socio-professional integration into their daily lives.

The empirical findings unequivocally demonstrate the efficacy of technical-scientific circle programs, unequivocally supporting the research hypothesis. These results align with findings from specialized studies, reaffirming that such extracurricular activities significantly contribute to students' competence in science and technology, ultimately leading to improved academic performance. Furthermore, they equip students with a diverse set of practical skills and effective problem-solving strategies.

A noteworthy aspect that deserves attention is the complementary role of extracurricular activities in conjunction with formal school activities. This complementarity, underscored by the practical nature

of these extracurricular initiatives, holds genuine significance. The application of knowledge acquired by students, whether in school or outside of it, is pivotal for the development of competencies in science and technology. Equally important is the involvement of students in both the initiation and organization of these activities, as well as their active participation in their implementation.

The technical-scientific extracurricular activity and not only remains a valuable and efficient component of the educational space, its importance is also given by the way in which it complements and completes the activities specific to the formal curriculum, so that students can benefit from various learning situations, having as purpose the increase of school performance. The formal school activities, even if they focus on the thorough acquisition of knowledge, skills, skills that lead to the formation and development of a creative personality, they cannot fully respond to the child's desire for knowledge and creation. The role of technical-scientific extracurricular activities is to "fill", to fill in the space not used by formal education, with light and less demanding situations, but full of informational content, in order to respond positively to the child's desire for knowledge and to provide performance to the education system. Extracurricular technical-scientific activities, as mentioned before, complement the compulsory curriculum, being organized by teachers, with the participation of students, maximizing their potential through different learning situations.

These activities can serve as a viable alternative to traditional "School after School" programs, offering a compelling incentive for students to willingly engage with their school environment. By augmenting formal education with activities within Children's Palaces and Clubs, the dual challenges of school dropout rates and functional illiteracy among lower secondary students can be significantly mitigated.

As a tip that we must take into account during these extracurricular activities is that the instructive-educational objectives always prevail, but at the same time we manage to present in a balanced way the recreational and relaxation moments. It is very important to give a relaxing touch to all extracurricular activities and these activities to be to some extent complementary to formal education.

Authors note:

Kerekes Jenő is a chemistry and physics teacher at "Váradi József" Secondary School in St. George, a school that places great emphasis on quality and well-being of students. He also taught applied electronics and experimental chemistry at the Children's Palace in Sf. Gheorghe where he is still director. The research for the PhD he conducted in the field of curricular area mathematics and natural sciences, combines the two activities, formal education and extracurricular education, aiming at the complementarity of creative but at the same time educational technical, scientific activities at the Children's Palace with formal technical-scientific activities. All research was guided by prof. univ. dr. habil. Ion Albulescu.

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