



RESEARCH/INVESTIGACIÓN

Received: 21/04/2021 --- Accepted: 03/08/2021 --- Published: 08/09/2021

FORMATIVE PROJECT: A DIDACTIC ALTERNATIVE IN A VIRTUAL ENVIRONMENT FOR THE TEACHING OF SCIENCES IN MEXICO

Proyectos formativos: una alternativa didáctica en entorno virtual para la enseñanza de las ciencias en México

   **Juan Salvador Nambo de los Santos¹**: Universidad Pedagógica Nacional/Centro Universitario CIFE. México.
crea-jnambo@upn.mx

How to cite this article:

Nambo de los Santos, J. S. (2021). Formative project: a didactic alternative in a virtual environment for the teaching of sciences in Mexico. *Vivat Academia. Revista de Comunicación*, 154, 53-69. <http://doi.org/10.15178/va.2021.154.e1374>
<http://www.vivatacademia.net/index.php/vivat/article/view/1374>

ABSTRACT

This article analyses, through Educational Action Research, the experience of implementing the methodology of Formative Projects in a group of Masters in Science Teaching at the Polytechnic University of the State of Morelos (Upemor). The Formative Projects are based on the Socio-formation educational theory in which, solving context problems through collaboration and metacognition is fundamental. The findings show that Formative Projects generate a change, both in the teacher and in the student, by promoting the development of cognitive skills, collaborative work, innovation, and the culture of entrepreneurship.

KEYWORDS: Formation; project; competencias; method; teaching; learning; education; communication.

RESUMEN

Esta investigación tiene como principal objetivo analizar, bajo el enfoque de la Investigación Acción Educativa, la experiencia de implementar la metodología de Proyectos Formativos en un grupo de Maestría en Enseñanza de las Ciencias de la

¹**Juan Salvador Nambo de los Santos:** Profesor de la UPN e investigador de CIFE. Autor de artículos y capítulos de libro sobre socioformación, políticas educativas, enseñanza de las ciencias, violencia escolar y libros de texto. Miembro del Sistema Nacional de Investigadores en México, Nivel 1.



Nambo de los Santos, J. S.

Formative project: a didactic alternative in a virtual environment for the teaching of sciences in Mexico

Universidad Politécnica del Estado de Morelos (Upemor). Los Proyectos Formativos se fundamentan en la teoría educativa de la Socioformación en la cual, resolver problemas del contexto mediante la colaboración y la metacognición es fundamental. Entre las conclusiones se destaca que, los proyectos formativos generan un cambio, tanto en el docente como en el alumno, además de que permiten desarrollar competencias cognitivas fomentando el trabajo colaborativo y la innovación, así como promover una cultura de emprendimiento.

PALABRAS CLAVE: Formación; Proyecto formativo; competencias; método; enseñanza; aprendizaje; educomunicación.

PROJETOS DE FORMAÇÃO: UMA ALTERNATIVA DE ENSINO EM AMBIENTE VIRTUAL PARA O ENSINO DE CIÊNCIAS NO MÉXICO

RESUMO

O objetivo principal desta pesquisa é analisar, sob o enfoque da Pesquisa-Ação Educativa, a experiência de implantação da metodologia de Projetos de Formação em um grupo de Mestrado em Ensino de Ciências da Universidade Politécnica do Estado de Morelos (Upemor). Os Projetos de Formação baseiam-se na teoria educacional da Socio Formação em que, resolver problemas do contexto através da colaboração e metacognição é fundamental. Dentro das conclusões, destaca-se que os projetos de formação geram uma mudança, tanto no professor como no aluno, além de permitir o desenvolvimento de competências cognitivas, promovendo o trabalho colaborativo e a inovação, bem como promovendo uma cultura empreendedora.

PALAVRAS CHAVE: Formação - Projeto de formação - competências - método - ensino - aprendizagem - educomunicação.

Translation by **Paula González** (Universidad Católica Andrés Bello, Venezuela)

1. INTRODUCTION

Being a teacher in any virtual learning platform implies knowing about education by competencies and its main didactic strategies, especially a series of responsibilities that give a special touch to teaching and, obviously, identity. Learning platforms in Mexico advance in such a way that, at the Ibero-American level, this country is the largest producer of online courses (Tobón et al., 2018), courses whose teachers, called virtual facilitators or advisers, include the use of social networks, simulators, digital games, podcasts, video editors, among others.

Thus, it is not only a training system in which the barriers of distance and time are eliminated but also advances are made that allow going beyond the change of behaviors or cognitions of the student (consequently, also of the teacher) and respond to the new needs of a knowledge society that demands new training processes (Grosso,

2004). In short, as Martín-Cabello points out: “global citizenry appears as an important rhetorical resource among global institutions and even among citizens, who buy the idea of being a citizen of the world” (2017, p. 12).

The above, added to the context of the pandemic in which we are living, in higher education in Mexico (Nambo & Chávez, 2020), represents an important challenge for a knowledge society that seeks that people work collaboratively to solve problems in the context and improve living conditions with a global, complex, and systemic vision, based on information and communication technologies (Cabrero et al., 2020).

2. OBJECTIVES

The purpose of this study is to analyze the experience of implementing the methodology of Formative Projects in a group of 15 students of the Master's Degree in Science Teaching of the Polytechnic University of the State of Morelos, which is carried out in a semi-face-to-face way and in which Moodle is used as a virtual learning platform.

In socio-formation, training projects consist of an articulated set of activities to solve a real problem of the context based on collaboration, seeking to achieve a series of learning purposes established in the curriculum, together with obtaining an integrating product (Tobón, 2019; Tobón et al., 2015).

The above is directly linked to the transfer of knowledge (Dixon, 2001) since it shows the concern of teachers to know if their students are capable of solving real problems and if the knowledge acquired in school can be applied to solve various situations outside of it.

The participants are science teachers in different public or private institutions in the region, who recognized that they needed knowledge in didactics, planning, and information management to improve their work in class. Therefore, one of the main purposes was to overcome the problems of traditional content-centered planning to focus on student learning.

It should be noted that research based on the design of didactic sequences is considered an emerging research line in science teaching (Guisasola et al., 2021).

3. METHODOLOGY

3.1. Type of Study

A study framed in educational research-action (Sandín, 2003) was carried out since it sought to implement an improvement in teaching practice. This implied identifying metacognition processes, training for new educational references, peer review at certain times based on collaboration, and socialization of the achievements with the educational community.

3.2. Procedure

The process to apply the Tobón, S. (2019) formative project in master degree's students had the following phases:

Phase 1. Dynamization. Raise student's awareness about formative projects and their relationship with science teaching, and planning a training project through a V-heuristic.

Phase 2. Development. A didactic sequence was taken in the area that the students were interested in and it was evaluated using a flow chart to detect needs. Based on the previous evaluation and planning, a new structure was formulated for the didactic sequence, which was the basis for its research protocol, subsequent thesis project, and/or article publication.

Phase 3. Socialization. Discussion forums for the presentation of projects with an emphasis on achievements and aspects to continue improving in the process. Presentation of a thesis to obtain a Master's degree in Science Teaching.

3.3. Context of the experience

The Polytechnic University of the State of Morelos was created in 2004, serves just over two thousand students in six engineering degrees, one bachelor's degree, and four master's degrees and the educational model established from its beginnings is the Competency-Based Model (Upemor, 2021).

The Master's Degree in Science Teaching (hereinafter MEC by its acronym in Spanish) is aimed at the professionalization of teachers in the areas of mathematics, biology, physics, and chemistry. It is offered in a semi-face-to-face way and four months periods for two years. Subjects related to educational research are included throughout the curriculum. The first two semesters: Educational research I and II. And the remaining semesters: Research Seminar I, II, III, and IV.

In this article, emphasis is placed on the first two semesters, which are those related to the presentation of their thesis research protocol. However, all the subjects indicated as the responsible subject teacher were followed up during the 2015-2017 generation:

Table 1: Structure of the two subjects addressed in the present experience

Subject	Educational research 1	Educational research 2
Justification	The subject will provide students with basic foundations for their research carried out in their daily academic activities with a theoretical argument, based on studies carried out by recognized authors. As well as having the	The subject will provide the student to identify the weaknesses and strengths of the methodological paradigm and identify its scope of educational research.

	necessary bases to specify the elements of the definition of the problem.	
Objective	That the student develops the ability to identify, research, analyze, and structure a problem statement.	The student will be able to identify the characteristics, as well as the particularities of the quantitative methodological paradigm, to assess its strengths and weaknesses that allow them to decide the relevance of its application in the development of the research problem.
Learning units	<ol style="list-style-type: none"> 1. Theoretical elements of a research problem statement 2. Specify the problem statement to be researched for the development of the research 3. Literature review of the problem to be researched 	<ol style="list-style-type: none"> 1. Quantitative paradigm in educational research 2. Qualitative paradigm in educational research 3. Theoretical framework
Evaluation	Course activities: 80% Forums: 10% Final work: 10%	Course activities: 80% Forums: 10% Final work: 10%

Source: Self-made, 2021

3.4. Instrument

Flow chart for the detection of needs. The purpose of this chart is to self-evaluate the research protocol, considering the socio-formative approach. It is made up of six indicators that assess the feasibility of the project and the role of both the student and the teacher (See Figure 1).

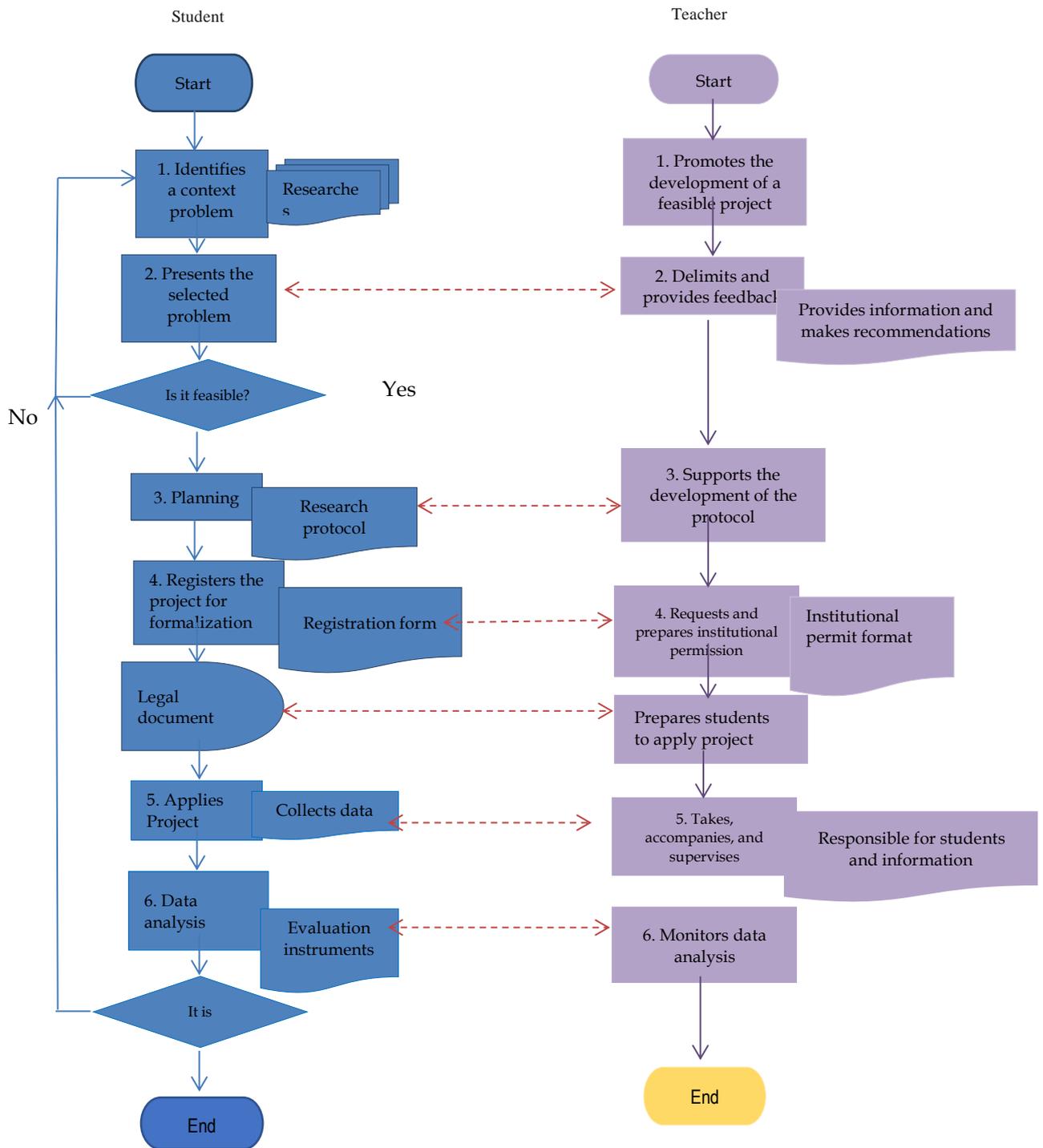


Figure 1: Flow chart for the detection of needs and delivery of the research protocol

Source: Self-made based on Nambo (2019)

Most of the MEC's activities, learning products, and assessment instruments were contained in a Moodle platform administered by the institution. It should be noted that the students met with the subject advisor twice a semester or at events that the institution held specifically for them. The advisor was free to intervene and adapt some

of these materials and direct specific activities at these events to enrich their research work (See Table 2).

Table 2. Activities, products, and assessment instruments during the first two semesters

Activity	Learning product	Assessment instrument
Project presentation through a V-heuristic (proposed by the teacher)	Concept map (proposed by the platform)	Checklist (proposed by the platform)
Making of a Literature Review (proposed by the platform)	Double-entry box (proposed by the platform)	Checklist (proposed by the platform)
Project planning and execution (proposed by the teacher)	Results report (proposed by the platform)	Checklist (proposed by the platform)
Research reports progress (proposed by the teacher)	Electronic presentation (proposed by the teacher)	Checklist (proposed by the teacher)

Source: Self-made, 2021

4. RESULTS

4.1. Phase 1. Dynamization

In this phase, it was possible to raise students' awareness about formative projects and their relationship with science teaching. Most of the teacher-students had initial training in Biology, Chemistry, Mathematics, or related Engineering and indicated that they had little experience in the Competency-Based Model and academic writing.

As part of the activities on the platform, the student was asked to carry out self-administered work, they complied with the asynchronous activities, and the teacher had the function of generating assertive feedback, either through the platform's forums or through email, WhatsApp, and even by Skype or in person. However, for the writing of the reports, it was necessary to use the premise raised by Ferreiro (2007): Each time and each historical circumstance gives new meanings to reading and writing, especially if it is considered that various things happen in school that can be told in different ways.

They were ordered to search their files, both physical and digital; in the work of their students, in the evidence folders, and in their bookshelves where they had kept dreams, motivations, and ways of facing life. They knew of specialized literature. They used specific materials, YouTube sites to feed their classes, they began to become familiar with games, simulators, augmented reality, and artificial intelligence. Without knowing it, they were science communicators because they were in charge of the scientific literacy of their students (Meinardi et al., 2010). So, they had to read everything differently. The purpose had to be writing (Richardson, 2011).

The teachers recovered the best classes they had had, the response to emerging problems for both themselves and their students, as well as the vicissitudes of their teaching practice, and reported various experiences that deserved to be told or replicated. However, they had to be aware that, to write, a plan was necessary to help them visualize the way forward, so the matrices offered a form of systematization that favored the teachers' written production (Nambo et al., 2016). The method was the formative project. The initial evidence: the V-heuristic (See diagram 2).

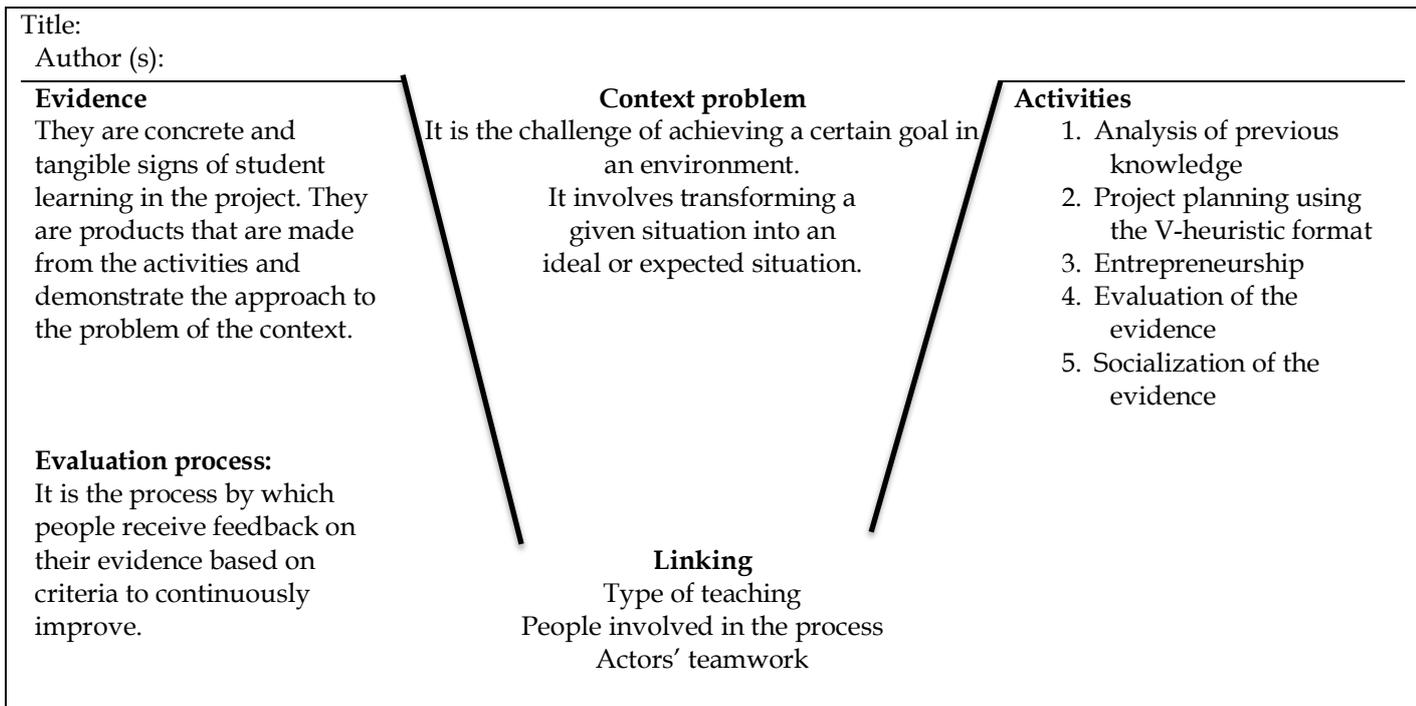


Diagram 2. V-Heuristic used during sessions
Source. Self-made. Based on Tobón (2019)

The evidence of the V-heuristic in this formative process was of total relevance because it allowed them to distinguish the specific product that they would have to present as an undertaking and other more related ones. Likewise, it allowed them to see their planning without the conventional bureaucratic obstacles, as they themselves expressed it. In this way, social, personal, institutional, scientific, or environmental projects were proposed. Some project titles that went through the entire institutional process and managed to culminate as theses were the following (See Table 3):

Table 3. Formative projects addressed in the classroom

Project titles
1. Information management for the development of disciplinary competencies in Chemistry in Upper Secondary Education
2. ABP's strategy to develop environmental impact assessments from the classroom
3. The formative evaluation in the acquisition of generic and disciplinary competencies in the subject of Analytical Chemistry II
4. Strategy to promote research through the development of disciplinary competencies in the area of experimental sciences in students of industrial food production from CBTIS 76.
5. Design and application of a didactic strategy to generate meaningful learning of the cell topic in students of upper secondary education.
6. The development of competencies for the scientific training of secondary education through the application of simulators in the teaching of physics

Source. Self-made, 2021

The formative project was outlined as a support for the teacher to systematize and develop undertakings to work with daily emergent situations that would bring students closer to the development of their capacities. This project contemplated six important characteristics:

- a) Analysis of previous knowledge: The student-teacher would identify the knowledge that allows their own students to learn in the best way, considering pertinent topics for the subject;
- b) Planning: It would seek to obtain relevant products through the planning and execution of activities and the communication of the results;
- c) Competencies: It would help to form one or several competencies related to the four pillars of education (being, doing, knowing, coexisting);
- d) Context problems: It is the challenge of achieving a certain goal in an environment, which would imply transforming a given situation into an ideal or expected situation;
- e) Entrepreneurship: It would generate relevant activities for both them and their students, related to the improvement of the social, individual, and environmental situation;
- f) Evaluation: mainly through learning maps, socialization, and metacognition.

4.2. Phase 2. Development

Once the project that the students of the MEC wanted to carry out had been proposed and evaluated with the flow chart for the detection of needs and delivery of the research protocol (See Figure 1), a new structure was formulated for the didactic sequence. An example of the work done is as follows:

The methodology of the didactic sequences was reviewed in a High School in the state of Morelos, to which the master degree's student was attached, and the methodology of formative projects was implemented.

Table 5 presents the format developed for the new planning proposal, which seeks to apply the references of socio-formation and is characterized by the following elements:

- 1) it focuses on expected learning as a key axis, instead of purposes and objectives, which is one of the recurring confusions among teachers who do not have previous teacher training;
- 2) the expected learnings are synthesized so that they are understandable and they are asked to work a maximum of two of them;
- 3) the resolution of context problems is incorporated, in such a way that the emphasis on content is overcome;
- 4) emphasis on approaching dynamic and motivating activities with students; and
- 5) have a simpler planning format that serves as a guide for students rather than being an administrative or activity control instrument.

Table 4. Improvement in the planning of the formative project regarding its didactic component (example)

Formative project title	Information Management for the Teaching of Chemistry in Higher Secondary Education
Subject (s)	Chemistry I
Context challenge or problem to be addressed or solved by students	Apply information management from videos and other teaching tools and/or strategies to awaken the student's interest in learning Chemistry, which allows them to assess its applications in different contexts and involve them in the stimulating and satisfying experience of learning and studying.
Central product to be achieved throughout the formative project by students based on the resolution of the problem	Timelines from the use of videos for teaching chemistry
Minimum contents (essential knowledge)	
Phases	Activities
Opening phase	The general content and form of evaluation of the subject are presented, so students become familiar with it. Emphasis is placed on the products that students must deliver throughout the course, indicating that an individual evidence portfolio will be formed. Didactic Material: Printed questionnaire, blackboard, blackboard marker, pencil or pen, video number 1.
Development phase	A diagnostic evaluation is carried out, 11 YouTube videos are used for a block, of these only the first was used to understand the concept of chemistry, its historical development, and its relationship with other sciences; Depending on the total number of students, homogeneous teams were integrated into the group, these being a minimum of 4 members, for the observation of videos and in this, the elaboration of a timeline about chemistry with the main moments of its development and show the transcendental moments that this science has lived in the national and international scope and the historical and social context in which it arises. The student developed a timeline in the classroom and teams of 2 people while receiving advice from the teacher.
Closing phase	Presentation of the timeline to the group. For the evaluation of this activity, a rubric was elaborated (See Table 1), with this rubric the reports of the videos will also be evaluated, without taking into account the point of "posture". The conclusions obtained about the products were analyzed with the students. Evidence: Timeline

Source: Self-made based on Vargas et ál. (2019)

4.3. Phase 3. Socialization

The previous example is part of an article that was written by a MEC student in co-authorship with his thesis supervisors. The proposal made his students improve their academic performance, so this proposal was replicated in other groups and institutions belonging to the High School.

Nambo de los Santos, J. S.

Formative project: a didactic alternative in a virtual environment for the teaching of sciences in Mexico

The information management carried out by the teacher in the first instance served to identify valuable sites on YouTube for the teaching of chemistry. The project that started from the first semesters managed to materialize in a contribution to the state of knowledge, which represented one of the best ways of socializing the results of each of the formative projects. Likewise, discussion forums were developed that allowed master degree's students external feedback for their projects.

It should be noted that the project-based didactic planning proposed in Phase 2 also served as a basis for the master degree's student advisor to develop their own project, articulating the subjects in Table 1.

This was done to address the subject of writing and developing projects based on their own teaching experience. In this new proposal, the evaluation focuses on achieving an integrating product relevant to the environment and motivating for the students, which makes it possible to assess the expected learning of both subjects and the detection of needs and delivery of the research protocol (see Table 5).

Table 5. Improvement in the planning of the formative project regarding its didactic component

Formative project title	Dare to write: Initiation to writing your research project
Subject (s)	Educational research I and II
Context challenge or problem to be addressed or solved by students	Generate learning environments that allow participants the appropriation of theoretical-conceptual and methodological tools, to advance their research project.
Central product to be achieved throughout the training project by students based on the resolution of the problem	Research protocol
Minimum contents (essential knowledge)	
Phases	Activities
Opening phase	Raise awareness about the reading and writing process as part of their ethical life project. Analyze specialized readings that allow the student to advance in their literature review. Point out myths around the writing process. Identify writing sources that allow the development of the student's academic work project (photographs, field diary, binnacle, activity log). Promote exercises that allow linking the academic work projects of students with their training in the MEC Carry out a V-heuristic with the topics of their research project
Development phase	Identify general rules of spelling, writing, specialized search for information, use of photographs, and citation established by the APA system. Develop an approach based on the formative project model, indexing, and a schedule of activities. Propose strategies to avoid the different conflicts in the writing process (rules of spelling, writing, use of technicalities). Review and adaptation of its didactic sequences In-person forums for the presentation of thesis advances
Closing phase	Elaboration of a problem statement. Develop a project under the socio-formative approach. Identify the main competencies to develop with their academic work project. Delivery of the research protocol. In-person forums for the presentation of thesis advances

Source: Self-made

5. DISCUSSION

Barber and Mourshed (2008) affirm that the success experiences of 25 educational systems highlight three points for attending and influencing their performance positively: getting the most suitable people to teach; develop them into efficient instructors, and ensure that the system is capable of providing the best possible

education. This continues to be appreciated in Mexico, where science teaching continues to be a challenge at all levels.

The teachers in charge of teaching science in Mexico have a different profile than normal teachers, but that is being built under a perspective enriched with the knowledge of experience and that places the teacher as an authorized voice of the knowledge society.

Faced with this situation, the teaching-learning sequences become an indispensable tool both for face-to-face work and through virtual learning platforms. In this sense, the pandemic caused by Covid 19 has blurred the borders and identities that remain around the teaching profession, especially regarding the use of digital tools.

This study presents a simple proposal focused on the key activities that it is proposed to carry out, based on the resolution of a problem in the environment. The didactic plans used by the master degree's students had a large number of components that made them difficult to carry out and ended up being a more administrative activity than focused on the learning of their students.

6. CONCLUSIONS

At the end of the Formative Project that was promoted in this research-action project, the student-teachers commented that they found greater application of the knowledge contained in their subject.

In this sense, the students claimed to have the ability to study out of motivation to solve a problem in their own context, besides allowing them to develop competencies for both themselves and their students, fostering innovation, as well as promoting a culture of entrepreneurship and edu-communication (Watson, 2001; Aramburuzabala, et al, 2013; and Jiménez-Marín et al, 2020; Elias-Zambrano, et al, 2021).

Implementing the methodology of formative projects, both individually and for students, allowed greater autonomy and less stress since there was more clarity of what was intended to be achieved and how the evidence of both the Master's Degree and its Science classes were articulated.

It is worth mentioning that a critical evaluation of the methodology of the didactic sequences was carried out in the institutions in which the students worked, where the lack of addressing real problems of the context was observed. This is common in many proposals of didactic sequences, which, although they pretend to be significant, remain in the approach of conceptual questions.

7. REFERENCES

- Aramburuzabala, P., Hernández-Castilla, R., Ángel - Uribe, I. C. (2013) Modelos y tendencias de la formación docente universitaria Profesorado. *Revista de Currículum y Formación de Profesorado*, 17(3), 345-357.
- Barber, M., y Mourshed, M. (2008). *Cómo hicieron los sistemas educativos con mejor desempeño del mundo para alcanzar sus objetivos*. PREAL.
- Cabrero, E., Carreón, V. y Guajardo, M. (2020). *México frente a la sociedad del conocimiento. La difícil transición*. CIDE, Siglo XXI editores.
- Dixon, N. (2001). *El conocimiento común. Cómo prosperan las compañías que comparten lo que saben*. Oxford University Press.
- Ferreiro, E. (2007). Leer y escribir en un mundo cambiante. *Versión. Estudios de Comunicación y Política*, 11, 99-112.
- Guisasola, J., Ametller, J., y Zuza, K. (2021) Investigación basada en el diseño de Secuencias de Enseñanza-Aprendizaje: una línea de investigación emergente en Enseñanza de las Ciencias. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias*, 18, 1-18.
https://doi:10.25267/rev_eureka_ensen_divulg_cienc.2021.v18.i1.1801
- Grosso, J. L. (2004). NTICS, educación virtual, lógicas de la comunicación social y "sociedad del conocimiento": anotaciones sobre el contexto y la responsabilidad social de la educación superior a distancia en ALC. *Revista Diálogo Educativo*, 4(13), 69-78.
- Jiménez-Marín, G., Elías Zambrano, R. y Bellido-Pérez, E. (2020). 'Meetings with Professionals': The Success of An Innovative Teaching Methodology Based on Real Business Scenarios at the University of Seville, Spain. *International Journal of Social Policy and Education*, 2 (8), 12-20.
- Martín-Cabello, A. (2017). Ciudadanía global. Un estudio sobre las identidades sociopolíticas en un mundo interconectado. *Arbor*, 193(786), a422-a422.
<http://dx.doi.org/10.3989/arbor.2017.786n4010>
- Meinardi, E., González, L., Revel, A., & Plaza, V. (2010). *Educación en ciencias*. Paidós.
- Nambo de los Santos, J. S. (2019). Investigación-acción: estrategia para la sustentabilidad. En Frías, G. y Montes, L. (Coord.). *Arar, sembrar y cosechar: planteles educativos sustentables* (pp. 104-108). UAEM
- Nambo de los Santos, J. S., & Chavez, V. G. (2020). Conceptual Cartography of School Safety: School Experiences in Managing the Covid-19 Pandemic in Mexico. *Revista*

Nambo de los Santos, J. S.

Formative project: a didactic alternative in a virtual environment for the teaching of sciences in Mexico

Romaneasca pentru Educatie Multidimensionala, 12(2Sup1), 86-92.
<https://doi.org/10.18662/rrem/12.2sup1/293>

Nambo de los Santos, J. S., Rodríguez, E. y Tobón, S. (2016). Proyectos formativos y análisis de casos en el desarrollo de la competencia de escritura. En Tobón, S., Guzmán, C., Vélez, J. y Nambo de los Santos, J. S. (Coord.). *Socioformación y sociedad del conocimiento. Experiencias en organizaciones empresariales, educativas y comunitarias* (pp. 257-274). Kresearch.

Richardson, R. (2011). *Primero leemos, después escribimos. El proceso creativo según Emerson*. FCE.

Sandín Esteban, M. P. (2003). *Investigación cualitativa en Educación. Fundamentos y Tradiciones*. Mc Graw Hill.

Tobón, B., Tobón, S., Veytia-Bucheli, M. G., & Escudero, A. (2018). Hacia un nuevo concepto: Plataformas Virtuales Socioformativas (PVS). *Revista Espacios*, 39(53), 27-27.

Tobón, S. (2019). *Metodología de los proyectos formativos*. Kresearch.

Tobón, S., González, L., Nambo de los Santos, J. S., & Vázquez Antonio, J. M. (2015). La Socioformación: Un Estudio Conceptual. *Paradigma*, 36(1), 7-29.

Vargas, B., Zapata, C. y Nambo de los Santos, J. S. (2019). Gestión de la Información para la Enseñanza de la Química en Educación Media Superior. *Academicus*. 1(15), 58-69.

Watson, D. M. (2001). Pedagogy before technology: rethinking the relationship between ICT and teaching. *Education and Information Technologies*, 6 (4). 251-266.

Upemor. (2021). Universidad Politécnica del Estado de Morelos.
<https://www.upemor.edu.mx/>

Elias-Zambrano, R., Sánchez-Gey, N., Román-San-Miguel, A. (2021). La evolución del aprendizaje a través de los medios: publicidad, comunicación audiovisual y periodismo como base de la educomunicación. En *La comunicación a la vanguardia. Tendencias, métodos y perspectivas*, 1664-1675.

AUTHOR/S:

Juan Salvador Nambo de los Santos:

Doctor of Education. Member of the National System of Researchers in Mexico (SNI 1). Post-doctorate in Methodology of Scientific Research, Socio-formation, and Human Development. Assigned to the research line: Socio-formation and Education for global citizens. Author of articles and book chapters on socio-formation, educational policies,

Nambo de los Santos, J. S.

Formative project: a didactic alternative in a virtual environment for the teaching of sciences in Mexico

science teaching, and textbooks. He is currently attached to the CIFE University Center, the National Pedagogical University, and the Center for Higher Studies "Lic. Benito Juárez García".

salvadornambo@gmail.com

ORCID iD: <https://orcid.org/0000-0002-3891-5228>

Researcher ID Thomson: <https://publons.com/researcher/AAR-7717-2020/>

Google Scholar: <https://scholar.google.es/citations?user=ncS5l3EAAAAJ&hl=es>

ResearchGate: <https://www.researchgate.net/profile/Juan-Nambo>

Academia.edu: <https://upn.academia.edu/JuanNambo>