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Strategic Planning of University Extension Projects: Innovative Application of Business Management Tools to Establish Indicators and Good Practices

Planejamento Estratégico de Projetos de Extensão Universitária: Aplicação Inovadora de Ferramentas de Gestão Empresarial para Estabelecer Indicadores e Boas Práticas

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Strategic planning plays a crucial role in ensuring coherence, sustainability, and impact monitoring in university extension projects. In the public education sector, the adoption of business management tools to organize and evaluate science outreach initiatives remains limited. This study presents the strategic planning process of the 1000 Future Scientists Program, which promotes chemistry education in public schools through low-cost and sustainable experimentation. The methodology integrates three planning tools—SWOT matrix, strategic map, and OKRs—adapted to the context of science education and community engagement. Results highlight how these tools supported the collective definition of objectives, alignment of actions with the program's mission, and establishment of measurable indicators for teaching and extension. The experience offers a replicable model for other chemistry-focused university extension programs seeking to enhance impact and foster collaboration between academic and basic education.

Keywords: University extension; Chemistry education; management tools; SWOT analysis; OKRs (Objectives and Key Results); educational indicators.

1. Introduction

Brazilian Constitution of 1988 regulated university extension activities as the third university pillar, along with education and research in Federal Universities. Initially, extension activities had only an assistance character.[1] Nowadays it promotes interactions between the university and society by linking research, education, interdisciplinarity, culture and politics.[2–5] These activities aim to establish an effective and interdisciplinary dialogue between university and society, fostering social transformation.

In chemistry education, technological innovation has become an important instrument for articulating teaching, research, and extension practices.[6] Innovative methodologies have been widely explored to make chemistry education more engaging and connected to students' realities, especially in public schools. Prior studies have shown the potential of project-based learning and digital tools to improve students' conceptual understanding and promote active learning environments. These findings reinforce the relevance of implementing strategic planning in university extension projects that prioritize contextualized experimentation and teacher engagement.[7,8] Recent studies in chemistry education have highlighted the effectiveness of project-based approaches and digital tools in promoting active learning and meaningful scientific engagement, particularly in public education contexts.

Organizational innovation in the public sector emphasizes people as central agents of change.[9–11] While the private sector is driven by efficiency and adaptability, public institutions face challenges such as bureaucratic structures and resistance to change.[12] Nevertheless, innovation in public education has gained relevance, especially when it enhances strategic thinking, decentralizes decision-making, and fosters interdisciplinary collaboration.[13-15] According to the Oslo Manual, innovation should be implemented in public services, including education.[16]

In Brazilian federal universities, university extension serves as a bridge between academia and society. When connected to third-sector initiatives, it promotes mutual benefits, offering innovation and knowledge to public services and supporting emerging social entrepreneurs who aim to scale their impact.[17]

Several tools can be adapted to be used in the management of extension projects, featuring organizational innovation in the public sector. Strategic Map [18,19] the SWOT (Strengths, Weaknesses, Opportunities and Threats) matrix analysis[20] and the OKR (Objectives and Key Results)[21] are some examples. The SWOT methodology started in the 1960s with Albert Humphrey research at Stanford University.[22] Project Management (PM) and Strategic Management (SM) are interconnected through the Balanced Scorecard (BSC) tool. In this system, its creators developed the concept of the strategic map, which connects strategy formulation and execution. The Objectives and Key Results (OKR) method was created in the 1970s by Andy Grove, then CEO of Intel, and in 1999 the goal tracking model was adopted by Google, which achieved its great success and began to spread around these tools to the world. This method encourages critical thinking and continuous discipline, stimulating employees to work together.[21] Although originally designed for corporate environments, these tools have proven adaptable and useful in educational planning and evaluation, particularly in university extension programs focused on science outreach.

In this context, this study presents the application of the SWOT matrix, strategic map, and OKR methodologies to develop the strategic planning of the 1000 Future Scientists extension program, coordinated by the Department of Chemistry at the Federal University of Minas Gerais. The goal is to define the program's mission, vision, and key indicators to guide and evaluate its activities since 2021. We also demonstrate how strategic planning fosters self-sustainability and contributes to the management maturity of academic extension projects.[23]

2. Experimental

In the present work it is discussed the elaboration of the strategic planning to 1000FC program, following 5 main stages, as shown in Figure 1.

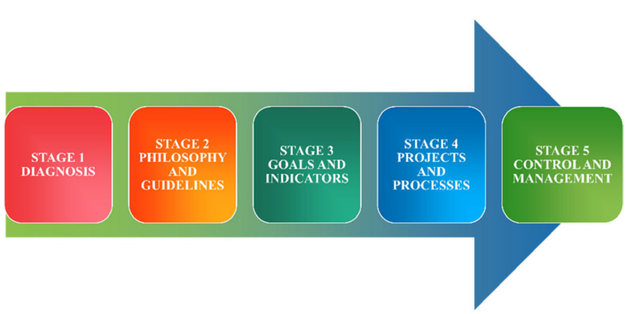

Figure 1. Stages for preparing strategic planning

In Stage 1, a diagnosis of the program is performed, essential to guide the other steps and to provide robust planning. The diagnosis is to detail how the program was conceived and implemented and the impact of its execution within the Chemistry Department. The program fundamentals are to reconsider the relationship between Basic Education – Chemistry Department – Society, analyzing and discussing questions such as: How does the Chemistry Department connect to society? What is the effectiveness of this connection? What impact has it had? Is it possible to establish new manners of interaction with society? Is it possible to provide a wider range of services to society? Discussions on these questions culminated in the formulation of hypotheses, which are analyzed using data collected during the development of the program over four years. In the results section, all hypotheses assumed will be discussed, together with the analysis of the data used to validate or discard them.

At this step, the SWOT methodology is applied. The goal is to identify the strengths and weaknesses related to the internal environment and the opportunities and threats associated with external environment, which are essential for strategic planning. In the next section, this agile management tool is properly discussed.

Stage 2 discusses the philosophy that guides the program, i.e. its mission describing the purpose of its existence and its vision, which says where the program wants to reach in the future and how it wants to be perceived. Also, it describes its values, as the attitudes promoted by the program and expectations from its collaborators. It is imperative that this philosophy is disseminated to the entire target audience, to provide a comprehensive knowledge of what inspires and guides the activities of the extension program.

In Stage 3 to 4, strategic macro-objectives for program development are defined. This step is essential for measuring the results achieved by the extension actions and the objectives are established and distributed to the collaborators. At this stage, we also define the indicators that will allow monitoring the objectives and the SWOT matrix analysis, strategic map and the OKR, which are used together. These tools are described in the next section.

In Stage 4, the processes are created comprising the action plans, these are linked to the objectives and in this phase, we define the execution priorities. The action plans elaborated for the program will be discussed along the Results section.

Stage 5 suggests constant monitoring of the results, with weekly team meetings and quarterly results review meetings, making it possible to adjust the objectives, goals, and action plans required for the good progress of the program.

2.1. SWOT matrix

The SWOT matrix is an acronym for: Strengths, Weaknesses, Opportunities and Threats, which allows the analysis of environments and factors related to the organizational aspects. This tool also allows the study of variables that influence the competitiveness of an initiative.[24]

Figure 2 shows a schematic representation of the SWOT matrix, commonly used to support strategic thinking in companies and organizations, divided into two main axes: factors versus environment. The factors in the axis consider those that help (positive) and disturb (negative) the strategic objectives. In the environment axis, the internal and external aspects are analyzed, considering the characteristics of the organization and the market.[25]

Figure 2. Schematic representation of the SWOT matrix

The established SWOT matrix presents Strengths as positive factors in the internal environment, Opportunities as positive factors in the external environment, Weaknesses as negative factors in the internal environment, and Threats as negative factors in the external environment. In a SWOT analysis the quadrants are correlated and affect each other. SWOT is one of the most widely used tools in strategic planning. The mapping of strengths and weaknesses allows the organization to study its internal environment to know how to take advantage of its resources and understand points for improvement.[26]

2.2. Strategic map

Project Management (PM) is widely being used for organizations that have invested time and money in methodologies to build strategic maps, personnel training, and even dedicated information systems for this activity. PM should not be an isolated activity and should ensure that the project is carried out in line with their strategies.[27,28] A currently adopted performance measurement model is the Balanced Scorecard (BSC), which presents a structure consisting of four different perspectives: financial, customers (or client), internal processes and learning and growth. [29] Each of these issues has specific strategic objectives with the respective indicators and targets. The definition of the initiative must be based on the organization vision and strategy. [30]

Strategic maps are an evolution of BSC, and its main purpose is to graphically describe how an organization creates value from its intangible assets. The strategic map is based on four original perspectives of the BSC and their respective strategic objectives but suggests the creation of cause-and-effect relationships between these objectives. Intangible assets, within the original structure of BSC, are located within the learning and growth perspective.[31]

2.3. OKR in educational projects

OKR is a methodology to understand the objectives in a project and the contribution of each one to achieve the main goals. The methodology separates the important points of strategic planning and illustrates, in a practical way, a path to carry out actions indispensable for the project development.[32]

The qualitative objectives situate the members in the project context, encouraging them to help the team achieve the mission established in the strategic plan.[33] At least three objectives are proposed in the OKR and to define them, the question: "What do we want to do?" can be used to guide a brainstorming meeting creating the framework, to the tasks and indicators that allow development to be measured the key results are quantitative targets that help the team to monitor and analyze the project progress, being implemented monthly or quarterly. To define the key results of each objective, the following question can be asked "How will we know if we are close to our goal?"

To achieve the proposed key results, short-term tasks are needed and are analyzed with the respective indicators. The OKR process is summarized in Figure 3, from the vision and mission, the starting points for.

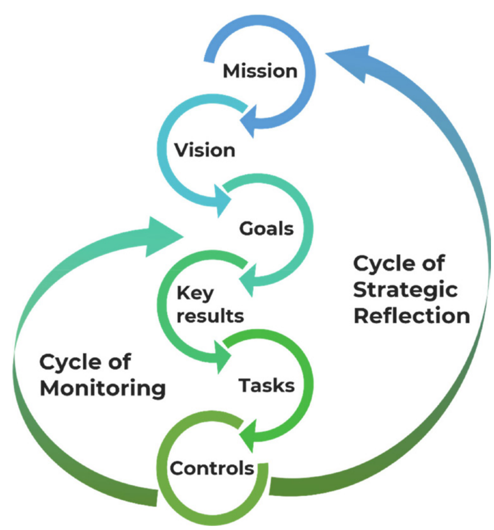

Figure 3. OKR development cycles

3. Results and Discussion

The Chemistry Department (DQ-UFMG) at the Federal University of Minas Gerais (UFMG) has 21 teaching laboratories which, until October 2018, were used exclusively for practical classes in 17 undergraduate courses at UFMG. Some of these laboratories are available during working hours, as they do not accommodate practical classes in the three shifts or are not used every day of the week. To improve the use of this infrastructure, the project 1000 Futures Scientists was proposed.[34-36]

The initial idea of the project considered only a visit from Elementary and High School students to allow the university interaction with basic education, stimulating the interest of visitors in science and chemistry. However, inspired by the students' feedback, in 2018, the project was improved, offering to the public some experimentation in the laboratories with technological and scientific material, which were specially developed to attend the basic education students. Since 2018, the project has presented an innovative service: sharing the structure of teaching laboratories with students from the public basic education of Minas Gerais.

In this project, teachers, technicians, undergraduate and graduate volunteer, and scholarship students are responsible for organizing technical visits to the Chemistry Department in UFMG, as well as organizing workshops in public spaces and monitoring the dissemination of digital content related to chemistry in the program website - (https://1000fc.qui.ufmg.br/1000-fc/). The team uses the university infrastructure, allowing the students to engage in active learning, where they are responsible for conducting chemistry experiments in the laboratories. The most intriguing hypothesis assumed to corroborate the success of the project is related to the lack of laboratories in public primary and high schools. This hypothesis can show the impact of the project on a significant number of people outside the academic community.

With the growing demand from schools to visit the Chemistry Department and the demand from undergraduate courses to increase the number of hours dedicated by students in extension activities (addition of 10% in curricular grade), new activities have emerged from this initial project and a program with 5 projects was organized. The mean activities of these projects are: (I) popularization of science through the development of chemical experiments that bring technological innovations in an appropriate language, (II) scientific dissemination of the research carried out in the Department, (III) connectivity among the actions and the ONU objectives of sustainable development (OSD), (IV) basic concepts of hyalotechnics and socio-environmental technologies that incorporate vitreous waste, (V) basic concepts of entrepreneurship to basic education (elementary and high school) and undergraduate students, (VI) production of digital content to be widely shared with basic education and the general population. Fig 4 illustrates some activities developed in the 1000 FC program.

Since all these actions were related, it was proposed to register them as extension projects in a converged 1000 FC extension program. During six years of operation, the necessity was verified to structure and organize the internal management of the program, using for example, agile management tools.[35] Nowadays the processes have been standardized, enabling easier management for future volunteers, scholarships, and participants.

The 1000 FC can be presented on three main fundamentals: the purpose of its existence, its performance, and its main results/impact on society. The purpose of the project is to make science more accessible, by sharing the public universities infrastructure and the intrinsic knowledge/technologies with the public primary schools in a proper language.

To manage the program, it was verified the necessity to control the processes and develop a strategic plan, a practice rarely used in research and extension projects in the universities. For the year 2023, members of the 1000 FC extension program used three agile tools for strategic

Figure 4. Images of the team performing activities, and the logo created for the 1000FC program

planning: SWOT matrix analysis, strategic map and OKRs. The results of each application are presented in the next sections.

3.1. SWOT matrix analysis

The SWOT matrix supported the strategic planning of the 1000 Future Scientists program by identifying internal and external factors relevant to chemistry education and science outreach. The main points are systematized in Figure 5 and detailed below:

Figure 5 summarizes the SWOT matrix developed for the 1000 Future Scientists program, highlighting strategic elements that support its planning and continuous improvement. The analysis reveals that the program's major **strengths** are directly related to its educational focus on Chemistry. The use of contextualized experiments adapted for basic education, the production of didactic materials, and the engagement of a multidisciplinary and qualified team enabled the program to deliver high-quality, inquiry-based learning experiences. Its large reach across schools and teachers confirms the program's capacity for impact and scalability.

The **weaknesses**, however, point to challenges commonly faced by university extension programs. The absence of dedicated funding and staff limits the program's ability to maintain and expand its initiatives. Moreover, the lack of robust tools to evaluate the learning outcomes of students in Chemistry suggests the need for improved impact assessment mechanisms. Institutional recognition of the workload dedicated to extension activities remains partial, which may hinder the long-term commitment of the team.

In terms of **opportunities**, the matrix underscores current policies in Brazilian higher education, such as the mandatory inclusion of extension hours in undergraduate curricula, which naturally drives student engagement. In addition, teacher training and partnerships with schools enhance the program's replicability, especially in regions with limited laboratory infrastructure. The demand for low-cost, contextualized teaching materials presents a valuable opening for innovation in science education.

Finally, the **threats** listed reflect broader systemic issues. The lack of fixed funding sources, high team turnover, and geographical limitations challenge the program's ability to maintain regular activities in all regions. These elements demand strategic actions focused on sustainability, such as formal institutional support and the establishment of long-term partnerships.

Overall, the SWOT analysis reinforces the relevance of using management tools in university extension programs. It not only supports strategic decision-making but also helps articulate the educational impact of initiatives focused on Chemistry teaching and science dissemination.

3.2. Strategic map analysis

The strategic program was prepared based on four main perspectives with the help of the BSC Designer Online tool, as shown in Figure 6.

STRENGTHS	WEAKNESSES
Use of chemistry experiments developed at UFMG, adapted for basic education students, promoting inquiry-based learning and active participation. **Qualified multidisciplinary team**, including university professors, lab technicians, undergraduate and graduate students, and basic education teachers. **Production of didactic materials**, such as experimental kits, manuals, and videos, supporting science teaching aligned with school curricula. **Large reach and impact**, with over 17,000 students and 500 teachers participating in activities that connect schools with the university environment.	**Limited and non-recurring funding**, restricting expansion and continuity of educational activities. **Lack of dedicated staff**, with team members balancing multiple roles, affecting project scalability. **Need for more robust evaluation tools** to measure the impact of the experiments on chemistry learning. **Partial institutional support**, especially regarding workload recognition for technical and academic staff involved.
OPPORTUNITIES	**THREATS**
Curricular demand for extension activities, generating greater interest from undergraduate students and potential team growth. **Teacher training and school partnerships**, enabling the dissemination and replication of the experiments in diverse educational contexts. **High demand for low-cost, contextualized teaching materials**, especially in public schools lacking laboratory infrastructure.	**Financial instability**, with no fixed funding sources to ensure the program's sustainability. **Team turnover**, requiring frequent training and reducing continuity in activities. **Geographical barriers**, limiting access to more remote or underserved regions.

Figure 5. SWOT diagnostic analysis for the 1000 FC program

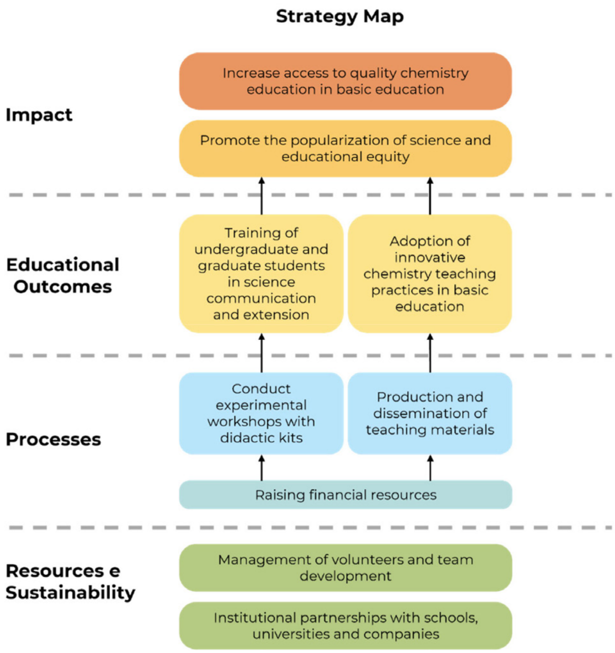

Figure 6. Strategic map of the 1000 FC extension program for the year 2023

Figure 6 presents the strategic map of the 1000 Future Scientists program, designed to align its operational processes with the educational and social impacts it aims to achieve. The structure follows four interconnected perspectives: Resources e Sustainability, Processes, Educational Outcomes, and Impact.

At the base of the map, the Resources and Sustainability layer highlights the importance of institutional partnerships and the structured management of volunteers and team development. These elements are fundamental for ensuring the continuity and quality of the program, especially given the challenges identified in the SWOT matrix related to funding and team turnover.

The Processes layer focuses on the core actions carried out by the program: conducting experimental workshops using didactic kits and producing/disseminating teaching materials. These processes operationalize the program's objectives and ensure the delivery of hands-on educational experiences in chemistry for students and teachers in basic education.

The Educational Outcomes perspective emphasizes two key results: (1) the training of undergraduate and graduate students in science communication and university extension, and (2) the adoption of innovative chemistry teaching practices in public schools. These outcomes are aligned with the national guidelines for curricular extension and contribute to teacher development and student engagement.

Finally, the Impact level consolidates the program's broader goals: to increase access to quality chemistry education and promote the popularization of science and educational equity. These outcomes reflect the program's alignment with public education policies and its potential to reduce inequalities in access to experimental science teaching.

By integrating the OKRs and the SWOT analysis, the strategic map reinforces the program's systemic logic and supports its long-term vision. It also serves as a guiding tool for internal evaluation and decision-making, ensuring that efforts in chemistry education, scientific outreach, and institutional collaboration are strategically connected.

3.3. Establishment and analysis of OKRS

The 1000 Future Scientists program adopted the OKR (Objectives and Key Results) methodology to support its strategic planning and monitor the impact of its actions. This approach enables the alignment of activities with the program's mission of expanding access to chemistry education and promoting scientific dissemination in public schools.

The process began with the definition of the program's mission — *to make knowledge accessible to all through the popularization and dissemination of science, generating social impact* — and its vision — *to become a national reference in producing and sharing low-cost, sustainable science education resources*. From these foundations, four strategic objectives were established, each with clearly defined and measurable key results.

The OKRs were formulated based on the analysis of demands identified across the program's projects and on insights from the SWOT matrix. The framework prioritizes essential themes such as: the promotion of chemistry education, teacher training, scientific outreach, sustainability, and student engagement.

Each objective focuses on delivering tangible educational results through specific actions such as experimental workshops, kit distribution, continuing education initiatives, and student participation in extension. Key results are reviewed in periodic cycles, and the methodology allows for dynamic redefinition of priorities based on outcomes.

Figure 7 summarizes the current OKR framework, which guides the implementation and evaluation of the program's impact across schools, students, and the academic community.

Figure 7 presents the set of Objectives and Key Results (OKRs) defined to guide the strategic actions of the 1000 Future Scientists program over a 12-month cycle. This framework connects planning with the program's educational and social mission, enabling effective monitoring and adjustment of actions.

The first objective emphasizes the promotion of chemistry education in basic education, through the implementation of experimental workshops using low-cost didactic kits and the distribution of materials aligned with the national science curriculum. These actions directly respond to demands identified in the SWOT matrix and address the gap in laboratory infrastructure in public schools.

The second objective focuses on the training of teachers and dissemination of scientific knowledge, reinforcing

Establishment and Analysis of OKRs

Objective 1 Promote Chemistry Education in Basic Education	Objective 2 Strengthen Teacher Training and Scientific Dissemination	Objective 3 Ensure Financial and Operational Sustainability	Objective 4 Encourage Academic Participation and Skill Development
KR1.1: Organize at least 15 experimental chemistry workshops with BE students using low-cost kits developed by the program.	**KR2.1:** Conduct 3 continuing education workshops for BE teachers on inquiry-based learning in chemistry.	**KR3.1:** Raise R$ 100,000 from public funding calls and R$ 20,000 from private partners.	**KR4.1:** Engage 300 undergraduate and graduate students in extension activities.
KR1.2: Reach a minimum of 2,000 students from public schools with practical activities in chemistry.	**KR2.2:** Publish 5 open-access materials (videos, manuals, experiment guides) on the program website.	**KR3.2:** Implement a platform to manage the distribution of materials and register activities.	**KR4.2:** Offer 4 training sessions in scientific communication, chemistry didactics, and educational technology.
KR1.3: Distribute 300 didactic kits aligned with the national science curriculum.	**KR2.3:** Expand the network of partner schools by at least 20%.	**KR3.3:** Consolidate partnerships with at least 5 institutions interested in replicating the program model.	**KR4.3:** Certify at least 500 hours of student participation in activities directly related to chemistry education.

Figure 7. OKRs of the 1000 Futures Scientists program

the program's commitment to continuing education and access to open educational resources. This approach contributes to the adoption of innovative chemistry teaching methodologies and expands the program's reach through strategic school partnerships.

The third objective aims to ensure financial and operational sustainability, with a combination of public and private fundraising, digital management tools, and institutional cooperation. These actions are essential for maintaining long-term impact and expanding the program's scope, especially in underserved regions.

Finally, the fourth objective relates to the engagement of undergraduate and graduate students, ensuring their active participation in extension activities and the development of scientific, pedagogical, and leadership skills. This reinforces the role of the program as a training environment for future educators and science communicators.

Altogether, the OKRs systematize the program's efforts in a structured and measurable format. By incorporating chemistry education explicitly into its strategic goals, the program not only aligns with the scope of this journal but also demonstrates its potential for replication and academic recognition.

Figure 8 presents a practical summary of the strategic planning process adopted in this study, adapted from management practices traditionally applied in the private sector. This model proved effective for organizing and evaluating actions within university extension projects, particularly in science education.

The process begins with the collaborative construction

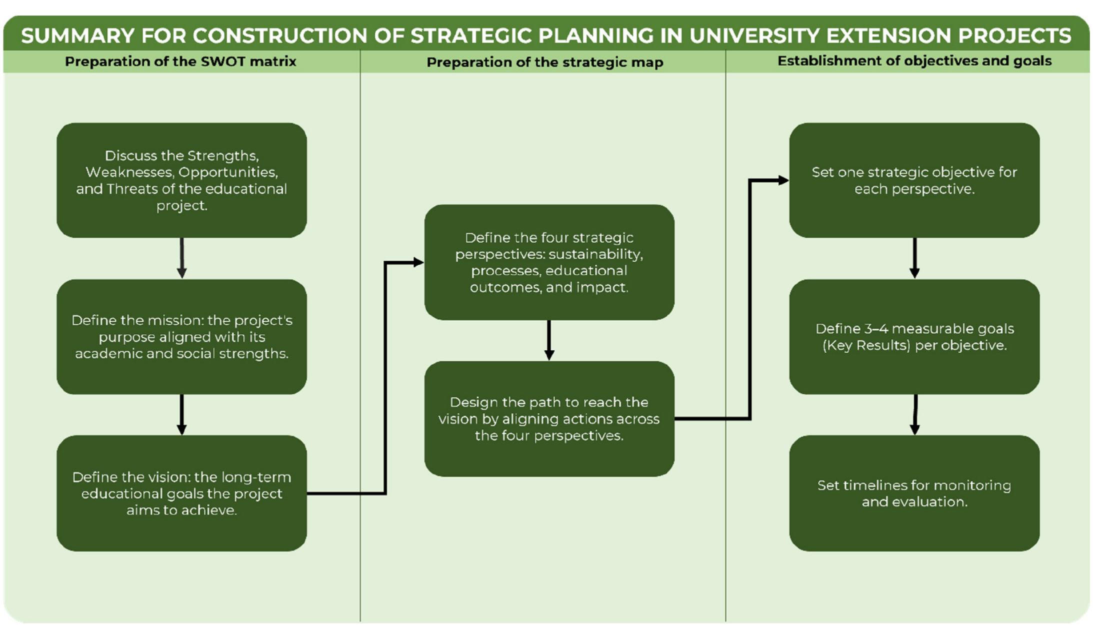

Figure 8. Strategic Planning Flow in University Extension

of the SWOT matrix, which helps identify internal and external factors relevant to the project's development. From this diagnosis, the team defines the mission (purpose) and vision (future aspiration) of the program.

The next step involves building the strategy map, connecting the program's actions across four perspectives — processes, educational outcomes, impact, and sustainability — to ensure alignment between operational efforts and long-term goals.

Finally, the OKRs (Objectives and Key Results) are defined based on each strategic perspective. For each objective, a set of 3 to 4 measurable goals is established, along with a timeline for execution and evaluation.

This integrated approach provided a clear structure for planning, implementing, and monitoring the educational initiatives of the 1000 Future Scientists program, reinforcing its impact on chemistry teaching and science popularization in public schools.

4. Conclusion

The application of strategic planning tools in the 1000 Future Scientists Program proved to be an innovative and effective approach to strengthening university extension initiatives focused on chemistry education and science popularization. The construction of the SWOT matrix enabled a systematic diagnosis of the program's main challenges—such as team turnover and limited financial resources—while also highlighting its key strengths, including the development of didactic experiments and collaborative training between the university and public schools.

The development of a strategic map, adapted from models traditionally used in the private sector, allowed the program's goals to be organized across four interconnected perspectives: sustainability, processes, educational outcomes, and impact. This structure ensured that the actions implemented were guided by clear objectives aligned with the institutional mission of democratizing access to scientific knowledge.

Based on this framework, a set of OKRs (Objectives and Key Results) was established to provide measurable indicators for monitoring goals related to chemistry education, teacher training, operational sustainability, and student engagement. This structure contributed to a more efficient organization of extension activities and enabled continuous tracking of progress and impact.

By integrating management tools with educational practices, this work highlights the potential of strategic planning to enhance university extension in public institutions. In addition to strengthening the articulation between teaching, research, and extension, the proposed approach promotes transparency, long-term vision, and alignment between academic goals and social responsibility.

The model presented here can be replicated in other programs aiming to integrate educational initiatives with measurable social impact, especially in contexts where science appreciation, pedagogical innovation, and educational equity are core priorities.

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