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3D Modelling and Printing Through a STEAM Approach in Preservice Primary Teacher Education

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Abstract

This study aimed to analyze preservice primary teachers' perceptions of the educational use of three-dimensional modelling and printing within a STEAM-oriented diorama project. The experience took place during the first semester of 2026 at a university in Chiloé, Chile. A descriptive, exploratory, non-experimental study was conducted using a questionnaire comprising 24 statements grouped into five dimensions and three open-ended questions. Eleven complete questionnaires were obtained from a population of 19 students, representing a response rate of 57.9%. Closed-ended responses were analyzed using frequencies and percentages, while open-ended responses underwent descriptive categorization. Agreement across dimensions ranged from 70.5% to 80.0% of pooled item responses. Participants highlighted opportunities to create tangible resources, develop interdisciplinary activities, and connect learning with the local environment. Identifying specific pedagogical uses received the lowest agreement, with seven participants (63.6%). The main anticipated challenges concerned teacher preparation, mentioned by seven participants, and resource availability, identified by six. The findings provide context-specific evidence of perceived educational possibilities and support needs. They suggest the value of connecting technical preparation with curricular objectives, assessment criteria, and classroom implementation conditions. Given its scope and sample size, the study neither demonstrates improvements in competencies nor supports generalization of the findings. Nevertheless, it informs future research on the pedagogical integration of digital fabrication into teacher education.

INTRODUCTION

Initial teacher education faces the challenge of integrating digital technologies through experiences that connect disciplinary knowledge, pedagogical decision-making, and problem-solving. Kroff Trujillo and Bellemans Fagalde (2026b) argue that teachers' digital competence in higher education is a dynamic, contextualized, and ethically grounded construct whose development requires comprehensive training and sustained pedagogical reflection. In their study of early-career teachers, Masoumi and Noroozi (2025) identify mentoring, professional development opportunities, and technical and pedagogical support as relevant factors in developing this competence. In this context, three-dimensional (3D) modelling and printing offer opportunities to connect the representation of ideas with the creation of physical objects and educational resources. Integrating these technologies into teacher education requires an understanding of both their technical operation and their pedagogical purposes. Tejera et al. (2026) emphasize the need to integrate technological, pedagogical, and content knowledge while considering the conditions that support their application in school settings. From this perspective, it is relevant to examine how preservice teachers interpret the educational possibilities of 3D modelling and printing through practical design and fabrication experiences.

STEAM education, which integrates science, technology, engineering, arts, and mathematics, provides an approach for connecting different fields of knowledge through shared problems and projects. This integration requires coherence among learning objectives, proposed activities, and the contributions of each discipline. In their theoretical framework for integrated STEM education, Ortiz-Revilla et al. (2022) emphasize the need to ground educational proposals in epistemological, psychological, and didactic foundations. This perspective frames interdisciplinarity as an intentional connection between bodies of knowledge that requires pedagogical planning. Complementing this approach, Chappell et al. (2025) propose a framework for STEAM education that emphasizes relationships among disciplines to address complex real-world problems. When incorporating the arts, their learning objectives and contributions to the project must also be made explicit. Sanz-Camarero et al. (2023) note that the development of artistic competencies receives limited attention in the STEAM experiences they reviewed and highlight the need for meaningful integration of these disciplines. In 3D modelling and printing projects, this perspective informs the planning of representation, composition, and design activities aligned with the educational purposes of the experience.

3D modelling and printing provide a context for developing these interdisciplinary connections. Creating an object involves moving from an idea to its digital representation and physical realization through decisions about

dimensions, shapes, materials, and fabrication procedures. Harron et al. (2022) argue that computer-aided design and 3D printing can connect engineering and the arts through experiences that cross disciplinary boundaries. In an undergraduate architecture course, Özeren et al. (2023) documented progress in using modelling tools and resolving difficulties in transforming digital designs into printable objects. In mathematics education, Ng et al. (2022) identified opportunities to visualize concepts and apply knowledge from different disciplines when constructing prototypes and three-dimensional objects. These findings suggest that the educational value of digital fabrication encompasses both the finished product and the process of exploring alternatives, solving problems, and revisiting decisions. From this perspective, its integration into higher education requires activities that connect technical decisions with learning objectives and problems relevant to each field of study.

In initial primary teacher education, these experiences provide opportunities to explore the relationship between technology use and the design of teaching activities. Barbosa et al. (2024) conducted an exploratory qualitative study with 72 preservice teachers through an engineering design experience involving Tinkercad and 3D printing. Most participants identified concepts associated with the STEAM disciplines, although they more readily recognized mathematics and science content. Participants also valued the transformation of virtual models into tangible objects and identified challenges associated with using these tools. Complementing these findings, Ching et al. (2025) examined the perceptions of 19 preservice elementary teachers who participated in a STEM module incorporating 3D printing within a university mathematics course. Participants reported improvements in their understanding of the technology, software use, and the application of mathematical concepts in STEM contexts. From another disciplinary perspective, Wargo et al. (2022) analyzed how 13 preservice teachers created responses to a literary work through 3D printing and artistic creation, identifying the possibilities and constraints of these media for expressing their interpretations. These studies illustrate the diverse educational purposes that can guide digital fabrication and support the relevance of examining how preservice teachers connect its technical possibilities with content representation and interdisciplinary integration.

Diorama construction offers an opportunity to contextualize these experiences. In the present study, a diorama is understood as a three-dimensional representation of a scene or setting that brings together architectural components, visual elements, and historical references. In a rural secondary education context in New Zealand, Taylor (2026) documented how constructing dioramas enabled students to represent ideas about local environments and sustainable futures, creating opportunities for reasoning and dialogue. Using dioramas as educational projects involves decisions about element selection, relative size, spatial arrangement, and communication of the represented context. From a heritage

education perspective, Chaparro-Sainz et al. (2022), in a study involving preservice secondary history teachers, highlighted the need to strengthen teacher preparation for integrating heritage resources into teaching. In the experience analyzed here, the photographic record includes a diorama of the Church of Nercón, connecting object fabrication with the representation of Chiloé's cultural environment. This thematic choice situates 3D modelling and printing within an approach to creating educational resources grounded in local cultural references.

The integration of these activities within the STEAM approach can be examined through the content and practices that guide the process. Studying the properties and transformations of materials can connect with science; digital modelling and file preparation with technology; and designing, testing, and refining solutions for fabrication, support structures, and assembly with engineering. Likewise, visual composition, painting, and scene-setting can serve purposes of artistic expression and representation, while dimensions, proportions, and spatial relationships provide opportunities to address mathematical content. These connections should be made explicit during planning and documented through evidence of the work undertaken during implementation. In a review of STEAM in primary education, Yim et al. (2025) identified a lack of empirically grounded guidance for defining learning content and assessing integrated approaches. In this regard, Cheng and Huang (2025) propose a STEAM assessment model that connects the characteristics of each discipline with specific performance criteria. Barbosa et al. (2024) also highlight the need to promote more balanced attention across the disciplines involved. From this perspective, analyzing integration requires identifying how disciplinary contributions connect to address the shared problem that structures the project.

In addition to describing processes and products, it is relevant to understand how students evaluate these experiences. Güleryüz (2023) identified an increase in positive attitudes toward the educational use of 3D printing following an eight-week intervention with 43 preservice science teachers. This finding supports examining participants' willingness to use these tools, the pedagogical uses they recognize, and the challenges they anticipate in implementing them. Complementing this evidence, Boice et al. (2024), within a teacher professional development program, analyzed teachers' interpretations of STEAM and the personal, professional, and contextual factors that supported or hindered its implementation. Cheng et al. (2024) combined questionnaires on teachers' beliefs with lesson plan analysis and found that, in general, these beliefs were not correlated with levels of 3D printing integration. These studies support considering participants' perspectives on educational experiences and examining them alongside evidence of their practice. Analyzing these perceptions is relevant because preservice teachers will be responsible for selecting, adapting, and integrating these technologies into future teaching practices. Their views help

identify the pedagogical uses they recognize, their willingness to incorporate digital fabrication, and the difficulties they anticipate in school implementation (Boice et al., 2024; Güleryüz, 2023). This information can inform the planning of teacher education experiences, technical and pedagogical support, and resource provision. However, perceptions are self-reported evaluations and should be considered alongside evidence of performance and practice, as reported beliefs do not necessarily correspond to demonstrated levels of technology integration (Cheng et al., 2024). Therefore, they do not constitute direct measures of professional competencies or educational effectiveness. In the present study, analyzing perceptions provides insight into students' self-reported evaluations and expectations, without constituting a direct assessment of professional competencies or evidence of effects on school pupils' learning.

Implementing these approaches requires attention to infrastructure, support, and curricular organization. Harron et al. (2022) emphasize the importance of combining technological resources with training and sustained support for teachers. Pearson and Dubé (2022) draw connections among pedagogical foundations, learning outcomes, and barriers to using 3D printing to formulate recommendations for its classroom integration. In primary education, Fokides and Lagopati (2024) identified teacher training needs, equipment costs, technical difficulties, and curricular integration challenges in a review of 50 publications. These studies support examining the difficulties anticipated by preservice teachers to inform future educational experiences and support provision. There is also a need to expand the available evidence across diverse contexts. Tejera et al. (2026), whose review included 20 studies published through 2023, identified no research from South America that met the established selection criteria. This finding supports the relevance of contributing context-specific evidence from initial teacher education in Chile, without implying that other studies or experiences in the region do not exist.

In this context, a group-based diorama construction project was conducted during the first semester of 2026 in the Mathematics and Technology course of the General Basic Education Pedagogy degree program at Universidad de Los Lagos, Chiloé campus. The project included guidance on ideation, digital modelling, file preparation through slicing, 3D printing, and finishing the printed parts. It also involved creating sketches and preliminary models and reflecting on the design process, connecting digital fabrication with the representation of historical and cultural content.

Unlike previous studies focused on attitudes towards 3D printing, proficiency in specific tools, or experiences conducted within particular disciplinary areas, the present study examines a project that integrates 3D modelling and printing, diorama construction, STEAM education, and the representation of local cultural heritage in preservice primary teacher education. Its contribution lies in

documenting a situated experience in the Chiloé Archipelago and jointly analyzing closed-ended and open-ended responses to identify recognized pedagogical possibilities, willingness to use these technologies, and the conditions participants considered necessary for their future classroom implementation. The study does not seek to demonstrate competency development or intervention effectiveness but rather to provide exploratory evidence of how preservice teachers interpret a territorially contextualized digital fabrication experience.

The present study aims to analyze the perceptions of students enrolled in the General Basic Education Pedagogy degree program regarding the educational use of 3D modelling and printing in a STEAM-oriented diorama construction project. The analysis encompasses recognized pedagogical uses, perceived contributions to teacher preparation, possibilities for designing learning experiences, potential applications in primary education, and willingness to use these technologies. It also considers the advantages, difficulties, and proposed activities expressed by participants. The study seeks to provide context-specific evidence to inform the pedagogical integration of digital fabrication into initial teacher education and identify support needs for its future application in school settings.

METHODS

The study adopted a descriptive and exploratory scope, with a non-experimental, cross-sectional design based on a single questionnaire administration (Wang & Cheng, 2020). Closed- and open-ended responses were analyzed to characterize perceptions of the educational use of three-dimensional (3D) modelling and printing. The unit of analysis was each student who completed the questionnaire. No comparison groups or equivalent pre- and post-intervention measurements were included; therefore, changes or causal effects attributable to the project were not estimated.

The experience took place during the first semester of 2026 in the Mathematics and Technology course of the General Basic Education Pedagogy degree program at Universidad de Los Lagos, Chiloé campus, Chile. The study population comprised 19 students, from whom 11 complete questionnaires were obtained (57.9%). Eight participants selected the age category “Between 20 and 30 years” (72.7%), two selected “20 years or younger” (18.2%), and one selected “30 years or older” (9.1%). The original questionnaire categories were retained, and their overlapping boundaries at ages 20 and 30 were acknowledged. Findings were restricted to the respondent group.

The educational project involved the collaborative construction of dioramas depicting historical and cultural settings. An introductory presentation provided guidance on ideation, digital modelling, slicing, printing, and post-processing. Topics included sketches, dimensions, proportions, tolerances, printing parameters, filament characteristics, and finishing procedures. STEAM integration

encompassed material properties, digital tools, design and fabrication decisions, artistic composition, and mathematical relationships. These guidelines constituted the preparation offered to students, although the application of every procedure by each group was not verified.

Course assessment comprised a progress report (30%), the final diorama (40%), and a process documentation video (30%). Students were asked to submit sketches, preliminary models, and design reflections, and assessment criteria addressed technological integration, creativity, historical accuracy, and presentation quality. Course grades were not included in the research analysis. Photographs were used to illustrate fabrication processes and products, without treating them as independent evidence of learning.

The instrument was initially developed with 28 items and underwent content validation through expert judgement. Five experts participated in the process, four from Chile and one from Spain. Two held doctoral degrees and three held master's degrees, with backgrounds in education or technology. All had experience in teaching, higher education, teacher education, educational technologies, educational research, and innovation projects. The review considered the relevance of the statements and the experts' qualitative observations. Based on their recommendations, the wording was revised, four items were removed, and the instrument content was reorganized. The final version comprised 24 statements grouped into five dimensions and three open-ended questions. This process provided evidence of content validity, although psychometric properties such as internal consistency, factor structure, and construct validity were not assessed.

The questionnaire included one age-related demographic question, 24 statements organized into five dimensions, and three open-ended questions. Its structure was summarized in Table 1.

Table 1. Questionnaire dimensions concerning 3D modelling and printing in initial teacher education

Instrument dimension	Content addressed through self-report	Number of items
Understanding of 3D modelling and printing	Educational purposes, pedagogical uses, and concept representation.	4
Development of pedagogical competencies	Perceived contributions to planning, teaching strategies, instructional resources, and creativity.	5
Design of innovative learning experiences	Perceived ability to propose activities, projects, and interdisciplinary experiences.	5

Application in school settings	Perceived possibilities for use in primary education, addressing diverse learning needs, and supporting conceptual understanding.	5
Willingness and personal valuation	Interest, motivation, and perceived value of incorporating these technologies into teacher education.	5
	Total	24

Note. Prepared by the authors based on the administered questionnaire. Dimension labels were retained from the original instrument and translated into English.

The statements offered five response options, ranging from “Strongly disagree” to “Strongly agree,” which were coded from 1 to 5 while preserving their ordinal nature. The open-ended questions asked participants to identify advantages for teacher preparation, anticipate difficulties with school implementation, and propose a learning activity involving a 3D-designed or printed object. Dimensions were interpreted as thematic groupings of perceptions, without attributing undocumented psychometric properties to them. The timing of questionnaire administration relative to the project stages remained unspecified; consequently, the questionnaire was not treated as a post-intervention assessment.

The completeness of all 11 records was verified. Quantitative analysis comprised absolute frequencies and percentages for each item, using 11 participants as the denominator. “Agree” and “Strongly agree” responses were grouped as agreement, while “Disagree” and “Strongly disagree” were grouped as disagreement; the neutral category was retained separately. Dimension-level summaries used 44 item responses for the first dimension and 55 for each remaining dimension. These percentages described aggregated responses, without treating responses from the same individual across items as independent observations or interpreting them as competency levels.

Open-ended responses were examined through descriptive content analysis focused on their explicit meanings (Kleinheksel et al., 2020). The procedure involved reading all responses, identifying meaning units, assigning codes, and grouping similar content. The initial domains were advantages, difficulties, and proposed activities; specific categories were developed from the responses. Each participant was counted once within each category but could contribute to multiple categories. Percentages were calculated using the 11 participants as the denominator and did not necessarily total 100% because multiple coding was permitted. Illustrative quotations were identified using codes E01 through E11.

Finally, closed-ended responses were compared with the arguments and examples provided in open-ended responses to contextualize their interpretation. Discrepancies were retained without modifying the original records. The analysis described participants' perceptions and expressed support needs, without demonstrating improvements in teaching performance or school pupils' learning.

RESULTS AND DISCUSSION

Of the 19 students in the study population, 11 completed questionnaires were obtained, yielding a response rate of 57.9%. No missing data were identified across the 24 statements or the three open-ended questions. The findings describe the perceptions of the respondent group, without assuming that they represent those of students who did not respond.

Agreement responses predominated across all five dimensions. In the development of pedagogical competencies, application in school settings, and willingness and personal valuation dimensions, favorable responses accounted for 44 of the 55 item responses in each dimension (80.0%). The design of innovative learning experiences dimension recorded 41 favorable responses out of 55 (74.5%), while understanding of 3D modelling and printing recorded 31 out of 44 (70.5%). These percentages summarize aggregated item responses and do not represent the percentages of participants attaining a particular competency level. Table 2 presents their distribution.

Table 2. Distribution of item responses by dimension

Dimension	Total item responses	Agreement, n (%)	Neutral, n (%)	Disagreement, n (%)
Understanding of 3D modelling and printing	44	31 (70,5)	4 (9,1)	9 (20,5)
Development of pedagogical competencies	55	44 (80,0)	6 (10,9)	5 (9,1)
Design of innovative learning experiences	55	41 (74,5)	9 (16,4)	5 (9,1)
Application in school settings	55	44 (80,0)	6 (10,9)	5 (9,1)
Willingness and personal valuation	55	44 (80,0)	6 (10,9)	5 (9,1)

Note. Agreement combines "Agree" and "Strongly agree"; neutral corresponds to "Neither agree nor disagree"; disagreement combines "Disagree" and "Strongly disagree." Denominators represent item responses from the same 11 participants: four items in the first dimension and five in each remaining dimension. These responses do not represent additional participants or independent observations. Percentages may not total 100% due to rounding.

Source: Prepared by the authors based on the administered questionnaire.

The favorable trend reflects recognition of the educational potential of digital fabrication. Kroff Trujillo and Bellemans Fagalde (2026a), through a review of 24

publications from 2020–2025 based on the analysis of abstracts and keywords, identified applications related to design and prototyping, alongside growing attention to their pedagogical possibilities. Responses in the present study align with this orientation by recognizing instructional purposes and school applications. This convergence concerns participants' perceptions and does not constitute evidence of strengthened STEAM competencies.

The item-level analysis showed that eight participants (72.7%) reported understanding the educational purpose of 3D modelling and printing. Eight agreement responses were also recorded for each item concerning support for primary education content and the concrete representation of concepts. The identification of potential pedagogical uses received seven agreement responses (63.6%), one neutral response (9.1%), and three disagreement responses (27.3%), making it the item with the lowest agreement in the questionnaire. Although the difference amounted to one response, this finding highlights the relevance of exploring how recognition of a technology's general potential translates into the identification of specific pedagogical applications. Tejera et al. (2026) emphasize the need to integrate technological, pedagogical, and content knowledge in teacher education, providing a foundation for designing activities that connect the use of these tools with specific school learning objectives.

The open-ended responses complemented this interpretation through references to the creation of hands-on learning resources. E07 stated that the technology enables users to "turn abstract ideas into concrete objects," while E11 highlighted the possibility of "planning an object for a specific pedagogical need." These comments relate to the applications identified by Novak et al. (2021), whose review recognizes the production of learning aids and opportunities for creativity and innovation. In the present study, giving concepts a tangible form emerged as a valued pedagogical possibility; its effectiveness in supporting understanding would require subsequent evaluation of these resources with school pupils.

Regarding perceived pedagogical preparation, nine agreement responses (81.8%) were recorded for each item concerning active teaching strategies, the design of resources for different learning levels, the connection between theory and practice, and creativity in developing instructional materials. The contribution to activity planning received eight favorable responses (72.7%). Likewise, eight participants (72.7%) reported feeling capable of designing a learning experience incorporating 3D-printed resources. These responses describe perceived contributions and capabilities rather than a direct assessment of the quality of lesson plans.

The item concerning the design of interdisciplinary activities received eight agreement responses (72.7%). This possibility also appeared in the open-ended comments: E02 described 3D printing as "an interdisciplinary technological tool,"

while other responses proposed connecting mathematics, science, history, and the arts. Barbosa et al. (2024) found that preservice primary teachers recognized connections among disciplines during a design and 3D printing experience, although they more readily identified mathematical and scientific content. In the present study, the comments express possibilities for integration recognized by participants but do not establish the degree of integration achieved in their products. Examining this integration can draw on the framework proposed by Ortiz-Revilla et al. (2022), which grounds integrated STEM education in coherence among its epistemological, psychological, and didactic components.

The diorama construction project provides a context for examining these relationships. The photographic records document architectural components during fabrication, printed parts retaining support structures, and a diorama representing the Church of Nercón (Figure 1). These materials illustrate the connection between digital fabrication and the representation of Chiloé's cultural environment. However, the photographs alone cannot establish students' autonomy in modelling, the accuracy of their calculations, or the knowledge applied during the process. Examining these aspects would require analyzing each group's sketches, digital files, reports, and documented decisions.



Figure 1. Photographic records of fabrication and the representation of the local cultural environment through a diorama

Note. A: component during 3D printing. B: printed part with support structures. C: diorama of the Church of Nercón. The photographs illustrate stages and products of the experience without implying that they depict the same piece or the work of the same group.

Source: Photographic documentation of the educational experience.

The artistic component is of particular interest in this experience. Kroff Trujillo and Bellemans Fagalde (2026a) identified a limited presence of artistic and creative dimensions in the literature they examined. Similarly, Sanz-Camarero et al. (2023) reported that few of the STEAM initiatives reviewed explicitly assessed the development of artistic competencies. Diorama construction offers opportunities to explore visual composition, scene-setting, color selection, and

architectural representation. However, the presence of these elements in the final product does not establish how they were addressed pedagogically. A potential extension of the experience would involve defining explicit artistic learning objectives and asking students to explain their aesthetic decisions and their relationship to the content represented, incorporating these explanations into the assessment of the process.

Regarding school applications, eight participants (72.7%) considered it feasible to implement 3D printing activities in primary schools. Nine agreement responses (81.8%) were recorded for each item concerning teaching content across different subjects, student inclusion, the representation of abstract concepts, and the development of practical and visual learning experiences. The views expressed on adaptation and inclusion reflect perceived possibilities for addressing diverse learning needs. The questionnaire does not provide evidence regarding the accessibility of the products, their suitability for specific needs, or the outcomes of their use with pupils requiring additional support.

Personal willingness was also predominantly favorable. Nine agreement responses (81.8%) were recorded for each item concerning interest in continuing to learn about 3D modelling and printing, motivation to use digital tools to create educational resources, and the relevance of 3D printing for supporting pedagogical innovation. The recommendation to incorporate similar experiences into other courses received nine agreement responses (81.8%), while incorporating these technologies into initial teacher education received eight (72.7%). These perceptions broadly align with Güleryüz (2023), who identified positive changes in attitudes following an intervention with preservice teachers, and with Khurma et al. (2023), who reported favorable perceptions in primary education settings. This alignment should be interpreted in light of differences in the populations and research designs. The present study involved a single questionnaire administration and therefore cannot establish an increase in motivation or a change in attitudes attributable to the project.

The anticipated difficulties centered on teacher preparation and resource availability. Seven participants (63.6%) mentioned training, software use, technological familiarity, or willingness to adopt these tools. Six (54.5%) identified financial and material barriers. Responses also referred to printing times and fabrication problems, such as filament feeding, build plate adhesion, and failures that could interrupt the work. Table 3 summarizes the categories identified.

Table 3. Anticipated difficulties in implementing 3D printing in schools

Category	**Participants, n (%)**
Teacher preparation, technological proficiency, and willingness	7 (63,6)
Availability of financial and material resources	6 (54,5)

Printing time and organization of activities	3 (27,3)
Technical fabrication problems	3 (27,3)
Differences in pupils' digital skills	1 (9,1)

Note. A response could belong to more than one category. Each participant was counted only once within each category. Percentages were calculated using the 11 participants as the denominator and do not total 100% because multiple coding was permitted. The difficulties reflect anticipated situations rather than a systematic record of incidents during the experience.

Source: Prepared by the authors based on the open-ended responses.

These findings distinguish between pedagogical value and implementation feasibility. Abu Khurma et al. (2023) emphasize the importance of technical and pedagogical training for integrating 3D printing into teaching. Complementing this perspective, Harron et al. (2022) propose connecting infrastructure, training, and curricular support. The difficulties expressed by the group suggest that future experiences should include time planning, material estimates, arrangements for shared equipment access, and contingency plans for technical failures. Incorporating these activities is proposed as a way to address implementation conditions alongside the development of teaching activities.

The availability of printers does not, in itself, ensure their pedagogical use. Thyssen and Meier (2023), in a study involving teachers in Germany, observed differences between equipment availability and classroom use, as well as differing conceptions according to experience with this technology. Complementing these findings, Üçgül and Altıok (2023) found that, after participating in a 3D modelling and printing course, most preservice information and communication technology teachers reported feeling prepared to incorporate these tools into teaching and learning activities. This finding reflects perceived preparedness without, in itself, demonstrating subsequent classroom implementation. In the group analyzed, references to training indicate that participants recognized teacher preparation as a relevant condition for future school applications. These findings suggest the value of providing opportunities to design resources, justify their alignment with curricular objectives, and practice teaching activities. This recommendation stems from considering participants' responses alongside the literature; its effectiveness was not tested in the present study.

The proposed activities encompassed geometry, natural sciences, and representations of the local environment. Three participants mentioned geometric shapes or solids; two proposed working with the solar system; and three suggested models of the human body, including the skeleton and digestive system. Four participants proposed activities related to the local area, community, or built environment: a stilt house incorporating sustainable energy, a representation of the school, a model of the archipelago, and a neighborhood scale model featuring accessibility improvements. These categories overlap, as a single response could include proposals from different areas.

E11's proposal addressed accessibility improvements through ramps, signage, and adapted playground equipment, incorporating angles, measurements, and proportions. E03 proposed representing the school and connecting history, mathematics, technology, and engineering. These examples illustrate envisioned uses that link school content to features of the local environment and, in E11's case, to a community need. Novak et al. (2021) identify opportunities for interdisciplinary work and recommend guiding experiences through educational design frameworks. From this perspective, locally grounded proposals can serve as starting points for formulating learning challenges, provided that the knowledge involved and the assessment criteria are explicitly defined. These activities represent participants' proposed applications and were not implemented or evaluated in the present study.

An individual-level review identified differences between some closed-ended and open-ended responses. E02 selected "Strongly disagree" for all 24 items but expressed favorable views about the technology's interdisciplinary possibilities. E09 selected neutral responses for all items while expressing positive views about teaching through tangible objects. Both records were retained without modification. It is not possible to determine whether these differences reflect interpretations of the response scale, nuances in participants' views, or other factors. Their presence reinforces the value of interpreting both types of responses together.

The group size warrants caution, as each participant accounts for approximately 9.1 percentage points in the item-level results. The absence of responses from eight members of the study population prevents determining whether their perceptions differed from those expressed by respondents. Furthermore, the data were self-reported, and no documented evidence of questionnaire validation was available; therefore, its dimensions were used as thematic groupings rather than scales with established psychometric properties. Grades, systematic observations, and assessments of products for research purposes were also excluded from the analysis. Consequently, the findings characterize participants' reported perceptions and support needs without demonstrating improvements in teaching performance or school pupils' learning.

The study's contribution lies in documenting these perceptions within a situated teacher education experience in Chiloé. Tejera et al. (2026) highlight the need to expand research in underrepresented regions, while Novak et al. (2021) emphasize the importance of strengthening the rigor of studies on learning with 3D printing. The findings provide a basis for guiding future research that combines questionnaires with analyses of products, process observations, and evaluations of classroom applications to examine whether the possibilities recognized by preservice teachers translate into pedagogical decisions and learning experiences, and under what conditions this occurs.

CONCLUSION

The study identified predominantly favorable views of 3D modelling and printing among respondents enrolled in the General Basic Education Pedagogy degree program at Universidad de Los Lagos, Chiloé campus. Their perceptions highlighted the potential to create tangible resources, propose interdisciplinary activities, and connect school content with situations in the local environment. The identification of specific pedagogical uses received the lowest agreement in the questionnaire, although it differed from other items within the same dimension by only one response. This finding suggests the value of providing support to help preservice teachers translate these recognized possibilities into pedagogically grounded teaching proposals.

Diorama construction provides a context for connecting digital fabrication, historical representation, and design decisions. Its integration with STEAM requires making each discipline's contribution explicit, including the artistic and mathematical dimensions, and documenting the reasoning developed throughout the process. The difficulties anticipated by the group identify teacher preparation, resource availability, and fabrication times as relevant considerations for future classroom implementation. These conditions should be considered when planning new experiences, alongside criteria for assessing the curricular relevance of the objects produced.

The study contributes exploratory, context-specific evidence on the perceptions and support needs of preservice primary teachers. Its conclusions are limited to the 11 questionnaires received from a population of 19 students and do not demonstrate improvements in competencies or support the generalisation of the findings. Future research should combine self-reports with analyses of designs, process observations, and evaluations of classroom applications to examine whether the possibilities recognized translate into pedagogical practices and verifiable learning outcomes, and under what conditions this relationship occurs.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

DECLARATION ON THE USE OF ARTIFICIAL INTELLIGENCE TOOLS

Generative artificial intelligence tools were used exclusively to support language refinement, improve clarity, and assist with the formal preparation of the manuscript. They were not used to generate, modify, or analyze the data or to formulate the results, their interpretation, or the study conclusions. The research design, data collection and analysis, critical discussion, and academic decisions were undertaken entirely by the authors. All content was reviewed and approved by the authors, who assume full responsibility for the originality, accuracy, and integrity of the manuscript.

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