Development and validation of a questionnaire on teaching and learning in remote education*

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Abstract

This article presents a questionnaire proposal to inquire about teaching and learning in remote education. The questionnaire consists of 6 dimensions, 38 indicators, and 2 open-ended questions. The dimensions pertain to instructional planning, teaching resources, assessment for learning, social interaction, and pedagogical support. The instrument was constructed through an iterative process according to criteria of coherence and relevance considering the literature on the subject. The questionnaire was validated by five expert trials with the same criteria for its construction. The instrument was applied to a non-probabilistic sample of 202 teachers at different levels of school education. The overall reliability of the questionnaire was 0.943, so it has a high consistency between the indicators and the construct. The factorial analysis performed on the questionnaire indicates that there are seven factors that explain 61.6% of the total variance. These results indicate that it is a valid and reliable tool to inquire about the teaching and learning process in remote education. It is concluded that this instrument is a proposal that collaborates with the elaboration of relevant research criteria to study this emerging issue.

Keywords

Questionnaire – Teaching and learning – Pandemic – Remote education.

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Introduction[2]

As the health emergency had a negative impact on the development of face-to-face education, education systems had to adopt multiple measures to mitigate its effects on students' educational trajectory through the implementation of remote education processes (REIMERS; SCHLEICHER, 2020). This involved challenges and problems for educational communities on how to deal with the formative processes in the school (JELIŃSKA; PARADOWSKI, 2021). Thus, school education institutions had to carry out actions to construct pedagogical alternatives with the aim of promoting methodological, didactic, and evaluative transformations in virtual support to give continuity to the teaching and learning process (PORTILLO PENUELAS et al., 2020).

This situation caused one of the worst educational crises worldwide (PORTILLO PENUELAS *et al*., 2020) and made it impossible to conduct face-to-face classroom classes, affecting 94% of students (GARCIA-ARETIO, 2021). Thus, the absence of face-to-face classes deepened the formative gaps (MORENO-CORREA, 2020) and implied a change in pedagogical practice (PORTILLO PENUELAS *et al*., 2020) in a "fast and improvised way to a modality where there is, in general, a lack of experience and skills on the part of teachers, students, and other actors of the system" (RUZ-FUENZALIDA, 2021, p. 139). However, this new educational context is also an opportunity to advance the design of innovations that take on more open, dynamic, diverse, combined and flexible approaches and pedagogical perspectives to guarantee the training of students (GARCIA-DE-PAZ; SANTANA BONILLA, 2021).

Considering the impact of emergency remote education on education systems, it is essential for educational research to develop proposals to account for the transformations, opportunities, and challenges experienced by teaching and learning in this new context. Therefore, the construction of research tools for the production of relevant and reliable knowledge is a compelling demand for proposing reflections, discussions, and responses aimed at strengthening remote education (QIU *et al*., 2020; REIMERS; SCHLEICHER, 2020).

The construction of a questionnaire to inquire about teaching and learning experiences in remote education is a proposal for an instrument that collaborates with educational research to collect valid and reliable data with the purpose of building knowledge that contributes to the educational challenges faced by different educational institutions (HIRAOKA; TOMODA, 2020). Indeed, given the scarce evidence of how teaching and learning processes have developed (STEWART, 2021; TRUNG *et al*., 2020) and in view of the possibilities of continuing with this educational modality, this article aims to present the development and validation of a questionnaire to explore teaching and learning in remote education as a robust alternative for the production of empirical evidence in school contexts.

2- The data set supporting the results of this study is not publicly available due to the ethics protocol and the characteristics of the information collected. Requests for access to the data can be made directly to the lead author by e-mail: david.herrera@usach.cl

Teaching and learning in remote education: background and conceptual approaches

Remote education is a response to the contingency brought about by the current health crisis. This is conceived as a temporary and provisional migration of the teaching and learning process to virtual spaces (ABREU, 2020) as a way to support and give continuity to educational training. This type of teaching modality, with limited technical resources and limited design times, requires an active teacher to adapt quickly to changes (HODGES; FOWLER, 2020). Teachers become emergency educational managers to adapt their classroom pedagogical practice to the virtual one without necessarily having the professional skills to implement it optimally (ABREU, 2020).

Remote teaching has two modalities: Synchronous and asynchronous. In the synchronous mode, students participate in a virtual class in real time. This allows teachers and students to share a temporary space in social interaction and organized according to a formal structure – with defined times – for the connection. The asynchronous modality is intended for students to interact in virtual learning platforms in an autonomous way, as they lead their own learning process according to the educational requirements that contemplate the work and/or activities of the digital modules (PICON, 2020). Therefore, this type of virtual education is not intended to create a system with robust technical and methodological support, as it seeks to provide a rapid response and contribute to the continuity of the teaching and learning process (HODGES; FOWLER, 2020).

Research in remote education has focused on three thematic areas (GAJARDO ESPINOZA; DÍEZ-GUTIÉRREZ, 2021): evaluation practices, perceptions or knowledge about Covid-19, and reflections and proposals for the management of health emergencies. Thus, in the evaluation practices and perceptions or knowledge of COVID-19, the studies are focused on experiences and proposals in school and higher education. Specifically, the research uses questionnaires and surveys without indicating the validation processes and, in turn, its results are partial according to recommendations for improving pedagogical practices (GILLES; CHARLIER, 2020), offering methods and experiences for training in telematic education (GONZALES-ZAMORA *et al.*, 2020) or how to develop the learning capacities of the different technological tools (GEWIN, 2020).

There are also studies that have more extensively investigated the teaching and learning process in remote education. These investigations present the design and validation of questionnaires that have aimed to characterize the processes of this modality of education through instruments of online perception, centered on technological conditions, digital competencies, teacher-student relationship, emotions, and teaching-evaluation in higher education (VILLARROEL *et al.*, 2021). In addition to a questionnaire to evaluate the promotion of subject-focused metacognition, task, context, planning, monitoring ,and evaluation at different educational levels—school and university—(ROMO-SABUGAL; JUAREZ-HERNANDEZ; TOBON, 2021). There is also research on the assessment of satisfaction in remote education on its difficulties and challenges in higher and school education regarding the usefulness of technology and social networks in training (FANDOS-IGADO *et al.*, 2021).

In this way, the aforementioned investigations apply reliability processes by means of internal consistency analysis of Cronbach, yielding general indices of 0.89 to 0.83 (VILLARROEL *et al*., 2021), 0.88 (ROMO-SABUGAL; JUAREZ-HERNANDEZ; TOBON, 2021) and 0.87 (FANDOS-IGADO *et al*., 2021). Most of these studies incorporate complementary statistics to reinforce the internal consistency and correlations of the items with factorial tests. Although they present important samples for the execution of statistical tests (between 346 and 2600) and high reliability indices, none is focused on the production of data in the process of teaching and learning in remote context in school education.

Teaching planning in remote education

The organization and incorporation of elements that fit remote education into planning is essential to ensure that no student is left behind (AZNAR SALA, 2020). This has meant curricular adjustments according to the criteria of virtual times (synchronous and asynchronous), resources, methodologies, strategies, and evaluations that allow the achievement of curricular objectives prioritized to mitigate the effects of the learning gap resulting from the health emergency.

The adaptations to the teaching planning "have demanded greater dedication in the preparation of the subjects than the one destined in the face-to-face format" (PEREZ-LOPEZ; VAZQUEZ ATOCHERO; CAMBERO RIVERO, 2021, p. 343). Thus, curriculum design in remote education is constituted by the preparation and adaptation of teaching and learning according to curricular decision-making; the specification of this design as a class session or development that requires synchronous or asynchronous didactic strategies.

Methodologies in remote education

The virtual context has required a pedagogical change oriented toward the implementation of methodologies that facilitate self-learning, interdisciplinary work, collaborative learning, based on projects, problems, or other active methodologies. This new reality requires greater dynamism, flexibility, and autonomy for the development of student-centered learning (BUSTAMANTE, 2020). In fact, methodologies or strategies that are specific to classroom teaching cannot be replicated (STEWART, 2021).

The challenge is to build a teaching and learning process that collaborates with student autonomy and active participation (MORGAN, 2020). Consequently, it is hoped that these methodologies will allow the development of "activities that motivate analysis, critical thinking, reflection, and the collective construction of knowledge" (GALINDO *et al.*, 2020, p. 10), so that they respond to contextual, cognitive, and emotional needs differentiated according to the virtual spaces of link between teachers, students, and among students. Likewise, this implies how synchronous and asynchronous modes allow interaction, metacognition, and academic motivation. These are fundamental and critical aspects (ZACCOLETTI *et al*., 2020) that have had a significant impact on students due to the absence of presence and the increased sense of social isolation.

Didactic resources in remote education

According to Arriagada Toledo (2020), teachers have had to reinvent themselves and incorporate new educational tools and materials to confront teaching and learning in the different virtual environments imposed by remote education. This leads to the need to use a range of digital teaching resources that are essential to ensure the teaching and learning process (PICÓN, 2020).

Due to the absence of classroom classes, didactic resources or educational materials must be adapted to the new digital methods that are used in the formative processes because they have to consider the technological gaps among the students, which represents a great challenge for the teachers (MACINTYRE; GREGERSEN; MERCER, 2020). Indeed, in the face of this unknown educational reality, the demand for the preparation of teaching resources requires more time for their production and preparation (PÉREZ-LOPEZ; VAZQUEZ ATOCHERO; CAMBERO RIVERO, 2021).

Evaluation for learning in remote education

An e-assessment in virtual learning environments (BARBERA, 2016) becomes a possibility for the consolidation of an authentic assessment or for learning in remote education. This demands a formative assessment with a strong component of effective feedback (RUÍZ-PRIMO; BROOKHART, 2018), which allows the construction of learning in synchronous and asynchronous spaces. The transformation of evaluative practice for online learning requires the development of relevant assessment to enhance formative evaluative coherence (COVID-19 SOCIAL EDUCATION TABLE PROPOSALS, 2021) and, thus, avoid replicating a face-to-face evaluative practice (HODGES; FOWLER, 2020).

The challenge lies in the development of a diverse, continuous, feedback-oriented formative evaluation model with active student participation (PHALARADRA; ABEYWARDENA, 2016; RAHIM, 2020; YAO *et al*., 2020). Online evaluative practice implies a flexible attitude on the part of teachers for the implementation of evaluative strategies and instruments relevant to the remote modality.

Finally, remote education requires a redesign of the evaluation system aimed at developing authentic, contextualized, decentralized evaluation experiences that integrate learning in synchronous and asynchronous spaces, accompanied by systematic feedback practices as a way to strengthen teaching and learning processes (GARCIA-PENALVO *et al*., 2020; MUNOZ RIVERS; HERRERA ARAYA, 2020).

Social interaction in remote education

Social interaction as socio-affective relationships in the classroom (ESCAMILLA *et al*., 2020) has had a negative effect on the achievement of learning in the remote modality. In this way, the social construction of teaching-learning is fundamental for the exchange of ideas, as it enables multiple communications based on argument and reflection. These

socio-educational processes require socio-affective support linked to motivation and academic achievement (ZACCOLETTI *et al.*, 2020).

It is important to mention that this link is not only related to academics, since the closure of schools has generated a heightened sense of loss and isolation among students (MILLER, 2021). Therefore, teachers have had to emotionally assist their students (BUSTAMANTE, 2020) in order to accompany and reinforce socio-affective support and academic motivation as facilitators of learning in remote education (MILLER, 2021). Thus, the construction of spaces in remote education based on trust is of vital importance (GALINDO *et al.*, 2020) and as an opportunity to reassess and reinvent relational ties through a sociopolitical practice of active-authentic care (MILLER, 2021).

Pedagogical support in remote education

Institutional pedagogical support is essential to consolidate the teaching and learning processes in remote education, both at the level of technical support and in the professional development of teachers (GARCIA ARETIO, 2021). This support not only consists of guidelines and training for the effective use of digital resources, but also involves continuous digital training processes that enable the creation of virtual learning environments (PORTILLO PENUELAS *et al.*, 2020). Pedagogical accompaniment refers to the assistance they received for planning and coordinating teaching actions for the effective construction of virtual learning environments, together with the strengthening of their methodological and technological skills for remote education (GARCIA ARETIO, 2021).

Thus, teachers in this context of health emergency with migration to remote training are exposed to different challenges related to methodological and didactic changes, evaluation strategies, the use of technologies, and the link they establish with their students. Both for pedagogical challenges and for the development of practice in remote education, collaborative work, together with agile pedagogical-institutional support, is fundamental to face these new forms of teaching (AZNAR, 2020).

Instrument design

The purpose of the questionnaire is to collect evidence to analyze the teaching and learning processes promoted by school teachers in remote education. This questionnaire is composed of dimensions that account for the central aspects of the teaching and learning process as indicated by the specialized literature (SIMÓN; MUÑOZ-MARTÍNEZ; PORTER, 2021). These dimensions are instructional planning, methodologies, teaching resources, assessment for learning, social or pedagogical interaction, and pedagogical support.

Construction of the questionnaire

The questionnaire was constructed through an iterative process (LÓPEZ-ROLDÁN; FACHELLI, 2015) by three evaluators. This process was structured by technical processing sequences presented in detail in Table 1.

Table 1 – Technical sequences for the elaboration of the questionnaire

N.°	Target sequence	Description	Product
1	Define the theoretical construct	Definition of the theoretical construct *Teaching and learning in emergency remote education.*	Theoretical literature review Construct defined.
2	Determine dimensions according to construct	Determination of dimensions according to the theoretical construct. Definition of each of the dimensions that make up the questionnaire. Likert scale determination with four levels of agreement (without social desirability).	Constructions of dimensions according to the theoretical construct. Definition of dimensions. Elaboration of the scale of agreement.
3	Operationalize indicators according to dimensions	Operationalization of indicators (items) according to the definition of the dimensions. Construction of items according to the established dimensions.	Indicators by dimensions.
4	Determine contextual variables of the instrument	Determining contextual variables for the questionnaire.	Contextual variables for teachers.
5	Analyze the relevance and coherence of the instrument (global and specific)	Analysis of global and specific relevance and coherence. Iterative review of evaluators responsible for each indicator based on dimensions.	Internal adjustment (global and specific) of the questionnaire (validity of content) inter-evaluators. Adjustment of items according to the iterative review (three systematic processes of iteration according to intra- and inter-item relevance and coherence).

Source: Prepared by the author.

Based on the technical sequences of the questionnaire, the instrument is composed of the dimensions that were defined according to the revised literature (GALINDO *et al.*, 2020; HODGES; FOWLER, 2020; PEREZ-LOPEZ; VAZQUEZ ATOCHERO; CAMBERO RIVERO, 2021; SIMON; MUNOZ-MARTINEZ; PORTER, 2021; YAO *et al.*, 2020). These dimensions considered the research focuses linked to the design and validation of questionnaires in remote education (FANDOS-IGADO *et al.*, 2021; ROMO-SABUGAL; JUAREZ-HERNANDEZ; TOBON, 2021; VILLARROEL *et al.*, 2021), with the aim of establishing greater precision and delimitation with respect to the operationalization of the teaching-learning construction in remote education. The dimension are presented in Table 2.

Table 2 – Questionnaire dimensions

Dimension	Description
Teaching planning in the context of remote education	This dimension refers to curricular coverage/curriculum prioritization (how teaching is oriented and redesigned), the preparation and adaptation of teaching-learning in relation to the curriculum, and the design of class-to-class work in the context of remote training, understanding design as session specification, the particular development of the class (strategy or activities at the design level), and the time spent by the teacher.
Methodologies in the context of remote training	Strategies and activities (peer work, authentic activities, problem-based learning, project-based learning, etc.) that the teacher practices in a given context (remote training), which allows interdisciplinary work and facilitates self-regulation of student learning.
Teaching resources in the context of remote training	Creation and use by the teacher of different didactic resources such as educational materials (guides, workbooks, books, among others), technological tools (social networks, slides, multimedia resources, among others) and virtual platforms (Moodle, Zoom, Meet, among others) as support for the development of their classes, it requires more time-consuming dedication and makes it easier for the student to understand the content in the context of remote learning.
Evaluation for learning in the context of remote education	The process in which the teacher constructs and applies evaluative instruments of a summative and formative type, in order for the students to demonstrate their learning, to improve the teaching-learning process through feedback and a qualification in the context of remote training.
Social interaction in the context of remote training	Interaction with the student and between students in a climate of mutual understanding, understanding interaction as the link or relationship around the communication among people. That is to say, it is the exchange of ideas or experiences in the teaching-learning process and the reciprocal influence between individuals in a dialogic context.
Pedagogical support in the context of remote training	Technical and pedagogical support received from the educational institution in the context of remote training. Technical accompaniment refers to the help offered by the teacher in the use of digital resources. The pedagogical support refers to the assistance it received for teaching planning and coordination of actions.

Source: Prepared by the author.

According to these definitions, the six dimensions that make up the questionnaire were operationalized in different indicators (items) in the form of positive phrases. For each of the items, a Likert scale with four levels of agreement was used. These indicate are described in Table 3.

Table 3 – Indicators of questionnaire dimensions

A. Teaching planning in the context of remote education
A.1 Curriculum coverage/prioritization was an orientation that collaborated with the design of teaching in the subject in which it is performed in the context of remote training.
A.2 Curriculum coverage/prioritization involved the redesign of teaching in the context of remote training.
A.3 Curriculum coverage/prioritization of the subject was fully covered in the context of remote training.
A.4 Preparation or adaptation of the classes incorporated strategies or activities of learning the subject in the context of remote training.
A.5 Preparation or adaptation of the classes responded to the learning (knowledge, skills, and/or attitudes) of the subject in the context of remote training.
A.6 Teaching design required more time in the context of remote training.
B. Methodologies in the context of remote training
B.1 Strategies used promoted the development of interdisciplinary work in the context of remote training.
B.2 Strategies used for classroom development were innovative (problem-based learning and/or project-based learning, among others) in the context of remote training.
B.3 The activities used facilitated the development of learning (knowledge, skills and/or attitudes) among students in the context of remote training.
B.4 The activities carried out allowed for peer-to-peer work in the context of remote training.
B.5 Activities promoted self-regulation of student learning in the context of remote learning.
C. Teaching resources in the context of remote training
C.1 The educational materials (guides, workbooks, etc.) used are sufficient to facilitate understanding of the content in the context of remote training.
C.2 The construction of educational materials (guides, workbooks, among others) required more time in the context of remote training.
C.3 The technological tools (social networks, slides, multimedia resources, among others) used were diverse for the development of activities in the context of remote training.
C.4 Technological tools (social networks, slides, multimedia resources, among others) were a fundamental support for the student to understand the content in the context of remote training.
C.5 The use of virtual platforms (Moodle, Zoom, Meet, among others) was effective for the teaching-learning process in the context of remote training.
C.6 The teaching resources (educational material, technological tools and virtual platforms) facilitated the explanation of the content and the resolution of questions in the context of remote training.
C.7 The use of didactic resources (educational material, technological tools, and virtual platforms) collaborated with the development of learning among students in the context of remote learning.
D. Evaluation for learning in the context of remote education
D.1 The formative evaluations made it possible to carry out an accompaniment to the teaching-learning process in the context of remote training.

D.2 Summative evaluations allowed certification of learning results in the context of remote training.
D.3 The evaluative instruments they used were consistent with the learning developed (knowledge, skills, and/or attitudes) in the context of remote training.
D.4 The evaluative instruments were adapted to the context of remote training.
D.5 The evaluation instruments used made it possible to demonstrate the learning developed (knowledge, skills, and/or attitudes) by the students in the remote training context.
D.6 The evaluation instruments used were pertinent to qualify learning (knowledge and skills) in the context of remote training.
D.7 The teaching feedback that was made to the activities or work of the students collaborated with the development of their learning (knowledge, skills, and/or attitudes) in the context of remote training.
E. Social interaction in the context of remote training
E.1 The instances of dialog between teachers and students were favored in the context of remote training.
E.2 The teacher-student relationship was favored in the context of remote training.
E.3 The instances for the exchange of ideas and/or experiences among students were favored in the context of formation.
E.4 The relationship among students was favored in the remote training context.
E.5 Student participation in instances of consultation and/or comment was strengthened in the context of remote training.
E.6 The construction of the classroom climate for the teaching-learning process was favored in the context of remote training.
F. Pedagogical support in the context of remote training
F.1 The educational institution in which you work has implemented mechanisms for monitoring curricular prioritization in the context of remote training.
F.2 The educational institution in which you work provided clear guidelines regarding the planning or design of teaching in the context of remote training.
F.3 The educational institution in which you work provided theoretical and practical knowledge regarding the didactic strategies that are necessary for the remote training context.
F.4 The educational resources provided by the educational institution were relevant to meet the training needs of teachers in the context of remote training.
F.5 The educational institution in which you work has digital platforms that helped teaching in the context of remote training.
F.6 The educational institution provided or reinforced theoretical and practical knowledge regarding the use of digital platforms that enabled facing the context of remote training.
F.7 The educational institution generated an evaluation plan to ensure the learning of its subject in the context of remote training.
G. Open questions
What facilitators can you mention about your experience as a teacher in the context of remote training?
What obstacles can you mention about your experience as a teacher in the context of remote training?

Source: Prepared by the author.

Validation

After completing the analysis of the overall and specific relevance and coherence of the questionnaire, which made it possible to develop the internal adjustment through the application of an iterative intra- and inter-item review for each dimension of the instrument, we proceeded to the process of validation by expert judgment to ensure the content validity of the questionnaire. Content validity is defined as the degree of positive relationship to measure the effectiveness of the theoretical construct according to the items that compose it (RUIZ BUENO, 2014). This process is known as an item analysis (LOPEZ-ROLDAN; FACHELLI, 2015), which makes it possible to guarantee descriptions or inferences from the results obtained.

The questionnaire was validated by five expert trials by adapting the Escobar-Pérez and Cuervo-Martinez validation criteria (2008). The validators have graduate degrees in education with a specialization in curriculum and evaluation, work in higher education and school contexts, and have more than ten years of teaching and research experience. A coefficient of expert competence was applied to each of the experts (CABERO ALMENARA; BARROSO OSUNA, 2013), according to the assessment variables on the level of knowledge of the subject (content) and its level of argumentation. The results showed a high value of expert competence for each one (0.8-0.9).

Thus, the criteria used for the validation process were:

(a) Relevance. Analysis according to the degree of logical integration of the aspects that constitute the indicator.

(b) Consistency. Analysis of the indicator in relation to its degree of logical articulation in relation to its evaluative dimension.

(c) Evaluation range. According to four levels of validation based on the application of the relevance and consistency criteria: Does not meet criterion (0); low level of compliance with criterion (1); moderate level of compliance with criterion (2); and high level of compliance with criterion (3).

Based on these criteria for content validation or item analysis, the questionnaire experienced a minor adjustment in the wording of some indicators related to verbal and temporal formulations. These adjustments were: (a) verb tenses from present to past, (b) lexical revision to specify the element(s) that constitute the indicators, and (c) precision of elements with the use of parentheses to specify some indicators in relation to categories such as “learning,” “educational materials,” “technological tools,” and “virtual platforms.” In addition, it obtained the maximum score for each of the dimensions based on the evaluation made by the five expert judgments according to the high level of compliance with relevance and coherence, which allows guaranteeing its intra- and inter-item validity.

Reliability

The questionnaire was applied to a sample of 202 teachers with a dual purpose: to test its overall reliability and by dimensions (RUIZ BUENO, 2014) and to collect information on the construct of teaching and learning in remote education to evidence its validity. Thus, the purpose of evaluating the reliability of the questionnaire was to:

(a) To check the reliability of the instrument (general and specific) to investigate teaching and learning in emergency remote education.
(b) Determine that dimensions and indicators (items) are consistent and relevant to research on the subject.
(c) To analyze whether the indicators (items) allow to obtain adequate information for research in the subject.

In this way, the questionnaire was analyzed internally by calculating Cronbach's Alpha coefficients globally and for each of its component dimensions. This methodological exercise ensures the consistency of the questionnaire for the collection of empirical data (TABER, 2018).

The non-probabilistic sample distribution used for the application of the questionnaire is presented in Table 4.

Table 4 – Sample distribution for questionnaire reliability analysis

Variables	Sample Distribution (%)
Sex	70% (female), 30% (male)
Years of classroom experience	30% (under 7 years), 36% (8 to 14 years), 18% (15 to 21 years), 16% (22 years)
The level of education of employment	4% (early childhood), 35% (primary), 51% (secondary), 10% (other)
Type of educational institution	40% (public), 38% (private-subsidized), 22% (private)
Distribution by disciplinary area	28% (humanist), 23% (scientific), 11% (technical-professional), 18% (language arts and physical education), 13% (other), 7% (none)

Source: Prepared by the author.

From the application of the questionnaire, a reliability analysis was carried out with the application of SPSS software, version 22, to determine the properties of the instrument by calculating the reliability measures of scales and the intra-item correlation of the instrument in order to establish the internal consistency according to the average of the correlations between the items. From the analysis carried out, it can be indicated that the result of the intra- and inter-item consistency analysis is reliable, given that for all the indicators that constitute the dimensions of the questionnaire it is positive (MUÑIZ; FONSECA-PEDRERO, 2019). The results of the confidence of the questionnaire are detailed in Table 5.

Table 5 – Reliability according to Cronbach's Alpha

Dimension in the context of remote training	No. of items	Reliability
Teaching planning	6	0.644
Methodologies	5	0.789
Didactic resources	7	0.767
Assessment for learning	7	0.851
Social interaction	6	0.884
Pedagogical support	7	0.879
All Dimensions (A+B+C+D+E+F)	38	0.943

Source: Prepared by the author.

It should be noted that the value of Alpha equal to or greater than 0.7 is considered an adequate internal consistency of the instrument GONZÁLEZ ALONSO; PAZMIÑO SANTA CRUZ, 2015). In the analysis of all the items, a 0.943 of reliability was achieved according to Cronbach's Alpha. However, the planning dimension of teaching is the only one with a reliability range slightly below 0.7, which does not affect its consistency.

As a complement, a Kendall's T correlational analysis (PÉREZ JUSTE *et al.*, 2009) was applied to verify and reinforce the reliability measurements using SPSS software, version 22. The correlations by dimension are presented in Table 6.

The results of the Kendall correlational test are summarized below:

1) Dimension A. Most items show statistically significant levels of association. However, the levels of association are mostly low (two moderate), which corresponds to the 0.644 value of Cronbach's Alpha.

2) Dimension B. Items show statistically significant levels of association, but are mostly low (two moderate). It should be noted that the values are higher than those found in dimension A, which corresponds to the value of 0.789 of Cronbach's Alpha.

3) Dimension C. Only one item shows no statistically significant association levels. The number of moderate associations is greater than those found in dimensions A and B, which corresponds to the 0.767 value of Cronbach's Alpha.

4) Dimension D. All items show statistically significant association levels, with the number of low associations being balanced with moderate associations, which corresponds to the Cronbach Alpha value 0.851.

5) Dimension E. The items present statistically significant levels of association, being mostly moderate and in two cases high, which corresponds to the value of 0.884 of Cronbach's Alpha.

6) Dimension F. The levels of association of the items are statistically significant, being mostly moderate with enough values in the upper limit of the range that defines them, which corresponds to the value of 0.879 of Cronbach Alpha.

Table 6 – Kendall test correlational analysis by dimensions

Dimension	Kendall T test results							
		P_1A	P_2A	P_3A	P_4A	P_5A	P_6A	
A	P_1A	1	0,167**	0,295**	-0,01	0,079	0,294**	
	P_2A	0,167**	1	0,281**	-0,017	0,311**	0,267**	
	P_3A	0,295**	0,281**	1	0,085	0,275**	**0,447****	
	P_4A	-0,01	-0,017	0,085	1	0,268**	0,136*	
	P_5A	0,079	0,311**	0,275**	0,268**	1	0,270**	
	P_6A	0,294**	0,267**	**0,447****	0,136*	0,270**	1	
		P_7B	P_8B	P_9B	P_10B	P_11B		
B	P_7B	1	0,320**	**0,442****	0,352**	0,279**		
	P_8B	0,320**	1	0,389**	0,360**	0,314**		
	P_9B	**0,442****	0,389**	1	0,373**	0,352**		
	P_10B	0,352**	0,360**	0,373**	1	0,354**		
	P_11B	0,279**	0,314**	0,352**	0,354**	1		
		P_12C	P_13C	P_14C	P_15C	P_16C	P_17C	P_18C
C	P_12C	1	0,272**	0,301**	0,293**	0,392**	0,180**	0,245**
	P_13C	0,272**	1	0,221**	**0,424****	0,429**	0,202**	**0,524****
	P_14C	0,301**	0,221**	1	0,336**	0,281**	0,051	0,322**
	P_15C	0,293**	**0,424****	0,336**	1	**0,406****	0,202**	**0,436****
	P_16C	0,392**	**0,429****	0,281**	**0,406****	1	0,201**	**0,534****
	P_17C	0,180**	0,202**	0,051	0,202**	0,201**	1	0,153*
		P_19D	P_20D	P_21D	P_22D	P_23D	P_24D	P_25D
D	P_19D	1	**0,454****	**0,481****	0,391**	0,368**	**0,558****	**0,562****
	P_20D	**0,454****	1	0,395**	0,318**	**0,499****	**0,489****	0,340**
	P_21D	**0,481****	0,395**	1	**0,465****	0,270**	**0,450****	**0,441****
	P_22D	0,391**	0,318**	**0,465****	1	0,194**	0,349**	**0,408****
	P_23D	0,368**	**0,499****	0,270**	0,194**	1	**0,474****	0,315**
	P_24D	**0,558****	**0,489****	**0,450****	0,349**	**0,474****	1	**0,485****
	P_25D	**0,562****	0,340**	**0,441****	**0,408****	0,315**	**0,485****	1
		P_26E	P_27E	P_28E	P_29E	P_30E	P_31E	
E	P_26E	1	**0,579****	**0,671****	**0,534****	**0,585****	**0,498****	
	P_27E	**0,579****	1	**0,606****	**0,449****	**0,500****	**0,468****	
	P_28E	**0,671****	**0,606****	1	**0,510****	**0,445****	**0,492****	
	P_29E	**0,534****	**0,449****	**0,510****	1	**0,414****	0,351**	
	P_30E	**0,585****	**0,500****	**0,445****	**0,414****	1	**0,465****	
	P_31E	**0,498****	**0,468****	**0,492****	0,351**	0,465**	1	
		P_32F	P_33F	P_34F	P_35F	P_36F	P_37F	P_38F
F	P_32F	1	0,369**	**0,479****	**0,471****	**0,497****	**0,533****	**0,594****
	P_33F	0,369**	1	0,351**	0,254**	**0,477****	0,395**	**0,430****
	P_34F	**0,479****	0,351**	1	**0,532****	**0,444****	**0,528****	**0,413****
	P_35F	**0,471****	0,254**	**0,532****	1	**0,428****	**0,504****	0,368**
	P_36F	**0,497****	**0,477****	**0,444****	**0,428****	1	**0,482****	**0,433****
	P_37F	**0,533****	0,395**	**0,528****	**0,504****	**0,482****	**1**	**0,447****
	P_38F	**0,594****	**0,430****	**0,413****	0,368**	**0,433****	**0,447****	**1**

*High correlation: 0.6-0.79; Medium: 0.4 - 0.59; Low: 0.2-0.39.
Source: Prepared by the author.

In summary, the study of Kendall's intra-dimensional correlations reinforces the levels of reliability found with Cronbach's Alpha.

In addition, an exploratory factorial analysis was performed using SPSS software version 22. This type of analysis allows to establish a greater precision on the latent and observed variables or constructs (LLORET-SEGURA *et al.*, 2014). Therefore, it seeks to establish whether there are matches between the factorial analysis and the dimensions defined a priori in the study.

As the first statistical sufficiency test, it was observed that the Kaiser-Meyer-Olkin (KMO) measurement analysis and the Bartlett sphericity test showed very positive values, between 0.920 and 0.000 [3], so that exploratory factor analysis is feasible (Table 7).

Table 7 – KMO and Bartlett tests

Kaiser-Meyer-Olkin sampling adequacy measure		0.920
Bartlett's sphericity test	Approx. Chi-square	4010.614
	Gl	703
	Sig.	0.000

Source: Prepared by the author.

Considering the results of this first test, a second analysis is carried out on the basis of the following criteria:

- Removal of main components: This is based on the fact that this is an exploratory analysis
- Orthogonal rotation or Varimax, since the correlations between the items are of very low significance
- Suppression of variance coefficients less than 0.3.

Table 8 – Total variance explained

Component	Rotation sums of squared loads		
	Total	% variance	cumulative %
1	5.321	14.003	14.003
2	4.421	11.633	25.636
3	4.339	11.420	37.056
4	4.298	11.310	48.366
5	1.912	5.031	53.398
6	1.812	4.770	58.167
7	1.308	3.441	61.608

Source: Prepared by the author.

3- The KMO value requires a minimum of 0.6 and Bartlett's sphericity test should be less than 0.05.

These results indicate that these seven factors explain 61.6% of the total variance, which allows to describe the teaching experience in the teaching process and learning in schools in remote education (Table 8). It should be noted that an appropriate model is considered when aggregations of the extracted factors exceed 50% of the variance explained (FLORA; LABRISH; CHALMERS, 2012).

The identification of factors and their influence on the total variance explained is presented in Table 9.

Table 9 – Identification of factors according to explanation of variance

Factor	% variance explanation
Availability of virtual platform tools and aspects associated with methodological strategies	14%
Educational institution where the pedagogical action is developed	11.6%
Interpersonal relationships with students	11.4%
Evaluation processes of learning both summative and formative	11.3%
Curriculum coverage in its design for remote training	5%
Time commitment of teaching duties	4.7%
Interdisciplinary work in the remote training context	3.4%

Source: Prepared by the author.

With respect to the dimensions defined in the original study design, there is a medium agreement with the factors found. The most relevant areas according to the factorial analysis are: The items linked to didactic resources (Dimension C), pedagogical support (Dimension F), interpersonal relations (Dimension D) and evaluative processes (Dimension E) indicated in Table 5.

Regarding the two open questions on facilitators and hinderers, these have a very high degree of validation by expert judgment (ESCOBAR-PÉREZ; CUERVO-MARTÍNEZ, 2008), since they delve into particular components of these areas associated with technological access, training in digital competencies and curricular-evaluative innovation processes, which allows us to maintain that they have consistent content validity.

Discussion of results

The results of the validation of the questionnaire show a high and significant level of internal consistency, both inter- and intra-dimensions. The reliability tests and factorial analysis carried out show that the questionnaire on teaching and learning processes in remote education is a reliable instrument for producing knowledge in educational research.

These findings are consistent with studies linked to questionnaire and test design and validation processes (RESTREPO-PALACIOS; SEGOVIA CIFUENTES, 2020). Thus, the six dimensions that constitute the questionnaire integrate two fundamental aspects: Operationalization of teaching-learning and the context of remote education. These dimensions are supported by theory (GALINDO et al., 2020; HODGES; FOWLER, 2020;

PEREZ-LOPEZ; VAZQUEZ ATOCHERO; CAMBERO RIVERO, 2021; SIMON; MUNOZ-MARTINEZ; PORTER, 2021; YAO et al., 2020), thus allowing an adequate integration that collaborates with the analysis of teaching and learning in remote education in school contexts. .In this way, the questionnaire offers a structural articulation (SÁNCHEZ-MARTÍ; MORENO; ION, 2019) that makes possible the inquiry of perceptions, declared practices and technological, pedagogical and institutional conditions for the discussion and problematization of the data (GAJARDO ESPINOZA; DÍEZ-GUTIÉRREZ, 2021).

In addition, the questionnaire presents a systematic process of design and validity, which allows strengthening research in remote education with a multidimensional perspective and enriches the production of data in a broader way with the purpose of deepening partial statistical analyses (GILLES; CHARLIER, 2020) in order to subject this type of instrument to a more complex discussion on the type of knowledge it produces (CAMIZÃO; CONDE; VICTOR, 2021; ROMO-SABUGAL; JUÁREZ-HERNÁNDEZ; TOBÓN, 2021).

In summary, it is possible to state the following: (a) that the overall high internal consistency of the instrument is checked according to the statistical tests performed; (b) a high consistency is determined for each of the dimensions of the instrument; (c) the indicators (items) are relevant and consistent for the collection of data for each of the dimensions that constitute the instrument; and (d) the dimensions of the questionnaire allow the description of teaching experience in remote education.

Conclusions

The questionnaire to inquire about the teaching and learning process in remote education has 6 dimensions, 38 items and 2 open questions that have a very high intra- and inter-item consistency, which allows to argue that it is a valid and reliable instrument for educational research. The theoretical construct and the factor analysis performed according to the Cronbach's Alpha values per dimension allow testing its overall reliability, which is 0.943 and for each of the items between a range of 0.644 and 0.879. Thus, this is an instrument for the collection of data according to the assessments and perceptions that teachers have regarding the development of teaching and learning in remote education.

The limits of the questionnaire are expressed in three aspects: Sample, dimensions, and methodological adjustments. The sample used (n=202 teachers) for the application of the questionnaire needs to be expanded to consolidate the validation process. In addition, it would be appropriate to incorporate students with an adjusted questionnaire to perform comparative statistical analyzes for the purpose of developing more sophisticated explanatory designs. The dimensions have adequate internal consistency, however, they do not integrate items related to learning diversity, inclusion, and differentiated training. These are fundamental aspects that the current school system strongly incorporates in the processes of educational quality and equity. It would also be interesting to apply inferential statistics in order to establish, with greater clarity and precision, the impact of each of the dimensions of teaching and learning in this form of education.

This work offers opportunities and lines of research that are under construction. The opportunities include the relevance of this type of instruments for the production of robust and pertinent statistical information that contributes to the knowledge of remote education

in schools. The data collected by means of this questionnaire become a substantial basis for knowing, discussing and reflecting on the impact of this type of education on teaching and student learning. Indeed, the results of this article open questions and lines of research related to the study of perceptions and conceptions of teachers and students about the experiences and impact of remote education; tensions, opportunities and challenges of remote education in schools in relation to diversity and inclusion; the processes of teacher-student and student-student interaction; initial and continuing teacher training in remote and/or hybrid school education; management, leadership and pedagogical support by the school for the development of remote education.

Due to the requirements and demands of research in the context of the Covid-19 pandemic, the construction of this type of instrument is a contribution not only to exploring how educational processes in remote education develop. it can also contribute to the production of empirical evidence, the discussion of data and the design of proposals aimed at improving teaching and learning in the current remote context. This is why the systematic design of the questionnaire, describing in detail the phases of elaboration, validation and reliability analysis, becomes a significant support for the production of scientific knowledge and thus respond to the new research challenges that arise from the current context of remote education.

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