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Practical Work in Natural Sciences Education: Development and Validation of a Qualitative Data Collection Instrument

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Abstract

This article presents the development and validation process of a qualitative data collection instrument aimed at analysing natural sciences teachers' perceptions of practical work in lower secondary education (third cycle) in Portugal. The methodological approach combined a systematic literature review following PRISMA guidelines with an analysis of relevant curricular frameworks and legal documents. Based on the triangulation of these sources, a semi-structured interview guide was constructed, validated by a panel of five experts from four Portuguese public universities, and tested through a pilot interview. The final instrument comprised seven dimensions and fourteen subdimensions, totalling 44 items. It demonstrated methodological rigour and practical applicability for qualitative data collection and analysis. Findings indicate that the instrument enables a comprehensive exploration of teachers' practices and perceptions regarding practical work, offering a valuable contribution to the research on didactics of science and to the professional development of teachers. Also, the application of this instrument will enable teachers and researchers to characterise the dynamics of practical work carried out with young students in natural sciences education across seven structuring dimensions: (1) Conceptual; (2) Limitations; (3) Advantages; (4) Evaluative; (5) Operationalisation; (6) Textbook; and (7) Curricular.

Keywords: practical work; natural sciences education; validation of qualitative instruments

1. Introduction

Practical work (PW) represents a central pillar in natural sciences education, playing a key role in promoting scientific literacy and in developing students' cognitive and procedural skills (Abrahams & Reiss, 2012). This pedagogical approach, often associated with hands-on and minds-on methodologies, fosters active and meaningful learning experiences, enabling the integration of theory and practice and supporting the construction of contextualised scientific knowledge (Harrison, 2016; Wei et al., 2019).

However, despite the consensus on the pedagogical value of PW, its effective implementation in schools faces significant constraints related to limited resources, time, teacher training, and curricular alignment (Akuma & Callaghan, 2019; Ramnarain & de Beer, 2013). As noted by Ferreira and Morais (2014), the conceptual and operational complexity of PW requires clear articulation among its conceptual, procedural, and evaluative dimensions; otherwise, it risks being reduced to a merely technical activity, lacking scientific and pedagogical intentionality.

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In this context, the need for valid and reliable instruments to collect data on teachers' perceptions and practices regarding PW becomes evident. Research on the didactics of science has emphasised that the development and validation of such instruments allow for a deeper understanding of how teachers interpret, implement, and reflect on PW within their professional practice (Abrahams et al., 2014; Hartman & Squires, 2024).

This study addresses this gap by developing and validating a comprehensive interview guide designed to collect qualitative data on PW in natural sciences education, specifically within the third cycle of Portuguese basic education. Grounded in a systematic literature review (SLR) (Oliveira & Bonito, 2023) and an analysis of the national curricular guidelines (DGE, 2018a, 2018b, 2018c; Martins et al., 2017), the instrument aims to explore teachers' perceptions regarding the conceptual, evaluative, operational, and curricular dimensions of PW, promoting a holistic understanding of scientific practice in educational contexts.

The focus of this study is the characterisation of practical work in natural sciences education in the 3rd cycle of basic education within the Portuguese education system. In addition, the study aims to contribute to this characterisation through the development of the qualitative data collection instrument, illustrated and characterised in this manuscript. The overarching research question that guided all procedures in this investigation was the following: How do natural sciences teachers in the 3rd cycle of basic education perceive and implement practical work in their teaching practice?

In the reference list of the main body of this scientific article, we include the references of the authors cited in the text, as well as those underpinning the domains, subdomains, objectives, questions, criteria, and indicators of the interview protocol, the full version of which can be consulted in Supplementary File S1—Qualitative Data Collection Instrument. These authors correspond to the corpus of 53 manuscripts selected through the previously conducted SLR. Additionally, legal regulations from the legislation of the Portuguese Republic, as well as the national curriculum guidelines for the subject of natural sciences in the 3rd cycle of basic education, were also consulted and incorporated into the reference list.

2. Methods

2.1. Systematic Literature Review on Practical Work

The first step in this process was conducting an SLR on the state of the art of practical work in science education. This review was carried out in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement guidelines (Page et al., 2021) and conducted across five distinct databases: B-on, ERIC, Google Scholar, Scopus, and Web of Science. Table 1 outlines the objective of the SLR, its research question, the keywords used in the search equations, and the inclusion/exclusion criteria applied to the selected databases.

Table 2 identifies the databases, query options, query criteria, and document count that resulted in the initial set of 163 potentially relevant manuscripts, which were subsequently subjected to a screening process.

In the initial phase of the SLR, 163 potentially relevant studies were identified. Following a screening process—which included the application of inclusion and exclusion criteria, removal of duplicates, and elimination of out-of-scope studies—a final corpus of 53 relevant studies was established for document analysis. Figure 1 presents the flow diagram illustrating the processes of identification, screening, and inclusion that led to the selection of these 53 manuscripts for documentary analysis.

Table 1. Structure of the Research Protocol.

Items	Description
SLR Objectives	To obtain an overview of how PW is currently conceptualised and implemented in pre-university science education, according to students, teachers, and researchers.
Research question	What is the state of the art regarding PW in science education at the pre-university level?
Keywords	Practical work; science education; secondary schools
Inclusion criteria	Full-text open access documents; peer-reviewed studies; research focused on or examining how science is taught in pre-university educational institutions; documents written in English.
Exclusion criteria	Systematic literature reviews; undergraduate theses or final reports; master's dissertations; documents published prior to 2011.

Note. Adapted from Oliveira and Bonito (2023).

Table 2. Findings from the initial identification of studies in the systematic literature review.

Databases	Query Options	Query Criteria	Document Count
B-on	*Limitators* - Latest 10 years - Peer reviewed - Available from the library - Full text available *Expanders* - Search the whole article body - Search for equivalent topics	"Practical work in science education" AND "secondary schools"	30
ERIC	- Latest 10 years - Peer reviewed	"Practical work" AND "science education" AND "secondary schools"	58
Google Scholar	- Latest 10 years	All in title: "practical work" "science education" OR "secondary schools"	43
Scopus	- Latest 10 years	"Practical work" AND "science education" AND "secondary schools"	19
Web of Science	- Latest 10 years	"Practical work" AND "science education" AND "secondary schools"	13
Total			163

Note. Adapted from Oliveira and Bonito (2023).

Through the graphical illustration in Figure 2, a simplified overview of the process followed throughout the various stages of the SLR on practical work in science education can be established.

This SLR highlighted four major dimensions of the dynamics of practical work in science education: (1) the conceptual dimension; (2) the advantages dimension; (3) the evaluation dimension; and (4) the disadvantages dimension. Figure 3 illustrates the categories of practical work dimensions under analysis.

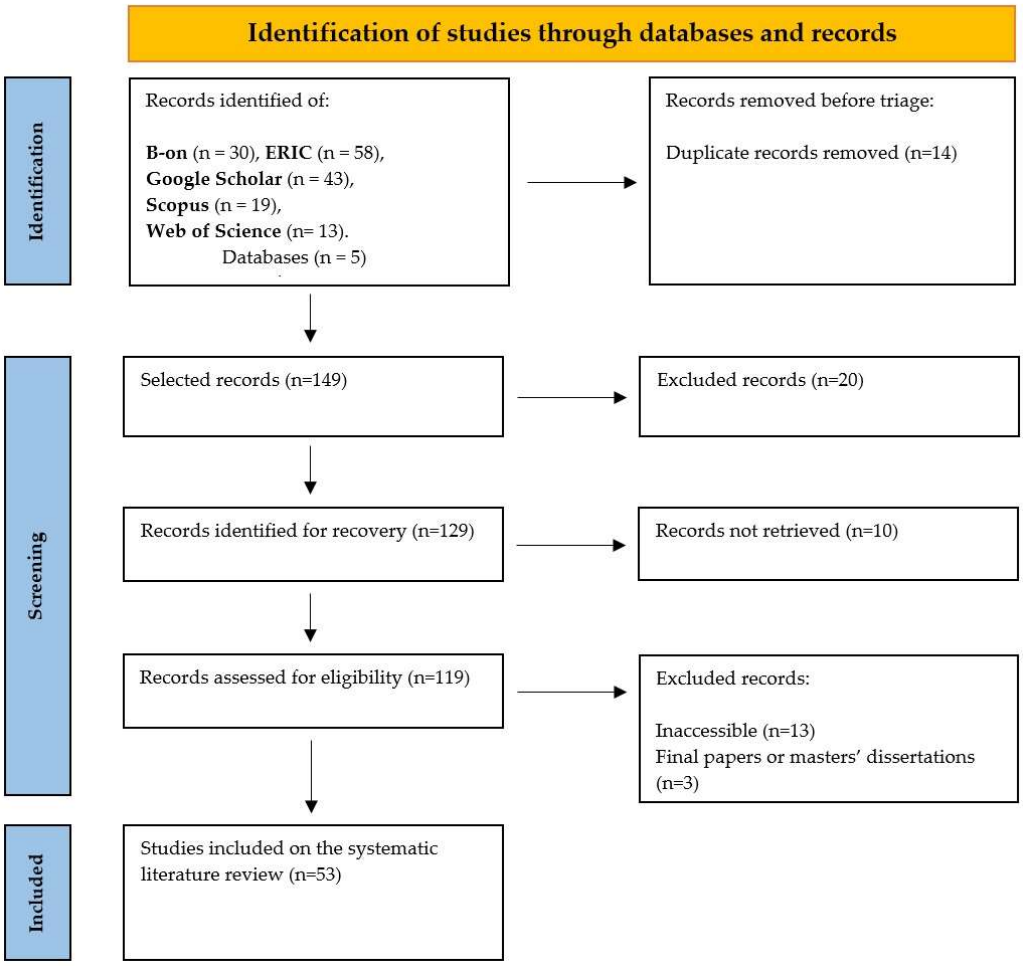

Figure 1. Screening results for the constitution of the corpus. Retrieved from Oliveira and Bonito (2023, p. 5).

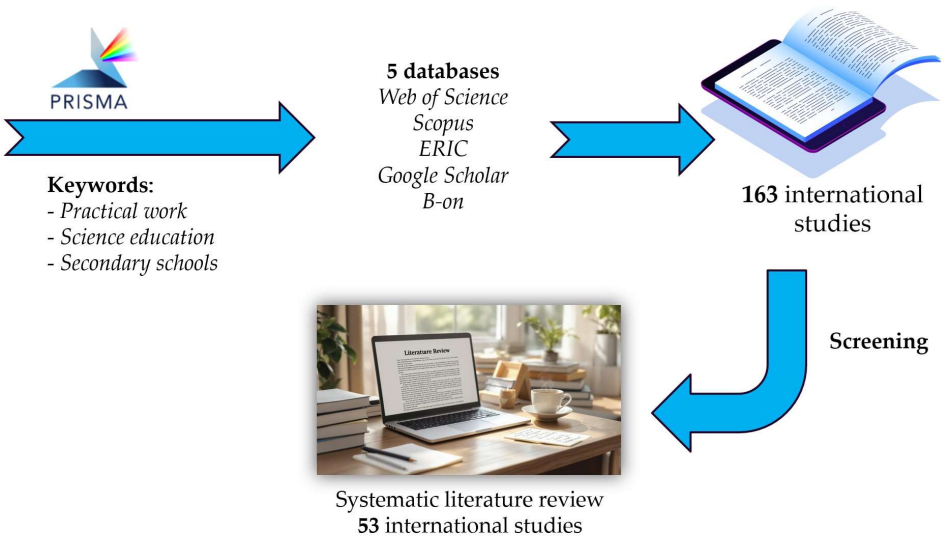

Figure 2. Outline of the methods applied in the systematic literature review. Figure created by the authors. Icons sourced from the Microsoft Office image library.

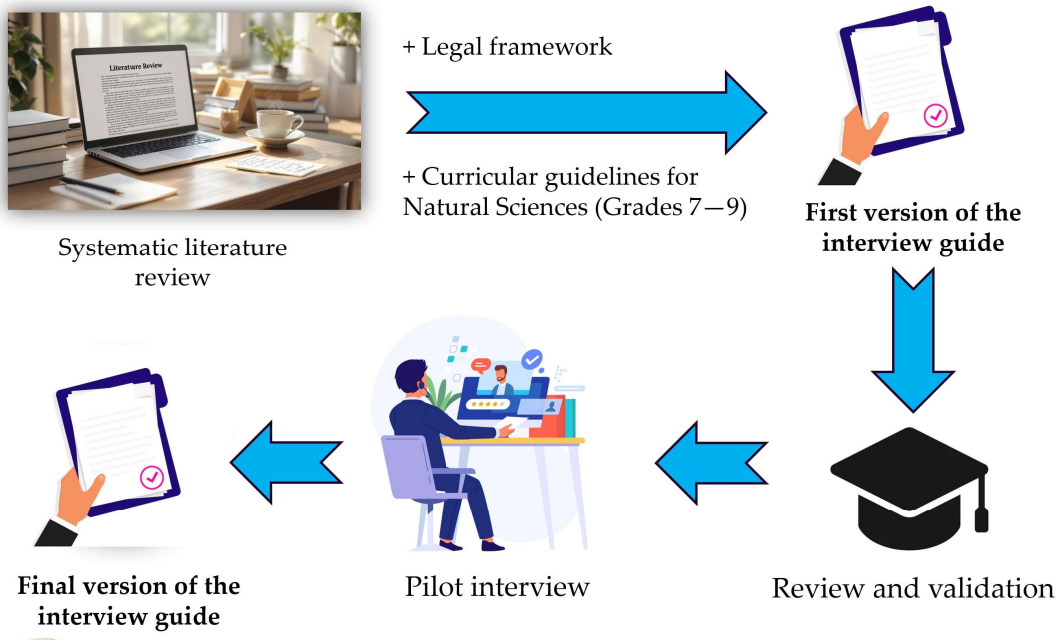

Figure 3. Outline of the methods applied in the design and validation of the interview guide. Figure created by the authors. Icons sourced from the Microsoft Office image library.

2.2. Design of the Interview Guide

By triangulating the data obtained from the SLR with the curricular guidelines for natural sciences in the third cycle of basic education and relevant legal frameworks, it was possible to structure the first version of the interview guide (including its objectives, questions, criteria, and indicators). In addition to the four dimensions considered in the SLR, the analysis of legal regulations and curriculum guidelines enabled the inclusion of three further relevant dimensions in the first version of the interview guide: the operationalisation dimension, the textbook dimension, and the curricular dimension.

More specifically, the intention to conduct an interview-based survey with teachers of the natural sciences subject in the third cycle of basic education led to the development of a comprehensive, semi-structured interview guide, grounded in the Kaufmann (2004) approach, which places particular emphasis on the context in which actions occur, and the meanings constructed within it. With the aim of analysing Biology and Geology teachers' perceptions regarding the PW carried out in the natural sciences subject at this educational level within the Portuguese education system, this instrument was developed and validated to enable an interpretative phenomenological analysis (IPA) (Hartman & Squires, 2024). This approach is intended to make it possible to interpret detailed, first-person accounts of the PW promoted in the natural sciences curriculum, thereby unveiling its underlying meanings. Reflecting on the value of IPA, we would acknowledge that its layered analytical structure—encompassing the exploration of content, contextual dimensions, and linguistic features such as metaphor—would offer a vivid and meaningful portrayal of participants' lived experiences. By comparing these elements within and across cases, the approach would allow for a deep and intimate understanding of the phenomena under study. Our engagement with IPA would reveal the immersive nature of the methodology, providing a comprehensive framework that could assist researchers in grasping the complexities embedded in participants' accounts. Moreover, IPA would prompt researchers to question and bracket their own taken-for-granted assumptions, enabling participants' underlying experiences to surface more clearly. This process would not only enhance the analytical depth but also contribute to a more nuanced and authentic representation of participants' perspectives.

The interview protocol developed herein was designed with the intention of conducting interviews with 23 natural sciences teachers within the Portuguese education system. For the study in which this qualitative data collection instrument will be applied, one natural sciences teacher from the 3rd cycle of basic education will be selected from a school or school cluster in each district of mainland Portugal, totalling 18 teachers. Regarding the archipelago of the Autonomous Region of the Azores, one teacher will be selected from each island group (Eastern, Central, and Western), based on convenience sampling, resulting in a total of three teachers. For the archipelago of the Autonomous Region of Madeira, two teachers will be selected, also through convenience sampling, who are currently teaching on Porto Santo Island and Madeira Island, respectively.

As previously demonstrated, the construction of the instrument was based on an SLR, concerning PW in science education at the pre-university level (UNESCO, 2012), which enabled the identification of the state of the art regarding the international adoption of this methodology. In a second phase, an analysis was conducted of the Portuguese curricular guidelines for the teaching of natural sciences in the third cycle of basic education, with the aim of gathering elements that would facilitate an adaptation as closely aligned as possible with the scope of this educational level. To this end, the Student Profile at the End of Compulsory Schooling framework (Martins et al., 2017) and the Essential Learnings defined for the natural sciences subject in the third cycle were examined (DGE, 2018a, 2018b, 2018c). Additionally, legal frameworks within Portuguese legislation were analysed for their potential impact on the dynamics of PW in science education (Portugal, 2018a, 2018b, 2018c), with a view to triangulating this information with the previously identified documents.

Based on the triangulation of information from the SLR, the curricular guidelines, and the legal frameworks, the questions that comprise the interview guide were defined. These questions are intrinsically linked to a set of criteria and indicators designed to serve as a guide for the interviewer, helping to steer the interview toward relevant topics and to more effectively capture the meanings attributed by natural sciences teachers to the phenomena under investigation. These sets of criteria and indicators will also serve, subsequently, as facilitators for the content analysis of the participants' discourse, particularly within the topics embedded in each dimension and subdimension of the semi-structured interview. Furthermore, to support the processes previously described, a set of clearly defined objectives was established for each of the outlined dimensions and subdimensions, clarifying the scope and purpose of the questions addressed in each area.

Subsequently, the first version of the instrument underwent a review process supported by five experts from four Portuguese public universities. Once validated, the guide was tested in a pilot interview with a natural sciences teacher from the Lisbon district, leading to its final version. A synthesis of this entire process is illustrated in Figure 3, which depicts the key stages and the sequence of steps followed.

3. Results

The SLR made it possible to identify four major dimensions associated with the dynamics of practical work in science education: (1) the conceptual dimension; (2) the advantages dimension; (3) the evaluative dimension; and (4) the disadvantages dimension. Figure 4 provides a synthesis of these results.

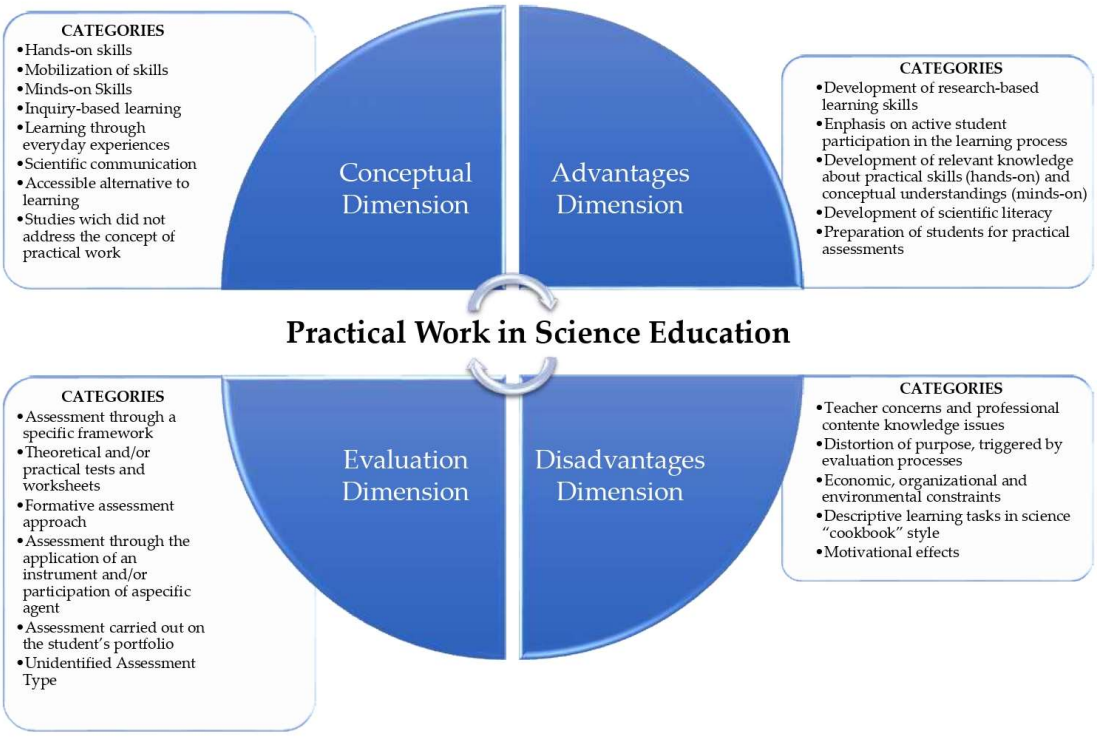

Figure 4. Dimensions of practical work and its emergent categories. Note. Adapted from Oliveira and Bonito (2023).

These four dimensions identified through the SLR were subsequently incorporated into the structure of the qualitative data collection instrument, to which the operationalisation dimension, the textbook dimension, and the curricular dimension were added. These additional dimensions emerged from the triangulation of data with relevant legal frameworks in Portuguese legislation and with the natural sciences curriculum guidelines for the 3rd cycle of basic education, as described in the previous section.

The overall structure of the first version of the interview guide is presented in Table 3, illustrating the distribution of the defined questions (items) across the respective dimensions and subdimensions under study.

Table 3. General Structure of the Interview Guide (First version).

Dimensions	Subdimensions
1. Conceptual dimension (7 items)	1.1. Typology of practical work implementation (**3 items**)
	1.2. Mobilisation of skills (minds-on and hands-on approaches) (**2 items**)
	1.3. Learning Through Everyday Experiences (**1 item**)
	1.4. Transdisciplinarity, multidisciplinarity, and interdisciplinarity (**1 item**)
2. Limitations dimension (8 items)	2.1. Limitations related to the suitability of spaces and organisational aspects (**1 item**)
	2.2. Teachers' concerns and issues related to professional content knowledge (**5 items**)
	2.3. Economic, organisational, and environmental constraints (**1 item**)
	2.4. Motivational effects (**1 item**)
3. Advantages dimension Research-based skills development (**3 items**)	
4. Evaluative dimension (9 items)	4.1. Assessment tools and feedback (**3 items**)
	4.2. Assessment within a specific framework (**4 items**)
	4.3. Theoretical and/or practical tests, worksheets, and assignments (**1 item**)
	4.4. Assessment through instrument application and/or involvement of a specific agent (**1 item**)

Table 3. *Cont.*

Dimensions	Subdimensions
5. Operationalisation dimension (5 items)	5.1. Integration of digital technologies in practical work (**2 items**)
	5.2. Student performance (**1 item**)
	5.3. Strategic options (**2 items**)
6. Textbook dimension (2 items)	General characteristics of the textbook
7. Curricular dimension (4 items)	7.1. Correlation between curriculum guidelines and the frequency of implementing practical tasks (**1 item**)
	7.2. Transition from Curriculum Goals to the Essential Learnings (**3 items**)

Note. Created by the authors.

An analysis of the overall structure of the first version of the interview guide reveals that it constituted an instrument comprising seven dimensions, which were further subdivided into nineteen specific subdimensions, encompassing a total of thirty-eight items.

Following the development of this initial version of the interview script, contact was established with five experts from four different Portuguese public universities (University of Aveiro, University of Lisbon, University of Minho, and University of Porto), with the aim of obtaining their contributions towards the validation of this qualitative data collection instrument. Accordingly, and in order of response to the invitation, the five experts are coded as presented in Table 4, which also includes the number of optimisation suggestions proposed by each expert.

Table 4. Coding of experts involved in the interview script validation process and their optimisation suggestions.

Experts	Portuguese Public Universities	Number of Optimisation Suggestions
P1	University of Porto	4
P2	University of Lisbon	2
P3	University of Aveiro	23
P4	University of Aveiro	17
P5	University of Minho	21

Note. Created by the authors.

The experts' recommendations primarily revolved around the following aspects: (a) paying attention to the potentially ambitious length of the interview script and the effects of fatigue during extended interviews; (b) simplifying the concepts of (multi)interdisciplinarity and transdisciplinarity and instead asking whether the teacher "usually conducts project work with colleagues from other disciplines, and in what ways?"; (c) balancing the number of items/questions addressing both the advantages and disadvantages of project work; (d) avoiding overly goal-oriented or directive questions, thereby allowing space for the interviewees' reasoning and discourse; and (e) requesting concrete examples or descriptions of everyday teaching practices.

After incorporating the experts' suggestions, the interview script was then validated and adopted its final structure, after a pilot interview, being structured as illustrated in Table 5.

The final version of the interview script adopted a more simplified structure, due to a reduction in the number of subdimensions. Nevertheless, six additional items were included overall. These details can be more thoroughly examined in the comparative table between the initial and final versions of the interview script (Table 6).

Table 5. General structure of the interview script (Final Version).

Dimensions	Subdimensions
1. Conceptual dimension (5 items)	1.1. Typology of practical work implementation (**3 items**)
	1.2. Mobilisation of skills (minds-on and hands-on approaches) (**1 item**)
	1.3. Learning Through Real-life Experiences (**1 item**)
2. Limitations dimension (6 items)	2.1. Limitations to the implementation of practical work (**4 items**)
	2.2. Motivational effects (**2 items**)
3. Advantages dimension: Research-based skills development **(6 items)**	
4. Evaluative dimension (6 items)	4.1. Assessment within a specific framework (**3 items**)
	4.2. Instruments and feedback (**3 items**)
5. Operationalisation dimension (9 items)	5.1. Integration of digital technologies in practical work (**3 items**)
	5.2. Student performance (**4 items**)
	5.3. Strategic options (**2 items**)
6. Textbook dimension: General characteristics of the textbook (**4 items**)	
7. Curricular dimension (8 items)	7.1. Connection between curriculum guidelines and the frequency of implementing practical tasks (**2 items**)
	7.2. Transition from Curriculum Goals to the Essential Learnings (**6 items**)

Note. Created by the authors.

Table 6. General structures of the first version and the final version of the qualitative data collection instrument.

	First Version		Final Version	
Dimensions	**Subdimensions**	**Items**	**Subdimensions**	**Items**
Conceptual	4	7	3	5
Limitations	4	8	2	6
Advantages	1	3	1	6
Evaluative	4	9	2	6
Operationalization	3	5	3	9
Textbook	1	2	1	4
Curricular	2	4	2	8
Total	**19**	**38**	**14**	**44**

Note. Created by the authors.

An analysis of the previous table reveals that both versions contain an identical number of dimensions. However, the initial version is structured into 19 subdimensions, whereas the final version comprises 14 subdimensions. Regarding the number of items, the initial version includes 38 questions, while the final version comprises 44 questions.

To provide a more comprehensive and detailed overview of the structure of this qualitative data collection instrument, Table 7 presents a fragment of the specific structure of its final version, focusing on the first dimension under analysis (conceptual dimension). Including the full qualitative data collection instrument in the main manuscript would exceed the recommended length for this article. To provide a concise yet informative overview of its structure, only an illustrative excerpt is presented. The complete instrument is available in Supplementary File S1—Qualitative Data Collection Instrument.

Table 7. Specific structure of the interview script—Conceptual dimension.

D	Subdimension	Objectives	Questions	Criteria	Indicators	Authors/Regulations
Concept	Typology of Practical Work Implementation	- Characterise the concept of practical work (PW). - Characterise the types of skills promoted by the PW. - Unveil how PW enables the development of knowledge-based skills.	1—What do you understand by PW? 2—What typologies of PW do you identify? Which do you most frequently apply in your teaching practice, and why? Please illustrate with a concrete example. 3—In your opinion, do students acquire knowledge-based skills during the execution of PW? In what ways do they acquire these types of skills?	- Definition. - Examples. - Typologies. - Knowledge-based skills (critical thinking, memorisation, concentration ability, self-motivation, understanding, and conceptual mastery). - Practical skills (handling materials and instruments, performing technical operations following appropriate methodology, developing fine motor skills, and transforming or creating products adapted to different contexts).	- Time management. - Evidence of the relationship between the scope of Essential Learnings (EL) and the selected PW typology. - Implementation of field work - Implementation of experimental work - Implementation of laboratory work - PW involves the mobilisation of scientific knowledge in order to enable the understanding of the processes behind certain phenomena, aligned with a "minds-on" approach that fosters critical thinking. - PW involves the mobilisation of scientific knowledge to enable the understanding of the processes behind certain phenomena, in line with a "minds-on" approach that promotes critical thinking.Evidence of the development of knowledge-based competencies within the areas defined by the Student Profile at the End of Compulsory Schooling (SPECS): • Languages and texts • Information and communication. • Reasoning and problem-solving. • Critical and creative thinking. • Interpersonal relationships • Personal development and autonomy • Well-being, health, and environment • Aesthetic and artistic sensitivity • Scientific, technical, and technological knowledge • Body awareness and control	(Martins et al., 2017) (DGE, 2018a) (DGE, 2018b) (DGE, 2018c) (Costa et al., 2022) (Dourado, 2001) (Leite, 2001) (Ferreira & Morais, 2014) (Erduran et al., 2020) (Fadzil & Saat, 2019) (Harrison, 2016) (Itzek-Greulich & Vollmer, 2017) (Karpin et al., 2014) (Oyoo, 2012) (Pols et al., 2021) (Ramnarain & de Beer, 2013) (Xu & Clarke, 2012) (Adamu & Achufusi-Aka, 2020) (Preethlall, 2015) (di Fuccia et al., 2012) (Malathi & Rohini, 2017) (Wilson, 2018) (Musasia et al., 2012) (Ruparanganda et al., 2013) (Viswarajan, 2017) (Mamlok-Naaman & Barnea, 2012) (Šorgo & Špernjak, 2012)

Table 7. *Cont.*

D	Subdimension	Objectives	Questions	Criteria	Indicators	Authors/Regulations
	Mobilisation of skills (minds-on and hands-on approaches)	- To describe how students and the teacher engage in the development of inquiry-based PW.	4—Let us focus on inquiry-based learning, in which students lead their own investigative process and may even define the problem to be explored. Do you usually implement this type of practical work? Could you provide an example?	- Identification/characterisation of inquiry-based PW. - Identifying how students develop inquiry-oriented questions.	- Mobilising practical skills in material manipulation within investigative scientific processes. - Mobilising conceptual skills within investigative scientific processes. - PW involves strong engagement in the process of developing research questions and designing experimental procedures, aligned with the principles of Inquiry-Based Learning.	(Oguoma et al., 2019) (Toplis, 2012) (Abrahams et al., 2014) (Abrahams et al., 2013) (Akuma & Callaghan, 2019) (Erduran et al., 2020) (Fadzil & Saat, 2019) (Hamza & Wickman, 2013) (Harrison, 2016) (Itzek-Greulich & Vollmer, 2017) (Köksal, 2018) (Karpin et al., 2014) (Kennedy, 2013) (Abrahams & Reiss, 2012) (Phaeton & Stears, 2017) (Ramnarain & de Beer, 2013) (Sharpe & Abrahams, 2020) (Wei et al., 2019) (Wei & Li, 2017) (Wei & Liu, 2018) (Adamu & Achufusi-Aka, 2020) (Preethlall, 2015) (Anza et al., 2016) (Danmole, 2012) (di Fuccia et al., 2012) (Malathi & Rohini, 2017) (Wilson, 2018) (Musasia et al., 2012) (Ruparanganda et al., 2013) (Viswarajan, 2017) (Lowe et al., 2013) (Mamlok-Naaman & Barnea, 2012) (Šorgo & Špernjak, 2012)
	Learning Through Real-life Experiences	- Identifying the ways in which PW can support the resolution of real-life problems.	5—In your opinion, does the PW developed help identify ways to solve everyday problems? Please provide an example.	- Evidence of the implementation of practical activities where PW contributes meaningfully to the resolution of real-life problems.	- Learning through everyday phenomena as a driver of student motivation and engagement, emerging from meaningful learning episodes drawn from selected experiences and contexts.	(Musasia et al., 2016) (Ramnarain & de Beer, 2013) (Wei & Li, 2017) (Xu & Clarke, 2012)

Note. Created by the authors.

In general, the specific structure of the qualitative data collection instrument comprises seven distinct columns. From left to right, these include the identification of the dimension under analysis, followed by its corresponding subdimension. Next is the column outlining the objectives, followed by the column listing the items/questions. The criteria column is also included, which is particularly useful during the interview process, as well as the indicators column, which plays a key role during the content analysis phase—both of which are highly valuable in these two critical stages of the interview-based inquiry. Finally, the last column presents the authors and/or legal frameworks that underpin the preceding content.

Following the validation process by the panel of reviewers, a pilot interview was conducted on 26 May 2023, with a natural sciences teacher from the 3rd cycle of basic education, who has been teaching at the same school in the Lisbon district for 27 years. During the semi-structured interview, which lasted 85 min, the script proved to be a robust instrument, enabling an intuitive and comprehensive collection of qualitative data. Additionally, the instrument also demonstrated its effectiveness in facilitating the content analysis process of the collected data, owing to the clear definition of its objectives, criteria, indicators, authors, and legal frameworks—elements supported by an SLR on the state of the art of PW in science education. For the reasons outlined above, this interview script is considered suitable for holistically analysing natural sciences teachers' perceptions of PW in their daily teaching practice, whether individually or in an integrated manner.

Finally, and as previously mentioned, the complete and final version of this qualitative data collection instrument is included as a Supplementary File to the main body of this manuscript (see Supplementary File S1—Qualitative Data Collection Instrument).

Table 8 summarises the dimensions of the qualitative data collection instrument, identifying the authors and regulations that underpinned its objectives, questions, criteria, and indicators.

Table 8. Dimensions and Theoretical Foundations of the Qualitative Data-Collection Instrument.

Dimensions	Authors/Regulations
1. Conceptual dimension	(Abrahams & Reiss, 2012) (Abrahams et al., 2014) (Abrahams et al., 2013) (Adamu & Achufusi-Aka, 2020) (Akuma & Callaghan, 2019) (Anza et al., 2016) (Costa et al., 2022) (Danmole, 2012) (DGE, 2018a) (DGE, 2018b) (DGE, 2018c) (di Fuccia et al., 2012) (Dourado, 2001) (Erduran et al., 2020) (Fadzil & Saat, 2019) (Ferreira & Morais, 2014) (Hamza & Wickman, 2013) (Harrison, 2016) (Itzek-Greulich & Vollmer, 2017) (Karpin et al., 2014) Kennedy (2013) Köksal (2018) (Leite, 2001)

Table 8. *Cont.*

Dimensions	Authors/Regulations
1. Conceptual dimension	(Lowe et al., 2013) (Malathi & Rohini, 2017) (Mamlok-Naaman & Barnea, 2012) (Martins et al., 2017) (Musasia et al., 2012) (Oguoma et al., 2019) (Oyoo, 2012) (Phaeton & Stears, 2017) (Pols et al., 2021) (Preethlall, 2015) (Ramnarain & de Beer, 2013) (Ruparanganda et al., 2013) (Sharpe & Abrahams, 2020) (Šorgo & Špernjak, 2012) (Toplis, 2012) (Viswarajan, 2017) (Wei & Liu, 2018) (Wei & Li, 2017) Wei et al. (2019) (Wilson, 2018) (Xu & Clarke, 2012)
2. Limitations dimension	(Abrahams & Reiss, 2012) (Abrahams et al., 2014) (Abrahams et al., 2013) (Adamu & Achufusi-Aka, 2020) (Akuma & Callaghan, 2019) (Anza et al., 2016) (Babalola et al., 2020) (Danmole, 2012) (di Fuccia et al., 2012) DGE (2018a) DGE (2018b) DGE (2018c) (Erduran et al., 2020) (Fadzil & Saat, 2019) (Hamza & Wickman, 2013) (Harrison, 2016) (Itzek-Greulich & Vollmer, 2017) (Karpin et al., 2014) (Kennedy, 2013) (Köksal, 2018) (Lowe et al., 2013) (Malathi & Rohini, 2017) (Mamlok-Naaman & Barnea, 2012) (Martins et al., 2017) (Musasia et al., 2012) (Oguoma et al. (2019) (Oyoo, 2012) (Phaeton & Stears, 2017) (Preethlall, 2015) (Ramnarain & de Beer, 2013) (Ruparanganda et al., 2013) (Sharpe & Abrahams, 2020)

Table 8. *Cont.*

Dimensions	Authors/Regulations
2. Limitations dimension	(Šorgo & Špernjak, 2012) (Tesfamariam et al., 2014) (Toplis, 2012) (Viswarajan, 2017) (Wei & Li, 2017) (Wei & Liu, 2018) (Wei et al., 2019) (Wilson, 2018)
3. Advantages dimension:	(Anza et al., 2016) (Babalola et al., 2020) (Bohloko et al., 2019) (Fadzil & Saat, 2019) (Itzek-Greulich & Vollmer, 2017) (Kennedy, 2013) (Köksal, 2018) (Martins et al., 2017) (Mkimbili & Ødegaard, 2019) (Musasia et al., 2012) (Musasia et al., 2016) (Oguoma et al., 2019) (Pols et al., 2021) (Portugal, 2018a) (Portugal, 2018c) (Ramnarain & de Beer, 2013) (Shana & Abulibdeh, 2020) (Šorgo & Špernjak, 2012) (Tesfamariam et al., 2014) (Wei & Liu, 2018) (Wilson, 2018)
4. Evaluative dimension	(Abrahams & Reiss, 2012) (Abrahams et al., 2014) (Abrahams et al., 2013) (Akuma & Callaghan, 2019) (Andersson & Enghag, 2017) (Costa et al., 2022) (DGE, 2018a) (DGE, 2018b) (DGE, 2018c) (di Fuccia et al., 2012) (Fadzil & Saat, 2019) (Hamza & Wickman, 2013) (Harrison, 2016) (Itzek-Greulich & Vollmer, 2017) (Martins et al., 2017) (Musasia et al., 2012) (Pols et al., 2021) (Portugal, 2018c) (Preethlall, 2015) (Sani, 2014) (Sund, 2016) (Viswarajan, 2017) (Wilson, 2018)

Table 8. *Cont.*

Dimensions	Authors/Regulations
5. Operationalisation dimension	(Costa et al., 2022) (Davies et al., 2020) (DGE, 2018a) (DGE, 2018b) (DGE, 2018c) (Holbrook et al., 2020) (Martins et al., 2017) (Portugal, 2018b) (Portugal, 2018c)
6. Textbook dimension:	(Costa et al., 2022) (DGE, 2018a) (DGE, 2018b) (DGE, 2018c) (Martins et al., 2017)
7. Curricular dimension	(Adamu & Achufusi-Aka, 2020) (Bonito et al., 2014a) (Bonito et al., 2014b) (Costa et al., 2022) (DGE, 2018a) (DGE, 2018b) (DGE, 2018c) (Donnelly et al., 2013) (Martins et al., 2017) (Phaeton & Stears, 2017) (Šorgo & Špernjak, 2012) (Tesfamariam et al., 2014) (Viswarajan, 2017) (Wei & Liu, 2018) (Wei et al., 2019)

Note. Created by the authors.

4. Discussion and Conclusions

The development of this qualitative data collection instrument aims to contribute to the characterisation of the dynamics of practical work across seven distinct dimensions, all of which are incorporated into the interview guide, the construction and validation process of which is presented in this manuscript. Designed to interview natural sciences teachers in the 3rd cycle of basic education, the instrument is intended to support the in-depth collection of teachers' accounts, thereby contributing to the grounding of policies, curriculum guidelines, the optimisation of school administration, and the promotion of collaborative practices that enhance the effectiveness and sustainability of practical work in natural sciences education with young students.

This study does not seek to generalise data concerning the acceptability and consistency of the interviews. Instead, it focuses on describing the design and validation process of the qualitative data collection instrument, carried out through expert review and pilot testing. The validation process involved assessment by five experts from four Portuguese public universities, which ensures the survey's credibility and scientific rigour. None of the experts involved in reviewing this qualitative instrument is affiliated with the authors' university or engaged in joint projects, thereby eliminating any potential conflicts of interest. At this stage, the data are used to confirm the instrument's clarity, reliability, and internal consistency, rather than to draw conclusions that can be extrapolated to broader populations. The methodological emphasis lies in validating and consolidating the tool, not

in generalisation. Future research may include broader and more quantitative validation of this instrument.

For a holistic discussion of the results, it is also highly relevant to establish a general characterisation of the qualitative data collection instrument, with particular emphasis on its potential. Accordingly, the following considerations can be made: (a) It is a robust instrument that enables the collection of data across seven dimensions of practical work dynamics in the natural sciences subject of Lower Secondary Education. (b) It subsequently facilitates the process of content analysis, supported by its clearly defined criteria and indicators. (c) It contributes to the analysis of teachers' perceptions regarding their individual pedagogical practice and may be particularly useful in processes of self-assessment and peer evaluation. (d) It also supports the analysis of teachers' perceptions of their pedagogical practice in interaction with colleagues and the broader educational community, offering valuable insights into the dynamics of practical work in natural sciences education.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/youth6010010/s1. The complete and final version of the qualitative data collection instrument is included as a supplementary file to the main body of this manuscript (see Supplementary File S1—Qualitative Data Collection Instrument). The reference list in the main article fully incorporates all citations from the Supplementary File.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The original contributions presented in this study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

ELs	Essential Learnings
IPA	Interpretative Phenomenological Analysis
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
PW	Practical Work
SLR	Systematic Literature Review
SPECS	Student Profile at the End of Compulsory Schooling

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