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The museum as a space for teacher training: training experience based on a supervised internship in Natural Sciences

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Abstract: This article analyzes a formative experience of undergraduate students in the Natural Sciences program at the Federal University of Vale do São Francisco (UNIVASF), developed during their supervised internship at the Museum of the American Man (MHA), located in São Raimundo Nonato, Piauí, Brazil. The study was guided by the theoretical framework of the Teaching Learning Focuses (TLF), which enabled the identification and understanding of the learning processes developed by future teachers in a non-formal educational context. This qualitative, participatory research was organized into five stages: exploratory research, theoretical training on non-formal spaces, planning and implementation of mediation strategies, monitoring of museum activities, and mapping of teacher learning. Data were collected through portfolios prepared by the undergraduate students and analyzed according to the TLF categories. The results revealed that the most prominent focuses were Interest in Teaching and Reflection on Teaching, indicating that internships in museum settings significantly contribute to the development of motivation, autonomy, and reflective capacity among future teachers. The experience also strengthened the relationship between the university, the museum, and the community, expanding students' understanding of science mediation and teaching in it can be concluded that the MHA internship represents a promising training model, capable of integrating theory, practice, and research, thereby strengthening teacher education and highlighting the educational role of science museums, providing integration between theory and educational practice.

Keywords: teacher education; supervised internship; non-formal education; Museum of the American Man.

1 Introduction

Over the past decade, the literature on science education has seen the emergence of a new research perspective: the contribution of museums to teacher education (Pugliese, 2015; Gareau; Guo, 2012). This relationship, which is still underrepresented in the curricula of teacher-training programs, is emerging as museums take on a new social responsibility focused on professionalizing the educational services they offer to their various audiences, including future teachers.

Calls for improvements in initial teacher education, though longstanding, have been taking shape more consistently in recent decades. Against this backdrop, there



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is growing interest in innovative training strategies that prioritize more engaging, immersive, and motivating experiences, integrating theory and practice in diverse contexts, especially in non-formal educational settings.

Marandino (2003) highlights the museum as a privileged learning space for teacher education. According to the author, supervised curricular internships in non-formal settings should expose pre-service teachers to the specific characteristics of these locations. In this way, it is hoped that pre-service teachers will recognize the educational potential of museums and be able to critically engage with the activities carried out in these spaces.

Along the same lines, Barzano (2008) argues that completing practicums in teaching and science outreach (DC) activities at museums allows teacher candidates to broaden their scope of teaching practice, since most training practices in teacher education programs still focus on traditional school experiences. This shift in the social space of teacher education, from the classroom to the museum environment, gives the internship a forward-looking, creative, and investigative dimension, allowing teacher candidates to experience new forms of mediating scientific knowledge.

Thus, reflecting on supervised internships in non-formal settings, especially in science museums, proves relevant from the perspective of acquiring the personal and intellectual competencies that qualify the future teacher as a reflective and distinguished professional. It is within this context that the present study is situated; its objective is to analyze a formative experience undergone by teacher education students in the Natural Sciences program at the Federal University of the São Francisco Valley (UNIVASF) during their supervised internship at the Museum of the American Man (MHA), based on the theoretical framework of the Focuses of Teacher Learning (FAD).

2 Supervised internships in museums: formative experiences

In Brazil, there has been a growing trend toward developing mediation experiences in non-formal settings, such as museums and science centers. These initiatives have established themselves as important strategies for initial teacher education. Research conducted by Ovigli (2009, 2011) highlights the potential of these spaces for developing innovative formative practices. This type of initiative highlights

the need to rethink teacher education by integrating specific content with broader knowledge of education and science communication. Although the potential for learning in out-of-classroom settings is recognized, such spaces are, unfortunately, only marginally addressed in teacher education curricula.

Ovigli (2011) notes that the topic of museum education has been gaining prominence in the development of curriculum guidelines for teacher education. In this context, teaching practice is being rethought, reinforcing the focus of teacher education courses not only on pedagogical experience but also on research.

Teaching internships can also foster museum-university collaboration, since teacher education students, by learning about the educational characteristics of non-formal spaces, begin to incorporate them into their future teaching practice. Therefore, schools, museums, universities, and even the community can work together, sharing the responsibility of training and teaching (Ovigli, 2009, 2011; Colombo Junior; Ovigli, 2020).

However, Sousa and Carvalho Neta (2014) point out that, despite recognition of the importance of extracurricular spaces for teacher training in terms of complementarity, there remains a disconnect between universities and museums, which ultimately limits such collaboration and the implementation of these activities in undergraduate programs. Consequently, there are considerable losses in the improvement of teaching practice due to the absence of this type of activity. Formal education seeks complementarity in its resources, content, and training, and museums seek to contribute to meeting these demands by developing a pedagogical approach and engaging in collaboration within this process (Bortoletto-Rela, 2017).

Marandino (2015) offers some important insights into the relationship between universities, museums, and schools, from the perspective of initiatives to promote scientific literacy (SL) in teacher training. Thus, the author confirms that access for different audiences occurs almost exclusively through schools; therefore, there is a need for museums to seek improvements to expand and better facilitate school access, particularly for pre-service teachers, whether as visitors or even as interns at the museum.

Given that schools play a key role in facilitating this access, it is essential that content related to museum visits be included in both initial and continuing teacher

education from the perspective of SL. Developing such training requires the incorporation of new topics into courses, making it urgent to rethink the curriculum content, practical activities, and field placements in teacher education programs (Marandino, 2015).

Topics could include planning extracurricular activities and discussions on the different types of educational modalities (formal, non-formal, and informal education), among others. In the context of museums, the topics to be included in the courses of teacher training programs could cover the history of these institutions and what the literature indicates about the possibilities and challenges of teaching and learning through museum visits, interaction with teachers and the public, connection, the history of humanity, physical expression, or other educational activities, as well as the relationship between Science, Technology, Society, and the Environment (CTSA), Socio-Scientific Issues and Controversies in Science (Scalfi; Iszlaji; Marandino, 2020; Ovigli, 2009; Mellini; Gomes, 2020).

Marandino (2015) further argues that it is necessary to promote teaching strategies that incorporate these topics, such as: museum visits, environmental studies, and educational mediation through museum objects, texts, images, and student-led guidance. These new topics and strategies could spark innovative pedagogical developments in higher education disciplines, potentially leading to new educational products, texts, articles, books, activities, and teaching materials, both physical and virtual, and consequently, the generation of new knowledge in the fields of education and science communication.

Higher education curricula are constantly adapting to new societal demands for education. Therefore, content and practices related to non-formal education in science teaching would be important elements for the professional development of these teachers, strengthening the relationship between universities, schools, and museums (Marandino, 2015; Bortoletto-Rela, 2017; Colombo Junior; Ovigli, 2020).

In addition to incorporating content and practices from non-formal education, museums must also contribute effectively to this process in its various dimensions. Thus, museums should be viewed as mediating and facilitating structures for the multiple possibilities of interaction between the individual and culture; however,

organized educational activities must be developed for this process to take place (Colombo Junior; Ovigli, 2020; Mellini; Gomes, 2020).

Therefore, whether in initial or continuing education, it is important for teachers of various science disciplines to visit museums and have formative experiences in these spaces. Furthermore, it is necessary for internships in non-formal settings to foster discussion about the relationship between museums and schools, promoting an understanding of how educational processes occur in these spaces and how schools and museums are organized. Thus, “It is not a matter of replacing or downplaying the importance of school-based teaching practicums in teacher education, but rather of effectively expanding training opportunities and promoting access to scientific culture through diverse avenues” (Marandino, 2015, p. 128).

For the intended research, we selected the Foci of Teacher Learning as an analytical framework. This choice stems from the alignment of this framework with research that explores the interface between the museum and the classroom. This perspective proves particularly relevant in the context of supervised teaching practicums, where these relationships materialize in concrete ways.

The Learning Foci can be considered an analytical framework comprising three dimensions: Scientific, Teaching, and Research. These Learning Foci originated within the Science and Mathematics Education Research Group (EDUCIM) at the State University of Londrina (UEL), inspired by Bernad Charlot’s ideas regarding “knowledge,” as he seeks to understand it based on what happens in the classroom through the actions of teachers and students. For this researcher, knowledge is a means of relating to the world, and learning extends beyond the school walls, making it possible to learn in any situation, circumstance, or place (Arruda; Portugal; Passos, 2018; Arrigo; Albertoni; Lorencini Júnior, 2013).

As a basic assumption, the Learning Focuses posits:

[...] that an individual is learning academic content when we perceive a change in their relationship with knowledge. Since we learn continuously and, for the most part, outside of school, changes in our relationship with knowledge are constantly occurring throughout our lives (Arruda; Portugal; Passos, 2018, p. 94).

Therefore, this analytical tool can provide evidence of changes in the relationship an individual establishes with knowledge, as evidenced through the

Learning Focuses. We are particularly interested in the dimension of Teacher Learning, conceived based on definitions related to learning situations pertaining to the teaching career and presented in the form of five Focus Areas. These focus areas, in turn, encompass characteristics that describe teacher learning, while also highlighting how practices carried out in non-formal settings contribute to this professional development.

The Foci, presented in Table 1, are understood as evidence of learning, and each represents a facet of teacher learning that can be developed in an integrated and gradual manner (Arruda; Passos; Fregolente, 2012; Arrigo; Albertoni; Lorencini Júnior, 2013; Arruda; Portugal; Passos, 2018). The five Focuses of Teacher Learning (FAD) are understood as categories of analysis:

Table 1 — Focus in Teacher Learning.

Focus 1: Interest in teaching

The student experiences interest, emotional engagement, curiosity, and motivation, driving them to practice teaching and learn more and more about it.

Focus 2: Practical knowledge of teaching

Through knowledge gained through action and based on reflection on that action, the student develops a body of case knowledge, a repertoire of didactic and pedagogical experiences that guide their daily practice in the classroom.

Focus 3: Reflection on teaching

Faced with new problems arising from their practice, which they were unable to resolve at the time they occurred, future teachers, using theoretical tools, systematically analyze the situation, engaging in research and retrospective reflection on their practice and their accumulated knowledge of it, in order to resolve the problems initially identified. The goal is to develop the research dimension in future teachers.

Focus 4: Teaching Community

The student participates in activities carried out within a teaching community, learns teaching practices and language from other teachers or future teachers, assimilates the values of that community, and develops collective reflection.

Focus 5: Teaching Identity

Students reflect on themselves as learners of teaching and develop an identity as individuals who will eventually become professional teachers.

Source: Lucas, Passos e Arruda (2015, adapted and translated).

FADs can be used to capture and analyze learning for teaching in a variety of settings, such as: initial teacher training, teaching internships, in-service or continuing teacher education, training programs, for example, the Institutional Program for Teaching Initiation Scholarships (PIBID), in informal everyday situations, and in planned non-formal educational settings, such as museums and science centers (Arrigo; Albertoni; Lorencini Júnior, 2013).

Brazilian studies, such as those by Lucas, Passos, and Arruda (2015), Arrigo, Albertoni, and Lorencini Júnior (2013), and Ramos, Quevedo, Lorencini Júnior, and Arruda (2014), illustrate the use of Teacher Learning Foci as an analytical tool. These studies employed this perspective to investigate teacher learning processes. Furthermore, they contributed to understanding aspects that permeate teacher education in different educational contexts.

The study by Arruda, Passos, and Fregolente (2012) is an example that aligns closely with our research focus. In this article, TLFs were used to analyze the teaching learning of a group of undergraduate students majoring in Physics and Chemistry, who served as interns at the Londrina Museum of Science and Technology. Data were collected through interviews, which were recorded and transcribed. To carry out this interpretive process, the authors employed Discursive Textual Analysis (ATD) as their method of discourse analysis.

The authors concluded that the activities conducted within the museum setting contributed significantly to the teacher education of the students studied. The results indicated that the experience in this setting fostered reflections on the role of the teacher and the teaching-learning process. Furthermore, many participants reported having developed a greater interest in teaching after participating in science outreach activities at the museum (Arruda; Passos; Fregolente, 2012).

It is observed that FADs can be used to identify evidence of learning to teach; they can be interpreted based on records and/or declarative statements and applied to various contexts. Furthermore, it is possible to expand or adapt them as an analytical tool, without compromising the original theoretical framework, to better suit the intended research context.

3 Methodological aspects of the research

This proposal is classified as participatory qualitative research and consists of a subset of data obtained as part of a doctoral dissertation. Participatory research, according to Soares and Ferreira (2006, p. 96), implies, as the name itself suggests, “[...] the participation of both the researcher in the context, group, or culture being studied, and the subjects involved in the research process.”

This serves as the foundation for one of its primary assumptions and, more importantly, as a critique of the traditional social science postulate of “neutrality” or detachment between the subject and the “object” of research. Through this critique, the researcher’s integration into the group, community, or culture they seek to understand is reinforced, as is the active participation of those being studied throughout the research process (Soares; Ferreira, 2006).

Therefore, considering the experiences and learning processes engaged by the teacher-candidates through the supervised internship program outlined in this study, it is also important to note that one of the researchers served as both the course instructor and internship coordinator at the time this study was conducted. This arrangement was crucial for fostering a deeper and more collaborative learning experience.

The research participants were 21 teacher education students in the Bachelor’s program in Natural Sciences at the Federal University of the São Francisco Valley (UNIVASF), Serra da Capivara campus, located in the municipality of São Raimundo Nonato, in the state of Piauí. The participants were regularly enrolled in the course “Supervised Internship III,” focused on conducting practical work in non-formal educational settings.

Participants were selected through purposive sampling, taking into account the students’ direct connection to the course under investigation and their participation in the activities proposed throughout the study. The inclusion criteria were as follows: being duly enrolled in the course, participating in the training activities, and voluntarily agreeing to participate in the study by signing the Informed Consent Form (TCLE). Authorization was also requested from the American Man Museum Foundation (FUMDHAM).

The research was conducted over the course of one academic semester, corresponding to the duration of the course “Supervised Internship III.” During this period, activities were organized systematically, encompassing different stages of the research process, from planning to the analysis of the data produced. Initially, the pedagogical activities and data collection instruments were designed in accordance with the study’s objectives. Next, the activities were implemented in the museum setting, enabling the observation, documentation, and critical analysis of the practices

carried out. Finally, the data obtained were analyzed in light of the adopted theoretical framework, seeking to understand the contributions of the experience to teacher education and science instruction.

With regard to ethical considerations, all participants were duly informed about the objectives, procedures, and possible implications of the research, and the anonymity and confidentiality of the collected information were ensured. Participation was voluntary, respecting the right to refuse or withdraw at any time, without any adverse consequences for those involved. To ensure the protection of the participants' identities, codes were used in the presentation and analysis of the data, avoiding any form of direct or indirect identification. Furthermore, the data were used exclusively for academic purposes, in accordance with the ethical principles governing research in the field of Education and Teaching.

Given that, at the time this research was conducted, the Federal University of the São Francisco Valley (UNIVASF) did not have an active institutional Research Ethics Committee (CEP) linked to Plataforma Brasil, the study was not submitted for formal ethical review and, therefore, a Certificate of Submission for Ethical Review (CAAE) number or a substantiated opinion. It should be noted, however, that the internship was duly formalized in accordance with legal requirements, ensuring the proper establishment of the relationship between the student, the educational institution, and the host organization, in this case, the museum. This formalization included the signing of the Internship Commitment Agreement (TCE), as well as the purchase of life insurance by UNIVASF for each intern. Nevertheless, the research was conducted in accordance with the ethical principles established by the National Health Council, particularly Resolution nº. 510/2016, which provides guidance for research in the field of Humanities and Social Sciences, taking into account their methodological specificities. Therefore, the research is classified as qualitative.

The Bachelor's Degree program in Natural Sciences at the Serra da Capivara campus is one of the degree programs offered by UNIVASF, headquartered in the city of Petrolina, Pernambuco. According to the program's Pedagogical Curriculum Proposal (PPC), it was established in 2009, with the first cohort enrolling in the second semester of 2009. Since then, 50 spots have been offered annually for the training of teachers in Natural Sciences.

The Natural Sciences program aims to train qualified professionals in this field to work in elementary school (grades 6 through 9), promoting an interdisciplinary and integrated approach to the Natural Sciences, organized around three main areas: Matter and Energy; Life and Evolution; Earth and the Universe (UNIVASF, 2020; Brazil, 2018).

Regarding the supervised internship course, which bridges theory and practice, one part is conducted in the classroom by the supervising instructor, during which teaching practice is discussed theoretically, amounting to 30 hours. The remaining portion of the course load takes place at the internship site, consisting of 100 hours of practical training under the guidance of the course instructor and a supervisor designated by the museum, typically from the museum's administrative staff. It is worth noting that the course's Curriculum (PCC) has undergone revisions, and the course load for this module has been increased to 140 hours, while the structure described above remains unchanged. Regarding the course syllabus:

Non-formal spaces and science communication; Historical context of museology in Brazil; Methodological aspects of educational processes in non-formal spaces and research in science education; The relationship between museums and schools; Mediation and learning in museums; Educational projects in natural sciences for non-formal settings: planning, structuring, implementation, and evaluation, with contributions from other courses in the semester and faculty members of the program, from an interdisciplinary perspective. Internship focused on mediation in non-formal settings: Museum of the American Man, Museum of Nature, Serra da Capivara National Park, and its Visitor Center. Analysis and sharing of lived experiences (UNIVASF, 2020, p. 76).

FUMDHAM, on the other hand, was founded in 1986 and is a non-profit, philanthropic civil organization headquartered in the municipality of São Raimundo Nonato (SRN-PI). It is at FUMDHAM where archaeological research, protection, and conservation activities are carried out. Since 1978, FUMDHAM's research has focused on humans in southern Piauí, from prehistory to the present day, and on human-environment interaction (FUMDHAM, 2025).

The MHA, which has existed since 1998, is located on the FUMDHAM campus. It was designed to complement visits to the Serra da Capivara National Park (PNSC)

by presenting more scientific aspects. It also serves an educational purpose to fulfill a sociocultural function aimed at improving the quality of education in the region (FUMDHAM, 2025).

Regarding the museum's permanent exhibition, the study by Morais and Ferreira (2019) provides further details on the museological discourse present at the MHA, describing the texts and resources found in each exhibition room. In general terms, it can be said that this museum features an exhibition distributed across four rooms or modules open to the public, titled: 1 — Zuzu Room, 2 — Cave Paintings Room, 3 — Death or Burials Room, and 4 — Stone Artifacts and Historical Remains Room. The museum is designed to be self-explanatory; visits are not guided, except during periods when the MHA has interns from UNIVASF. Visitors are free to explore the museum at their leisure.

These rooms showcase the history and culture of the prehistoric peoples who inhabited the region, with a focus on rock art, burial and death rituals, and the stone artifacts that have been found. Room 1, titled "Zuzu," serves as the exhibition's entrance hall. On display is a skull approximately 10,000 years old, considered the oldest ever found in Brazil. The skull, named Zuzu, was one of the key artifacts that challenged existing theories and sparked questions about the history of humanity on this continent. Visitors can sense the mystery, academic debates, conflicts, and a tireless quest to understand the origins of the American people. The room also pays tribute to researcher Dr. Niéde Guidon (in memoriam), who dedicated her life to the study of prehistory in the region (FUMDHAM, 2025).

Room 2, Cave Art, is dedicated to the rock art found in the region, with a focus on the paintings discovered at archaeological sites, such as those at the PNSC. Room 3, on the first floor, Death or Burials—presents information on the funeral rituals and burial practices of the region's ancient peoples, as well as urns and skeletons dating back thousands of years. Finally, Room 4, "Lithic Materials and Historical Remains," displays tools, objects, and other materials that shed light on the lives and technologies used by prehistoric inhabitants and the indigenous peoples of Piauí.

The museum's collection comprises approximately 90 artifacts (chipped and polished stones, skeletons, ceramics), covering the fields of archaeology, paleontology,

ethnology, and more. The museum objects on display are enclosed in glass domes or display cases, except for the replicas, which visitors are allowed to touch.

At FUMDHAM, in addition to the museum, there are laboratories where studies are conducted on fossils and collected lithic materials, among other items, which undergo cleaning, maintenance, sorting, preparation, and technical preservation before being cataloged and stored for research. Access to the laboratories is restricted to researchers and staff only.

Regarding the structure of the intervention, we sought to organize a multidimensional and dynamic intervention centered on the individual and their personal and social experiences, aiming to connect the past, present, and future, that is, a methodological design grounded in the concept of lifelong learning. We emphasize that the intentional design of learning scenarios or experiences can enhance participants' learning. Below, we present the five stages that comprise the design of the aforementioned intervention.

Stage One, In this first stage, we adopted an exploratory qualitative approach, based on participant observation, during the teacher-candidates' visit to the Museum of the American Man (MHA), as part of the Internship III course. The researchers accompanied the group throughout the activity, seeking to understand the interactions, perceptions, and meanings the students attributed to the exhibition.

As a complementary procedure, an informal discussion circle was held, guided by previously prepared guiding questions, with the aim of learning about the teacher candidates' prior experiences in non-formal educational settings, such as museums and exhibitions. This session served as a dialogic space for listening and sharing experiences, enabling participants to express perceptions, expectations, and knowledge built up throughout their educational journeys. In addition, the researchers sought to capture their initial impressions of the exhibition they visited, considering aspects such as organization, language, interactivity, and educational potential. The discussions that emerged helped build an initial overview of the relationships established by the student teachers with non-formal education, informing the analysis of the learning and meanings attributed to the experience throughout the research.

The following were used to record data: 1) a field journal, in which the researchers noted observations, relevant statements, and impressions throughout the

visit and conversation; 2) audio recordings (with participants' permission), later transcribed for analysis; 3) photographs of the exhibition space (when relevant), focusing on the context of the experience; 4) internship portfolios and experience reports prepared by the teacher-candidates and submitted at the end of the course.

These procedures enabled the construction of a dataset of a descriptive and interpretive nature, which is fundamental to understanding the teacher-candidates' formative experiences in the museum setting. This data was compiled from records of the activities carried out, the interactions that took place during the visit, and the reflections shared by the participants throughout the research process. By bringing together different sources and perspectives, it was possible to capture not only the observable aspects of the practices experienced but also the meanings and interpretations attributed by the teacher candidates to these experiences within the context of non-formal education. Thus, the material produced supported a more in-depth analysis of the contributions of the museum setting to teacher education, particularly with regard to expanding pedagogical repertoires and reframing science teaching practices.

Second Stage, In the second stage, theoretical-reflective training activities were conducted in the classroom, with the aim of fostering study and debate about non-formal learning spaces, particularly the museum context. Among the strategies used, the following stand out: a) reading and guided discussion of previously selected academic texts; b) thematic seminars led by the teacher-candidates, addressing concepts such as formal, non-formal, and informal education, as well as the social function of museums; c) collective analysis of previous experiences in museum settings, based on the students own accounts; d) guided studies on the Museum of the American Man (MHA), including its museographic characterization; and e) development of initial proposals for planning visits and educational interventions.

These activities were organized to foster critical inquiry, critical reflection, and the collective construction of knowledge, in line with a dialogic educational perspective. In this regard, the aim was to foster learning situations that encouraged questioning, the exchange of ideas, and the appreciation of participants' diverse experiences and knowledge. Pedagogical mediation was guided by a constant dialogue between theory and practice, enabling a critical analysis of experiences within the context under

investigation. Furthermore, the activities developed encouraged the active participation of the teacher candidates, contributing to the development of intellectual autonomy and the formation of individuals who are more reflective and engaged with the teaching and learning process. Thus, the activities served as spaces for dialogue and the shared construction of meaning, reinforcing a training approach centered on interaction and collaboration.

Regarding data collection and recording, various instruments were used, such as: i) written records produced by the student teachers (portfolio-style practicum reports, notes, and intervention plans); ii) the researchers' field journals, containing descriptions of classes, interactions, and emerging reflections; iii) audio recordings of classroom discussions (with participants' consent), subsequently transcribed; and vi) materials produced during seminars and activities (presentations, diagrams, and concept maps).

These data were organized and analyzed using an interpretive approach, seeking to understand the meanings attributed by participants to their training experiences, as well as the processes of knowledge construction related to non-formal learning spaces. To this end, the empirical material was systematized, taking into account recurring themes, unique features, and relationships established in the accounts and records produced throughout the research. The analysis focused on identifying emerging thematic categories, enabling an understanding of how the pre-service teachers interpreted their experiences in the investigated setting and how these experiences contributed to expanding their educational repertoires. In this way, it was possible to highlight not only the descriptive aspects of the practices developed but also the reflective and formative dimensions that underpin the relationship between science education and non-formal education.

Third Stage — Planning Mediation Strategies: It was observed that the focus of Stage III, prior to the revision of the PPC, as demonstrated in the course syllabus, was limited to observing the day-to-day operations of the museum space. However, an effort was made to develop a proposal with a different approach that would provide opportunities to experience museum practices, more specifically, the practice of mediation. To this end, the student teachers were asked to plan strategies that

addressed the themes running through the MHA exhibition and that could be applied within the museum during the internship period.

The proposal consisted of promoting experiences that addressed specific content from the exhibition through mediated interventions. The aim was to move beyond the purely narrative experience typical of museums, fostering opportunities for visitors to engage hands-on, interact, and construct knowledge. In addition, the student teachers were able to experience not only the role of mediators but also that of proposers of mediation strategies. The development of these proposals was guided by the course instructor, who also served as a researcher within the classroom setting. All activities were presented, discussed, and refined collectively and reflectively.

Stage Four — Monitoring the Implementation of Strategies Developed by Teacher-Candidates at the MHA: Next, the implementation of the planned proposals was monitored to observe how these participants carried out the planned strategies within the museum space. The proposals were initially put into practice during an event titled “1st Educational Exhibition on the MHA,” and the participating audience consisted of first-semester students in the Natural Sciences program. Following this initial experience, a schedule was developed in which each group would implement its proposal on pre-established dates and times, with a workload of eight hours per week, until the course’s 100-hour practical requirement was fulfilled. The idea was to implement various mediation strategies in the museum’s outdoor space over the course of several months.

Stage Five — Mapping of Faculty Learning Outcomes: Finally, we mapped the faculty’s learning outcomes based on the FADs. We thus analyzed the formative contributions that emerged from the scenario designed within the context of the interface between the museum and the university. These mappings were carried out through academic portfolios, individually compiled by the teacher-candidates, as a final systematization of all activities performed and their impressions of the internship process.

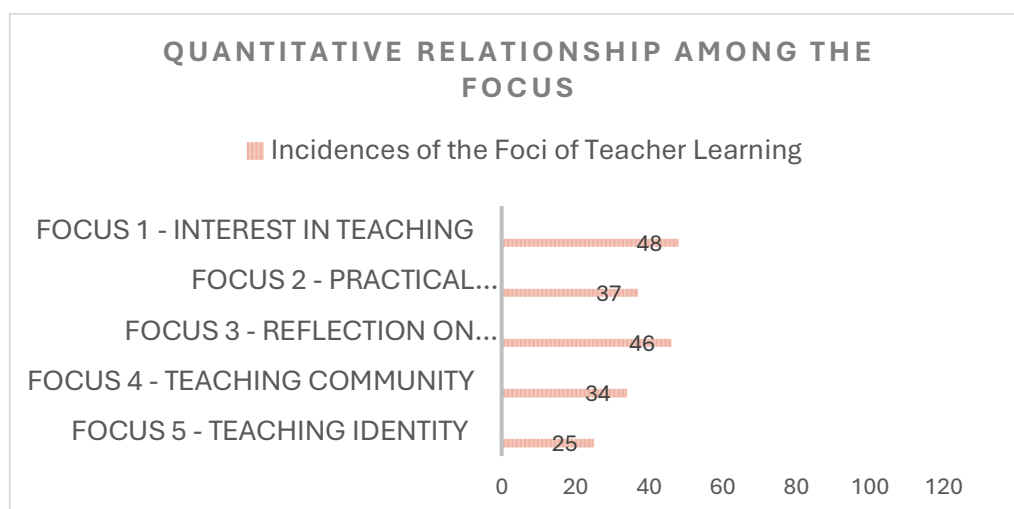
The five focal points were considered a priori categories, in accordance with the theoretical framework. We followed this sequence of analysis: 1) Careful reading of the written reports (academic portfolios); 2) Identification of evidence of Teaching Learning Focal Points in the portfolios; 3) Categorization of the excerpts found by

Focus; these were numbered in the text according to the order in which they were found, using the following nomenclature for easier identification: FAD1(n), FAD2(n), FAD3(n), FAD4(n), FAD5(n), where (n) corresponds to the number of the identified excerpt. It is worth noting that the same excerpt could fall under more than one focus; 4) Analysis of the data found and understanding of the phenomenon under study.

4 Results and discussion

According to the data presented in Chart 1, 131 excerpts were identified across the 21 portfolios analyzed. Focus 1 – Interest in Teaching showed the highest frequency, with 48 occurrences ($\approx 37\%$), followed by Focus 3 – Reflection on Teaching, with 46 ($\approx 35\%$). Focus 2 – Practical Knowledge of Teaching presented 37 pieces of evidence ($\approx 28\%$), Focus 4 – Teaching Community, 34 ($\approx 26\%$), and Focus 5 – Teaching Identity, 25 ($\approx 19\%$). As shown in Chart 1.

Chart 1 — Overview of the Foci of Teacher Learning



Source: research data.

Focus 1: Interest in Teaching, According to Arruda, Passos, and Fregolente (2012), interest in teaching is justified by the fact that every teacher is driven by a desire or motivation to practice their profession. This focus is easily perceptible, since teacher learning begins with the individual's involvement and willingness to learn about educational practice.

In the research, this focus showed the highest incidence, demonstrating how much the internship, in a non-formal setting, contributed to awakening interest in and

appreciation for teaching. The evidence appeared when the pre-service teachers highlighted the importance of the museum internship for their personal and professional development, emphasizing collective work, the integration of theory and practice, and the connection between university, museum, and community.

Pre-service teacher 1, identified in their account as FAD1,5 (4), showed indications related to both Focus 1 and Focus 5. The number (4) refers to the identification of the excerpt within the analyzed corpus. Regarding Focus 1, the pre-service teacher exemplifies this perception by stating in their internship portfolio that:

It is possible to see how important the practice of supervised internships in non-formal spaces has been, as it shows us how many possibilities exist in teaching that is not limited to the classroom within a school. Bringing better teacher training, so that in the future we can apply it in school practice, using strategies that spark students' interest in a given content" FAD 1.5 (4) (E1. Undergraduate student 1, 2021).

It is concluded that the museum internship encouraged the awakening of interest in teaching and in the mediation of knowledge among the pre-service teachers. This experience connected theory and practice, allowing participants to experiment with different ways of teaching and learning in non-formal contexts. In this way, the internship contributed to broadening future teachers' understanding of the educational role of museums.

Focus 2: Practical Knowledge of Teaching, According to Arruda, Passos, and Fregolente (2012), practical knowledge of teaching is developed through reflection in actu. In this process, the future teacher builds a repertoire of experiences that guide their pedagogical actions.

It was observed that this focus appears right after Interest and Reflection on Teaching, reflecting the importance of the practical experiences lived at the MHA. The evidence indicates that the development of mediation strategies, interaction with the public, and contact with the museum space were fundamental to consolidating practical and situated knowledge.

Pre-service teacher 3, in their written internship portfolio, highlights this process, reporting:

Over the course of the other days we spent there guiding tourists, we were able to confirm the many doubts that visitors often have regarding dating methods, dating techniques, how the interactive tables work, among other things — so the question arises as to why the museum, despite being self-

explanatory, still left so many doubts among visitors. But the fact is that whenever we had the opportunity to guide someone, we could, as much as possible, clear up some of those doubts, which, without guides, they would take back home with them. So being able to be at the museum as a guide was, in a way, important to me, as I not only cleared up doubts but also learned more about the museum and the knowledge that can be gained in these spaces. And as a future educator, I will certainly be better prepared to work with this kind of non-formal knowledge with my future students FAD1, 2, 3, 5 (15) (E2. Undergraduate student 3, 2021).

These narratives reveal the construction of experiential knowledge, based on action. This type of knowledge is formed through concrete practice and reflection on it, allowing future teachers to understand not only the content to be taught, but also the processes involved in mediating learning.

Experiential knowledge is an essential element of teacher learning, as it connects theory and practice, fostering the development of pedagogical competencies, decision-making in real teaching situations, and the ability to adapt to different educational contexts. Thus, teacher learning is not limited to the acquisition of information, but is built through practical experience, interaction with the learning environment, and critical reflection on one's own performance.

Focus 3: Reflection on Teaching, According to Arrigo, Albertoni, and Lorencini Júnior (2013), this focus involves the teacher's ability to reflect on their practice and analyze pedagogical situations. In addition, it mobilizes theoretical frameworks to improve their teaching performance.

During the internship, the pre-service teachers had the opportunity to reflect critically on teaching, mediation, and the museum's technical challenges. The difficulties faced, such as structural limitations or a lack of materials, prompted reflections on possible solutions and improvements for future practices.

Pre-service teacher 11 illustrates this movement by reporting, in their internship portfolio, the search for new knowledge to support their mediation strategy:

Building it gave us a great learning experience, since we sought knowledge that went beyond the university and the Museum itself. Our team was responsible for Room 3, "Burial or Death." To make the strategy easier to develop, we visited Cerâmica Serra da Capivara, where we had the opportunity to talk with the workers, who explained to us the processing of clay, the construction of ceramic objects, and the technique used to give them strength and durability. The purpose of our visit to this site was to understand the technique used to make ceramic vessels, which, despite being a modern technique, shows some similarities to the process of making the funerary urns found in Room 3, since the raw material used in construction is the same — clay FAD3 (59) (E3. Undergraduate student 11, 2021).

These records demonstrate that reflection on teaching was incorporated into the pre-service teachers' education. This process fostered the development of an investigative stance, allowing future teachers to critically analyze their practices. In addition, reflection contributed to more informed pedagogical decision-making and to the construction of more effective mediation strategies.

Focus 4: Teaching Community, Arruda, Passos, and Fregolente (2012) explain that teacher learning is strengthened when the student participates in a community of practice. In this context, the future teacher shares knowledge, experiences, and values characteristic of the profession. This interaction fosters the collective construction of knowledge and a sense of belonging to a professional group.

The internship proposal structured in this research allowed for a prolonged experience at the MHA, which favored interaction among pre-service teachers, museum professionals, and visitors. This immersion brought the pre-service teachers closer to a museum educational community, promoting a sense of belonging and recognition of the space's social relevance.

Pre-service teacher 19 describes, in their internship portfolio, their mediation experience and their perception of the young public's interest:

The lithic materials room is the room of materials produced by man, narrating man's passage through our territory. In the room's collection are lithic materials dated from a thousand years ago up to European colonization; there are several pieces used for piercing, peeling, and spear tips that served as weapons for capturing animals. This room is the last one in the collection of the Museum of American Man; it is located right by the exit and does not convey much information about what is being presented, as the language is very technical, and for those without prior knowledge, it becomes uninteresting. During the internship, several groups of young people between 12 and 17 years old came through, and I noticed that they would only glance around and not stay long. On one occasion, when I took one of these groups and began explaining the room, others soon joined in and this visit took considerably longer than others through the room. Questions soon came up, some of which I was able to answer based on my own knowledge, while others I could not answer FAD 3, 4 (116) (E4. Undergraduate student 19, 2021).

These experiences reveal the construction of collaborative competencies among the pre-service teachers, resulting from collective work and constant dialogue with their peers. In this process, the sharing of experiences and knowledge fostered the development of attitudes of cooperation and responsibility. In addition, a strengthening of professional identity was observed, within a broader teaching community, in which learning and teaching are built jointly.

Focus 5: Teaching Identity, the internship also served as a space for building professional identity. Although this focus showed a lower incidence, it is strongly related to Interest in Teaching. In this context, teaching identity is gradually consolidated, being strengthened by practical experiences and critical reflection.

Pre-service teacher 4 sums up this perception in their internship portfolio, stating:

Experience in non-formal spaces contributes to building the educator's identity during their training, thereby taking Science Teaching beyond traditional practices, with professionals equipped with the skills to understand and critically examine the situations they observe FAD 5 (25) (E5. Undergraduate student 4, 2021).

The pre-service teachers demonstrated a recognition of teaching as a field of practice committed to innovation and the pursuit of new pedagogical approaches. This understanding reflects an appreciation for non-formal educational spaces as legitimate environments for teaching and learning. In addition, the students highlighted the importance of these spaces for their cultural relevance and for the connection they established with the local context.

The results obtained in this research showed that the supervised internship developed at the Museum of American Man constituted a unique formative experience, capable of enhancing teacher learning across multiple dimensions. The analysis of the portfolios revealed the presence of all five Foci of Teacher Learning (FTL), demonstrating the richness and complexity of the processes experienced by the pre-service teachers in a non-formal teaching context.

The Foci with the highest incidence, Interest in Teaching and Reflection on Teaching, indicate that the museum experience awakened in the pre-service teachers not only enthusiasm and appreciation for the teaching profession, but also a reflective stance toward practice. This result converges with Arruda, Passos, and Fregolente (2012), who point out that interest and reflection are foundational components of teacher learning, driving the future teacher to reconstruct knowledge and meanings about teaching.

The significant presence of Practical Knowledge of Teaching reinforces that internships in non-formal spaces offer real opportunities for the construction of experiential knowledge, grounded in action and mediated by interaction with the public

and other professionals. Such experiences constitute privileged moments of situated learning, as proposed by Lave and Wenger (1991), when pre-service teachers actively participate in a community of educational practice.

In turn, the Foci of Teaching Community and Teaching Identity revealed more subtle, yet equally relevant, dimensions of initial teacher education. Interaction with the MHA's mediators, researchers, and visitors enabled the development of a sense of belonging and collaboration, bringing the pre-service teachers closer to a broader professional community. In addition, although less frequent, the indications related to the construction of teaching identity pointed to a recognition of teaching as a field of practice committed to scientific education, inclusion, and the valuing of local knowledge.

Overall, the results suggest that supervised internships in non-formal spaces constitute a fertile environment for the development of the FTL, as they integrate the practical dimension of teaching, theoretical reflection, and cultural mediation. This connection broadens the pre-service teachers' understanding of the teacher's role as a mediator of scientific knowledge in different contexts, as argued by Marandino (2003) and Barzano (2008).

Thus, the MHA was configured not only as an exhibition space, but as a formative environment that fosters dialogue between science, culture, and education. The experience analyzed demonstrated the potential of museums as strategic partners in initial teacher education, reinforcing the need for these spaces to be further explored in teacher education curricula.

5 Final Considerations

The internship proposal outlined proved to be significant, as it gave Natural Sciences pre-service teachers a formative experience with a more forward-looking stance. The internship allowed for the construction of practical knowledge based on mediation experiences lived beyond the classroom, moving past the perspective of an internship that is merely observational.

The results indicated a promising internship model to be consolidated in the exchange between UNIVASF and the Museum of American Man. This is a model guided by theoretical and methodological frameworks that integrate knowledge from

both educational contexts, formal and non-formal, and that fosters more experiential learning, based on practice, action, and reflection.

It is worth noting that, after the internship course ended, the MHA invited the pre-service teachers to present their proposals at the XIII Museum Spring and the XVII National Museum Week. They also took part in UNIVASF's 2nd Chemistry Week and the event celebrating the tenth anniversary of the Natural Sciences program, held at the Serra da Capivara campus. These invitations represented recognition of the work carried out and the strengthening of the collaboration between the university and the museum.

The Foci of Teacher Learning (FAD), as an analytical framework, proved fundamental for understanding the formative outcomes promoted by the internship, both for the pre-service teachers' future teaching practice and for the improvement of the museum space's educational actions. The most evident Foci were Interest in Teaching and Reflection on Teaching (FAD 1 and 3), revealing the engagement and reflective character of the experiences lived.

The pre-service teachers showed a repositioning in their teaching identities and recognized the museum's educational potential from a new perspective, valuing the learning built, autonomy, and the multidimensional nature of non-formal spaces. In addition, they came to see themselves as mediators and facilitators of knowledge, interested in deepening their future teaching practices.

Taking a critical view, it can be said that the design of this research represents the beginning of a promising educational partnership, capable of generating new collaborations. For future internships, continuity and diversification of the proposals are expected, as well as greater support from the museum, not only logistical, but also in terms of instruments, training talks, monitoring, and technical guidance. In this way, both institutions benefit from the actions developed, strengthening the integration among research, internships, Scientific Outreach, and education.

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