METHODOLOGY FOR PLANNING EXTRACURRICULAR ACTIVITIES IN INFORMATICS

Baxtiyorova Muxlisa
Student of MI 403 Group, Shahrisabz State Pedagogical Institute
E-mail: baxtiyorovamuxlisa13@gmail.com
Baratova Gulhayo
E-mail: baratovagulxayo28@gmail.com
Kodirov Akbar Shuhratovich
Senior Lecturer, Department of Mathematics and Applied Mathematics, Shahrisabz State Pedagogical Institute (Scientific Supervisor)
E-mail: akbar2005ak@gmail.com | ORCID: 0000-0002-3656-5770
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Abstract

This article develops a practical methodology for planning extracurricular activities in informatics for secondary and higher pedagogical education contexts. The study argues that extracurricular informatics activities are most effective when they are planned as a competency-based, project-oriented, inclusive, and evidence-informed system rather than as occasional competitions or informal computer practice. The proposed methodology includes six stages: needs assessment, formulation of learning outcomes, selection of content and activity formats, implementation, assessment of learning evidence, and reflective improvement. The article presents planning tables, diagnostic tools, diagrams, and monitoring indicators that teachers can adapt for programming clubs, digital literacy circles, robotics laboratories, AI literacy sessions, cyber-safety workshops, and informatics Olympiad preparation. The novelty of the article lies in combining formal curriculum goals with learner motivation, digital citizenship, computational thinking, teamwork, and local school resources. The results show that systematic planning increases student engagement, supports differentiated instruction, and makes extracurricular informatics activities measurable and sustainable.

Keywords: informatics, extracurricular activities, planning methodology, digital literacy, computational thinking, programming club, project-based learning, assessment, digital citizenship.

Annotatsiya

Ushbu maqolada informatika fanidan darsdan tashqari mashg‘ulotlarni rejalashtirish metodikasi yoritiladi. Maqolada ehtiyojlarni aniqlash, maqsad va kompetensiyalarni belgilash, mazmun va shakllarni tanlash, amalga oshirish, baholash hamda takomillashtirish bosqichlaridan iborat tizimli yondashuv taklif etiladi. Natijalar darsdan tashqari mashg‘ulotlar o‘quvchilarning raqamli savodxonligi, algoritmik tafakkuri, ijodkorligi va jamoada ishlash ko‘nikmalarini rivojlantirishini ko‘rsatadi.

Kalit so‘zlar: informatika, darsdan tashqari mashg‘ulot, rejalashtirish metodikasi, raqamli savodxonlik, algoritmik tafakkur, loyiha asosida o‘qitish.

Аннотация

В статье рассматривается методика планирования внеурочных занятий по информатике. Предлагается системный подход, включающий диагностику потребностей, постановку целей и компетенций, выбор содержания и форм работы, реализацию, оценивание и последующее совершенствование. Результаты показывают, что грамотно спланированные внеурочные занятия развивают цифровую грамотность, алгоритмическое мышление, творческие способности и навыки командной работы учащихся.

Ключевые слова: информатика, внеурочная деятельность, методика планирования, цифровая грамотность, алгоритмическое мышление, проектное обучение.

Introduction

The rapid digitalization of education, public services, business, agriculture, and everyday communication has increased the importance of informatics as a school and university subject. Informatics is no longer limited to the ability to use a computer; it includes computational thinking, data literacy, algorithmic reasoning, safe behavior in digital environments, understanding of artificial intelligence, and the ability to design digital products. Formal lessons provide the basic structure of learning, but the time allocated in the curriculum is often insufficient for deep practice, creative projects, teamwork, and participation in competitions. For this reason, extracurricular activities in informatics have become an important pedagogical mechanism for widening access to digital competencies and supporting talented learners.

International evidence confirms the relevance of this problem. The ICILS 2023 cycle involved more than 130,000 students and more than 60,000 teachers across 35 education systems, showing that computer and information literacy is now a measurable global educational priority [1]. The OECD also emphasizes that the quality and purpose of digital technology use matter: in PISA 2022, moderate use of digital devices for learning was associated with better results than excessive or poorly structured use [2]. UNESCO documents on digital education and AI literacy highlight the need for human-centered, inclusive, ethical, and competency-based approaches to technology in education [3; 4]. These findings indicate that extracurricular informatics activities should be planned carefully, not organized randomly.

The relevance of the present article is determined by the need to create a clear methodology that helps teachers plan informatics clubs, coding workshops, robotics sessions, digital creativity studios, cyber-safety training, and project exhibitions. The object of the research is extracurricular learning in informatics. The subject of the research is the methodology for planning, organizing, and evaluating extracurricular informatics activities. The purpose of the article is to develop a structured model for planning extracurricular informatics activities and to provide practical recommendations for teachers and educational institutions. The main tasks are: to analyze theoretical approaches, to identify planning stages, to develop sample tables and diagrams, to propose assessment indicators, and to formulate recommendations for implementation.

Literature Review

Modern studies of digital education show that learners need not only technical skills but also the ability to evaluate information, create digital content, solve problems, communicate responsibly, and participate ethically in digital society. ICILS defines computer and information literacy as the ability to use computers to investigate, create, participate, and communicate in school, home, work, and community contexts [1]. This definition is especially useful for extracurricular informatics because clubs and projects can integrate real-life tasks: creating websites, analyzing data, developing educational games, preparing digital posters, or building simple robots.

UNESCO emphasizes that educational technologies must be used in a human-centered and equitable way. Its digital education framework stresses that technology is not a goal in itself; it must support quality learning, inclusion, and learners' rights [3]. In the context of informatics, this means that extracurricular activities should not merely teach software commands. They should develop problem-solving, critical thinking, creativity, collaboration, and ethical judgment. UNESCO's AI competency framework for students also recommends age-appropriate knowledge of data, algorithms, AI applications, and responsible use of intelligent tools [4]. Therefore, extracurricular activities provide an appropriate space for introducing AI literacy, prompt engineering basics, data ethics, and practical experimentation under teacher supervision.

The OECD's analysis of digital resources in learning warns that more technology does not automatically lead to better learning outcomes. Productive digital learning depends on teacher guidance, learning purpose, feedback, and balanced use [2]. This is a key methodological conclusion: extracurricular informatics must have clear objectives, schedules, differentiated tasks, and assessment criteria. Without planning, even well-equipped computer laboratories may become spaces for passive browsing or unstructured entertainment. With planning, the same laboratory can become a place for research, coding, design, and collaborative problem solving.

Pedagogical literature on extracurricular education highlights several principles relevant to informatics: voluntariness, learner interest, practical orientation, continuity, individualization, connection with formal lessons, and public presentation of results. In informatics, these principles can be translated into concrete formats: programming clubs, Olympiad training, hackathons, digital design studios, cybersecurity days, robotics and microcontroller workshops, peer tutoring groups, and project-based exhibitions. The distinctive feature of informatics is that outcomes can often be demonstrated as working products: a program, website, database, animation, mobile prototype, algorithm visualization, or digital portfolio.

Research Methodology

The article uses a qualitative methodological design based on comparative analysis, pedagogical modeling, and practical planning. First, international recommendations and research findings on digital skills, computational thinking, and educational technology were analyzed. Second, the requirements of scientific article structure were taken into account: abstract, keywords, introduction, literature review, methodology, analysis and results, conclusion, and references. Third, a planning model was constructed for informatics extracurricular activities. Fourth, tables and diagrams were developed to help teachers transform the model into weekly and annual plans.

The methodological framework is based on the following principles: (1) competency orientation, where each activity is linked with a measurable learning outcome; (2) continuity, where extracurricular tasks extend and deepen the formal curriculum; (3) differentiation, where beginners and advanced learners receive tasks of different complexity; (4) project orientation, where students produce visible digital products; (5) inclusiveness, where participation is open to learners with different achievement levels; (6) safety and ethics, where digital citizenship is integrated into every module; and (7) evidence-based assessment, where student progress is documented through rubrics, portfolios, self-reflection, and teacher observation.

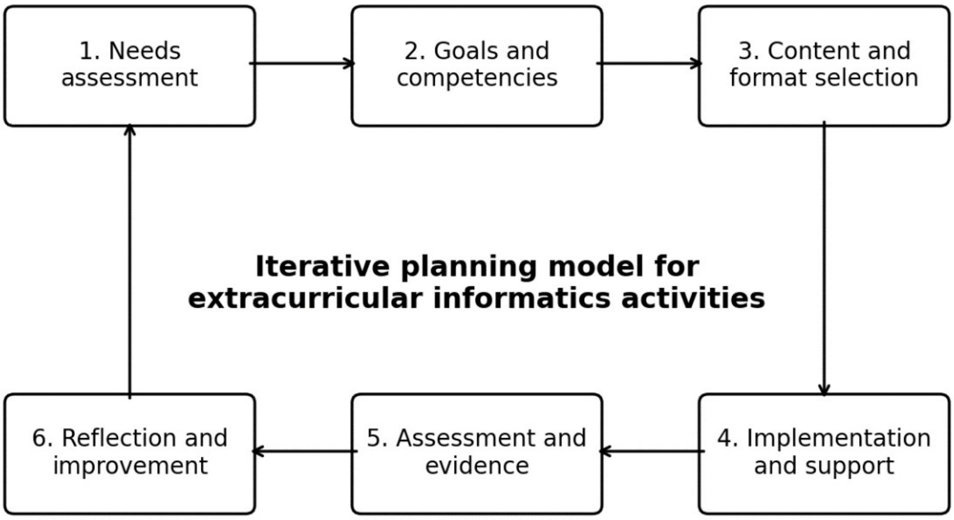

Figure 1. Six-stage planning cycle for extracurricular informatics activities.

Analysis and Results

A planned extracurricular informatics system should begin with diagnosis. The teacher needs to identify students' interests, previous experience, access to devices, preferred activity formats, and learning difficulties. Diagnosis may include a short questionnaire, a practical mini-task, interviews with students, consultation with class leaders, and analysis of previous academic results. The purpose is not to select only the strongest learners, but to create groups and tasks that correspond to different starting levels.

Planning stage	Teacher actions	Expected result	Evidence
Needs assessment	Survey students, analyze resources, identify interests and barriers	Clear profile of learners and school conditions	Questionnaire, observation sheet, diagnostic task
Goal setting	Define competencies: coding, digital literacy, CT, collaboration, ethics	Measurable learning outcomes	Competency map and module objectives
Content selection	Choose modules: programming, robotics, AI literacy, cyber-safety, projects	Balanced annual plan	Syllabus and calendar plan
Implementation	Conduct sessions,	Active	Attendance, project

	mentor teams, support peer learning	participation and digital products	drafts, portfolios
Assessment	Use rubrics, demonstrations, tests, self-assessment	Evidence of progress	Rubric scores, reflection forms, project defense
Improvement	Discuss results and update plan	Sustainable and adaptive extracurricular system	Teacher report and updated plan

Table 1. Methodological stages of planning extracurricular informatics activities.

The second step is the formulation of goals. Extracurricular informatics should support both subject-specific and general educational competencies. Subject-specific competencies include algorithmic thinking, programming, data handling, digital content creation, and understanding of hardware and networks. General competencies include communication, collaboration, creativity, self-management, and problem solving. A useful planning rule is to connect every session with one visible outcome. For example, after a session on variables and conditions, students should create a simple quiz program; after a session on spreadsheets, they should analyze a small dataset; after a session on cyber-safety, they should prepare a digital safety checklist for younger learners.

Activity format	**Main purpose**	**Recommended frequency**	**Example product**
Programming club	Develop algorithmic thinking and coding skills	Weekly, 60-90 minutes	Calculator, quiz, simple game, algorithm visualizer
Digital literacy workshop	Improve safe and effective use of digital tools	Twice per month	Digital portfolio, infographic, presentation
Robotics or microcontroller group	Connect informatics with engineering practice	Weekly or project cycle	Sensor model, line-following robot, automation prototype
AI literacy session	Introduce data, algorithms, ethics, and responsible use	Monthly thematic module	AI use rules, chatbot evaluation, dataset mini-project
Cyber-safety day	Build safe online behavior and privacy awareness	Once per term	Password guide, phishing poster, safety quiz
Olympiad preparation	Support talented learners and competitive problem solving	Weekly intensive sessions	Solved problems bank and strategy notes

Project exhibition	Publicly present student achievements	Once per semester	Website, app prototype, research poster, demo video

Table 2. Recommended extracurricular informatics formats and products.

The third step is content selection. The content should be attractive, feasible, and connected with the formal curriculum. A balanced annual plan may include programming and algorithms, digital literacy and online safety, project-based work, robotics or AI practice, competitions, and reflection. Figure 2 shows selected international indicators that support the need for systematic digital enrichment. The large scale of ICILS participation demonstrates that digital competence is no longer a narrow technical topic but a global educational measurement area [1]. The PISA finding on moderate digital use also suggests that structured planning is more important than simply increasing screen time [2].

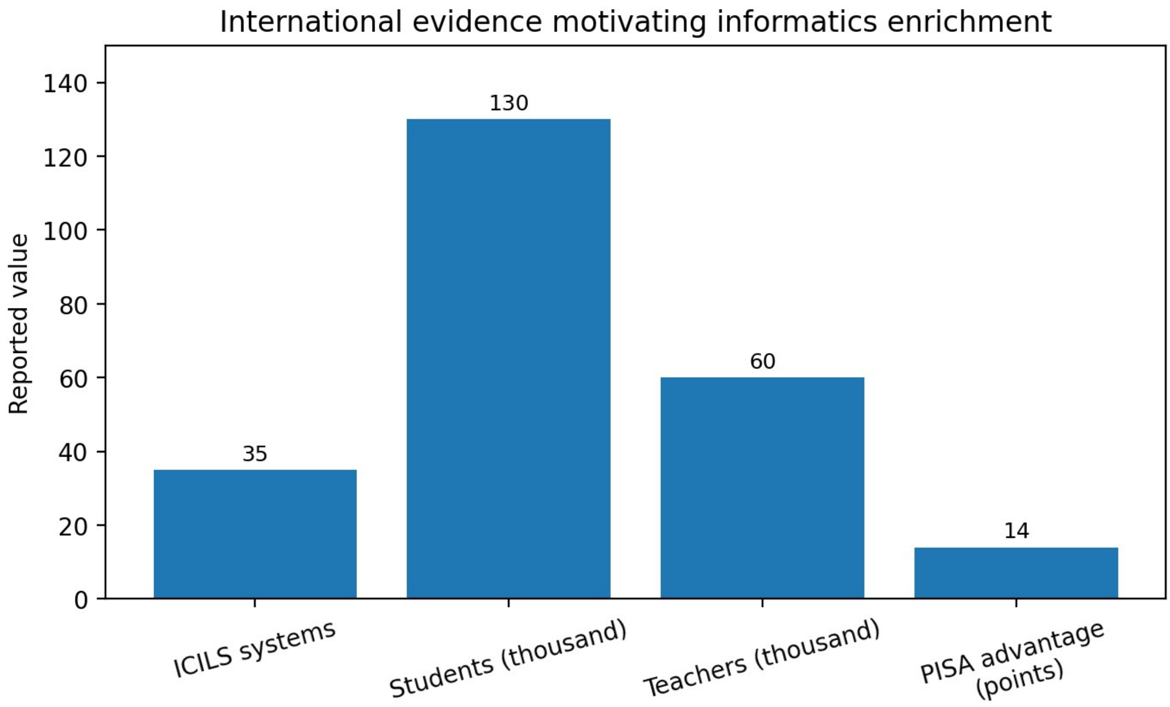

Figure 2. International evidence motivating informatics enrichment. Note: ICILS participants are shown in thousands; PISA value is a mathematics-score advantage reported for moderate learning use of digital devices.

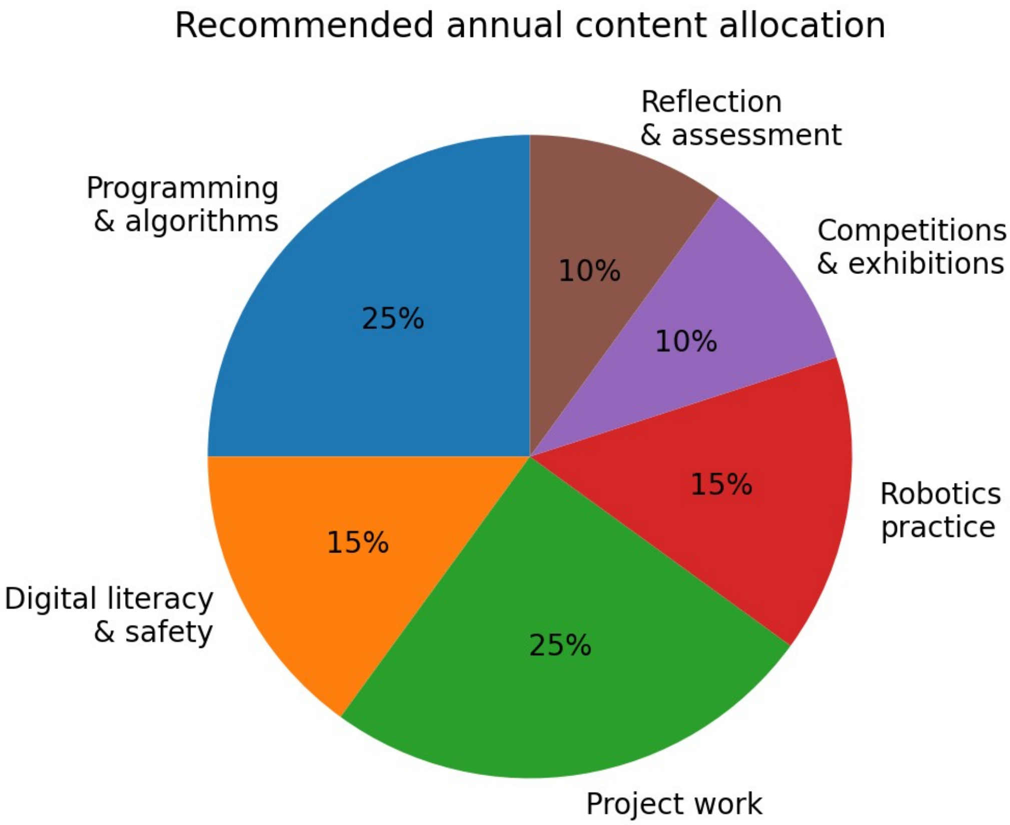

Figure 3. Recommended annual content allocation for extracurricular informatics activities.

The fourth step is implementation. A good extracurricular session should contain four structural parts: motivation, explanation, practical work, and reflection. Motivation may be a problem situation, short video demonstration, puzzle, or real-life task. Explanation should be brief and connected to the task. Practical work should occupy most of the session and may be individual, pair-based, or team-based. Reflection should help learners understand what they have achieved, what difficulties appeared, and how the product can be improved. This structure prevents the activity from becoming only a lecture or only free computer use.

Session component	Approximate time	Teacher role	Student role
Motivation and problem setting	5-10 minutes	Present a challenge and explain relevance	Discuss, ask questions, predict solutions
Mini-instruction	10-15 minutes	Explain concepts, demonstrate tools	Observe, take notes, repeat key steps
Practical project work	35-50 minutes	Consult, differentiate, monitor progress	Code, design, test, collaborate
Presentation and feedback	10-15 minutes	Organize peer feedback and summarize	Show results, reflect, plan improvements

Table 3. Recommended structure of a 70-90 minute extracurricular informatics session.

The fifth step is assessment. Extracurricular activities should not reproduce the pressure of formal grading, but they still need assessment to make progress visible. The most appropriate tools are rubrics, portfolios, self-assessment, peer review, project defense, and teacher observation. A rubric should measure not only the final digital product, but also planning, originality, functionality, teamwork, documentation, and ethical use of digital resources. Table 4 presents a sample rubric that can be adapted for programming or digital project work.

Criterion	Excellent - 4	Good - 3	Basic - 2	Needs support - 1
Problem understanding	Problem and user needs are clearly defined	Problem is mostly clear	Problem is partly defined	Problem is unclear
Technical solution	Product works reliably and uses suitable tools	Product works with minor issues	Product works only partly	Product is incomplete
Creativity	Original idea and attractive design	Some creative elements	Limited originality	No creative contribution
Teamwork	Roles are clear and collaboration is active	Most members contribute	Unequal participation	Teamwork is weak
Digital ethics	Sources, privacy, and safety are fully considered	Most ethical rules are followed	Some rules are unclear	Ethical issues are ignored
Presentation	Clear demonstration and evidence of learning	Mostly clear presentation	Limited explanation	Unable to explain product

Table 4. Sample rubric for assessing extracurricular informatics projects.

The sixth step is reflection and improvement. At the end of each module, the teacher should collect feedback and compare planned outcomes with actual evidence. Reflection questions may include: Which tasks motivated students most? Which concepts caused difficulty? Did all students have enough access to devices? Were girls and boys equally involved? Did beginner students receive sufficient support? Did advanced students receive challenging tasks? Based on these answers, the teacher updates the next module.

Monitoring indicators are important for sustainability. Figure 4 presents an illustrative example of monitoring an eight-week informatics club. The values are not universal norms; they show how a teacher can visualize engagement and skill progress over time using attendance, completed tasks, portfolio quality, and rubric results. Such simple monitoring helps school administration and teachers justify resources, identify problems early, and support students more effectively.

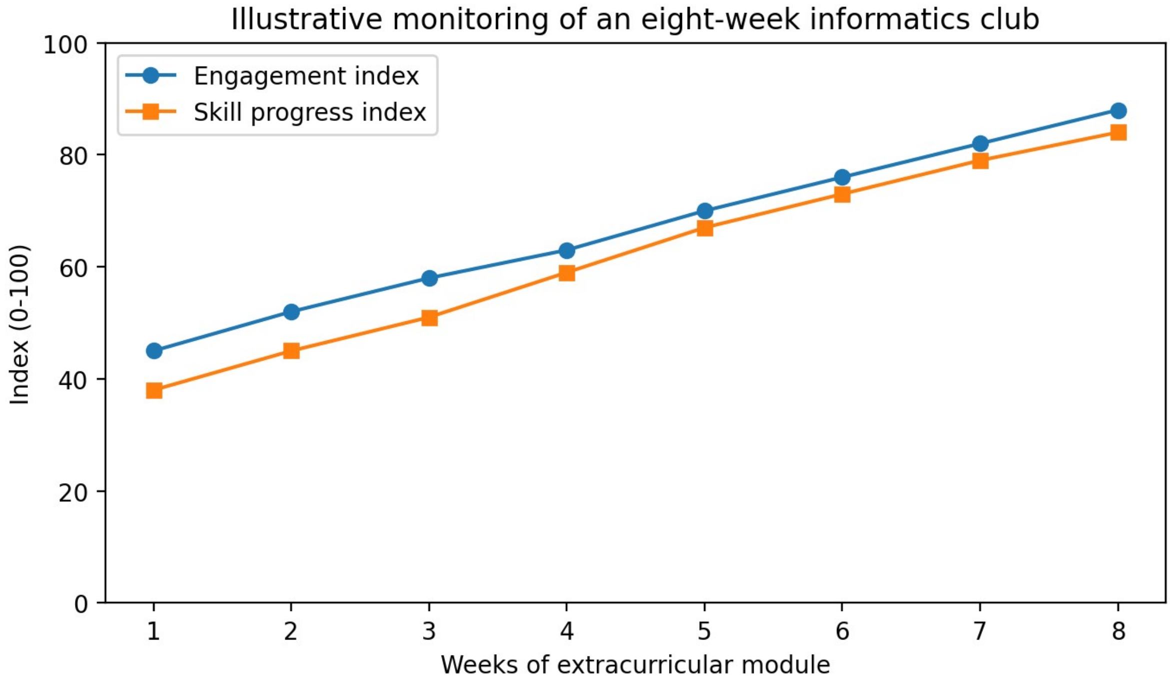

Figure 4. Illustrative monitoring of an eight-week informatics club.

Discussion

The proposed methodology shows that extracurricular informatics activities should be treated as a planned pedagogical system. Their effectiveness depends on the logical relationship among goals, content, methods, resources, and assessment. A programming club without diagnostic grouping may discourage beginners; an Olympiad group without reflection may develop only speed rather than deep understanding; a robotics workshop without safety rules may create technical and organizational risks; an AI session without ethical discussion may form superficial tool use. Therefore, planning is not a bureaucratic requirement but a condition of educational quality.

The teacher's role also changes. In formal lessons, the teacher often explains and controls the learning process. In extracurricular informatics, the teacher becomes a mentor, project manager, consultant, motivator, and evaluator. Students learn through experimentation, debugging, discussion, and public demonstration. This requires flexible classroom management and differentiated tasks. For example, in a Python club, beginners may write simple conditional programs, intermediate learners may create functions and lists, and advanced learners may work with files or simple data visualization. All students can participate in the same theme while working at different levels of complexity.

Another important issue is inclusion. Informatics extracurricular activities should not be available only to students who already have computers at home or high achievement in mathematics. Schools can organize open sessions, peer tutoring, shared devices, offline coding tasks, unplugged computational thinking games, and group projects to reduce barriers. Gender inclusion also requires attention. Activities should include socially meaningful projects, design tasks, communication, and real-life problem solving, not only competitive coding. This broader approach can attract more diverse groups of learners.

Practical Recommendations

Based on the analysis, the following recommendations can be proposed. First, every educational institution should prepare an annual extracurricular informatics plan connected with the curriculum and school resources. Second, teachers should conduct a short diagnostic survey before forming groups. Third, each module should end with a visible product: a program, website, poster, data analysis, robot model, or presentation. Fourth, digital safety and ethics should be integrated into all modules. Fifth, assessment should be based on portfolios and rubrics rather than only tests. Sixth, the best student projects should be presented at school exhibitions, local competitions, or online portfolios. Seventh, teachers should cooperate with mathematics, physics, technology, language, and art teachers to create interdisciplinary digital projects.

Month	Theme	Main activity	Product / result
September	Digital diagnosis and safety	Survey, safety rules, account management	Student digital profile and safety checklist
October	Algorithms and programming basics	Block coding or Python basics	Interactive quiz or calculator
November	Data and spreadsheets	Collect and analyze school-related data	Chart-based mini-report
December	Digital creativity	Presentation, infographic, web page basics	Digital poster or simple web page
January	Cyber-safety and media literacy	Phishing examples, password hygiene, source evaluation	Cyber-safety campaign material
February	Robotics / AI literacy	Sensor logic, AI examples, data ethics	Prototype model or AI evaluation report
March	Project development	Team projects and mentoring	Working project draft
April	Competition and debugging	Code review, testing, improvement	Improved project and solved tasks bank
May	Exhibition and reflection	Public presentation and portfolio defense	Final portfolio and certificates

Table 5. Sample annual plan for extracurricular informatics activities.

Conclusion and Suggestions

Extracurricular activities in informatics are a powerful means of developing students' digital literacy, computational thinking, creativity, and readiness for modern technological society. However, their effectiveness depends on systematic planning. The article proposed a six-stage methodology: needs assessment, goal setting, content selection, implementation, assessment, and improvement. This model helps teachers transform extracurricular informatics from occasional events into a coherent educational system.

The main conclusion is that extracurricular informatics should combine competence development, project-based learning, inclusion, ethics, and measurable outcomes. When teachers use planning tables, rubrics, monitoring diagrams, and student portfolios, they can better support learners with different abilities and interests. The proposed methodology can be applied in schools, academic lyceums, colleges, and pedagogical institutes. Future research may test this model experimentally by comparing student motivation, digital skills, project quality, and competition results before and after the introduction of systematic planning.

As practical suggestions, educational institutions should allocate time and resources for informatics clubs, support teacher professional development, create digital project exhibitions, involve parents and local communities, and encourage collaboration among subjects. Such measures will help make extracurricular informatics activities not only interesting, but also academically meaningful and socially useful.

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