

Guiding principles for investigating one's own practice: a model for basic education teachers

Principios rectores para investigar la propia práctica: un modelo para docentes de educación básica

Principes directeurs pour l'investigation de sa propre pratique : un modèle pour les enseignants de l'éducation de base

Princípios de orientação para investigar a própria prática: um modelo para professores da Educação Básica

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Abstract

The objective of this article is to provide a model with guiding principles for Basic Education teachers to conduct research into their own classroom practices. The model incorporates elements that are already present in common teaching practices, such as tasks, records, student productions, and reflection on practice. However, it also proposes a level of research intentionality that, in our opinion, renders these practices investigative. In order to demonstrate the application of our guiding principles model, we examined instances of authentic practice of a teacher-researcher who initiated investigations into his own practice. The teacher-researcher implemented exploratory teaching in their classes and explored the concept of symmetry to articulate algebra and geometry in a 9th grade public school class, in the state of São Paulo. The analysis of instances of the teacher-researcher's research enabled us to determine how the indicators in our guiding principles model could be identified within classroom research. This

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revealed signs that the model could potentially serve as a parameter for other teachers to conduct investigations into their own practices, thereby promoting practical wisdom and professional development based on classroom practice.

Keywords: *Investigation of the practice itself; practical wisdom; mathematics education; teacher training; investigative posture.*

Resumen

Este artículo tiene como objetivo presentar un modelo de principios rectores para que los docentes de Educación Básica realicen investigaciones sobre sus propias prácticas en el aula. El modelo implica el uso de elementos ya presentes en las prácticas docentes comunes (uso de tareas, registros de producciones de los estudiantes y reflexión sobre la práctica), sin embargo, con una propuesta de intencionalidad investigativa que las convierte, a nuestro entender, en prácticas investigativas. Para ilustrar el uso de nuestro modelo de principios rectores, analizamos episodios de práctica genuina de un profesor-investigador que se propuso realizar investigaciones sobre su propia práctica, adoptando la enseñanza exploratoria en sus clases e investigando el concepto de simetría para el álgebra articular y la geometría en una clase de noveno grado de una escuela pública del estado de São Paulo. El análisis de los episodios de la investigación del docente-investigador nos permitió identificar cómo los indicadores presentes en nuestro modelo de principios rectores podrían ser identificados en una investigación de aula, revelando aquellos que tienen potencial para que el modelo sirva a otros docentes. como parámetro para la realización de investigaciones sobre las propias prácticas, favoreciendo la promoción de la sabiduría práctica y el desarrollo profesional a partir de la práctica presencial.

Palabras clave: *Investigación de la propia práctica; Sabiduría práctica; Educación matemática; Formación de profesores; Postura investigativa.*

Résumé

Le but de cet article est de discuter de la recherche de sa propre pratique effectuée par un enseignant de l'éducation de base dans sa classe et, en s'appuyant sur la littérature en conjonction avec les pratiques de recherche, de proposer un modèle de principes directeurs pour la recherche de sa propre pratique en mettant l'accent sur l'enseignant de l'éducation de base, visant à la promotion de la sagesse pratique. L'étude présentée ici est de nature qualitative, dans une perspective interprétative. Les analyses sont effectuées en identifiant le lien entre les éléments de *tâche*, de *dossier* et de *réflexion*, présents dans la pratique d'un enseignant de l'éducation de base et utilisés avec des intentions de recherche. Les résultats indiquent que les

réflexions fournies à l'enseignant-chercheur par la recherche de sa propre pratique basée sur l'utilisation de fiches de tâches exploratoires, ont contribué au raffinement de la pratique et de l'apprentissage de l'enseignant en classe, favorisant la sagesse pratique et le développement professionnel. De cette manière, il est conclu que l'utilisation du modèle de principes pour guider la recherche de sa propre pratique a un grand potentiel pour être reproduit dans la classe d'autres enseignants en encourageant la recherche de sa propre pratique qui peut favoriser la promotion de la sagesse pratique. en articulation avec l'expérience et la théorie.

***Mots clés:** Enquête sur la pratique elle-même; Sagesse pratique; Enseignement des mathématiques; Formation des enseignants; Posture d'investigation.*

Resumo:

Este artigo tem como proposta apresentar um modelo de princípios de orientação para que professores da Educação Básica realizem pesquisas em suas próprias práticas em sala de aula. O modelo envolve o uso de elementos já presentes em práticas comuns de ensino (uso de tarefas, registros de produções dos estudantes e reflexão sobre a prática) porém, com uma proposta de intencionalidade de pesquisa que os tornam, em nosso entendimento, como práticas investigativas. Para ilustrar o uso de nosso modelo de princípios de orientação, analisamos episódios de prática genuínos de um professor-pesquisador que se propôs a realizar investigações em sua própria prática, adotando o ensino exploratório em suas aulas e investigando o conceito de simetria para articular álgebra e geometria em uma turma de 9º ano de escola pública no litoral do estado de São Paulo. A análise dos episódios da pesquisa do professor-pesquisador nos permitiu identificar como os indicadores presentes em nosso modelo de princípios de orientações puderam ser identificados em uma pesquisa em sala de aula, desvelando indícios de que possuem potencial para que o modelo sirva para que outros professores possam utilizar como parâmetro para a realização de investigações em suas próprias práticas, favorecendo a promoção da sabedoria prática e o desenvolvimento profissional com base na prática em sala de aula.

***Palavras-chave:** Investigação da própria prática; Sabedoria prática; Educação matemática; Formação de professores; Postura investigativa.*

Guiding principles to investigate one's own practice: a model for Basic Education teachers

Research in education has increasingly recognized practice as the basis for teacher education, whether initial or continuous, thus subverting the traditional logic of theory *versus* practice to a new conception that looks into practice to find possibilities for professional development and learning (Webster-Wright, 2009; Marcondes, 2013; Fiorentini & Crecci, 2017). However, this understanding of the need for practice to understand practice is not a novel idea. Freire (1991), used to state the following about teacher practice and training:

No one begins their career as an educator on a given Tuesday at four o'clock in the afternoon. Being an educator is not an innate trait nor a predetermined destiny. We embrace the role of educators and undergo training as educators, consistently engaging in practice and deliberate reflection on our practice (Freire, 1991, p. 58).

From this maxim it is evident that training does not conclude upon completion of a degree; rather, it is built in conjunction with the experiences and reflections of classroom practice (LAMPERT, 2010) in an effort to evaluate the efficacy of their practices, professionals should be able to reflect on their own actions (SCHÖN, 2000) This underscores the significance of critical reflection and learning through experience (Ball & Cohen, 1999) in the development of reflective professionals.

It has been noted that reflections on practice can be obtained through investigations on the teaching practice itself (Alarcão, 2001; Ludke, 2001; Marin, 2014). This involves viewing the classroom as a research laboratory where classes are conducted as experiments to be examined, explored, and analyzed in order to develop teaching knowledge and enhance learning (Lima & Nacarato, 2009; Anderson & Herr, 2016). In this respect, the adoption of an investigative approach by teachers (Cochran-Smith & Lyttle, 2009) can also contribute to their professional autonomy and strengthen their role as producers and not just consumers of knowledge (Taylor, 2017). Thus, the aim is to encourage teachers to become active participants in discussions involving the guidelines for their own work, going beyond merely technical aspects so that they can counter the influence of the neoliberal policies that have dictated the direction of education (Lopes & Cáprio, 2008; Freitas, 2012; Favero & Passinato, 2020).

In light of this scenario and considering the fact that teachers are already overburdened by workload demands, our study included questionings about (i) *which strategies can be used, and which obstacles are faced by Basic Education teachers when performing investigations in their own practice?* and (ii) *how a guiding model for investigations of one's own practice can contribute to continuous professional qualification and development of Basic Education teachers?* The purpose of these questions is to operationalize the objective of this article, which is to *identify and map the research practices of a teacher and develop a guiding model that contributes to the investigative practices of Basic Education teachers.*

To help gather the supporting arguments to achieve the aforementioned objective, the following section presents the conceptual elements for the model of guiding principles of research on one's own practice. Subsequently, under the light of the academic literature, we discuss how the elements of our model connect to each other in an attempt to take the research into the classroom of a Basic Education teacher. Finally, we present the investigative practices of a Basic Education teacher in conjunction with our model and conclude with the remaining unanswered questions and providing suggestions for further research.

The Guiding Principles Model

Teachers encounter several demanding scenarios that necessitate prompt and efficient decision-making while performing their duties in the classroom (Loughran et al., 2016). While these decisions are common in daily teaching, they are not automated. This is because each new group of students presents unique characteristics, difficulties, and challenges that require effort beyond simply applying predetermined teaching methods (Ponte & Serrazina, 2004; Lampert, 2010). However, what specific knowledge and skills should teachers acquire through their education in order to effectively navigate the difficulties presented by the classroom environment?

Shulman (1987) identified four major sources of knowledge for teaching: appropriate qualifications in the field; educational structures and materials; formal academic training in education; and *wisdom of practice*. From such sources, the author empathizes the importance of further studies on the *wisdom of practice*, which is "the wisdom acquired through practice

itself, the maxims that guide (or provide) reflective rationalization for the practices of competent teachers" (Shulman, 1987, p. 11).

Lunenberg and Korthagen (2009) distinguish practical knowledge used by teachers in the classroom from formal, abstract, and generalized knowledge that researchers systematize. They define *practical wisdom* as “the sensitivity and awareness of the fundamental aspects of a specific practical situation, which influence our perception of the situation and aid in identifying potential actions” (Lunenberg & Korthagen, 2009, p. 227). The authors argue that theoretical knowledge is crucial for cultivating practical wisdom. However, they emphasize that information must be integrated with real-life experience. This integration enables teachers to comprehend the significance of theory in their practice and ultimately cultivate practical wisdom. The authors propose a triangle interaction (Figure 1) between teachers, who are at the center, and the three elements. The teachers have the ability to either connect or not these aspects, depending on their professional development.

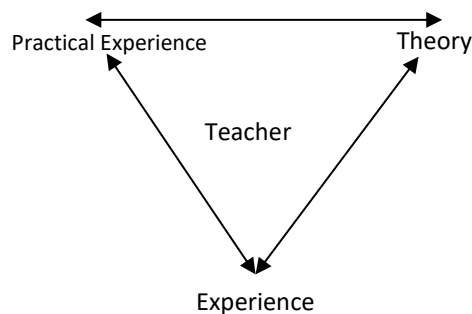


Figure 1

Triangular Model (Lunenberg & Korthagen, 2009)

Lunenberg and Korthagen (2009) argue that the shift in teacher training towards valuing classroom experiences over the traditional approach of theory and practice has resulted in a more profound comprehension of how to cultivate practical wisdom in teacher education. In order to achieve this goal, the authors provide effective methods to enhance practical wisdom in teacher training by integrating theoretical knowledge with practical experience. Such methods include using authentic case studies, engaging in thorough reflection, and encouraging self-study. Lunenberg and Korthagen (2009) address these three techniques individually, drawing on multiple research that indicate their efficacy in fostering practical wisdom derived

from experience. Thus, Lunenberg and Korthagen (2009) incorporate teacher practice into the discussion regarding fostering practical wisdom within teacher education.

This article suggests a shift in perspective, by transitioning from *training for practice* into training within practice. Specifically, rather than addressing the conflict between theory and practice, we suggest connections between theory and practice that promote professional learning. The aim is to promote practical wisdom that is based on the cases, reflections, and self-study of Basic Education teachers. In this regard, we suggest that we investigate these three methodologies (authentic cases, detailed reflection, and self-study) in a unified manner within our model, with the objective of identifying correlations and experiences in the practice of Basic Education teachers.

In this context, Loughran (2004) states that the origins of *self-study* lie in the work of teachers and teacher educators in their attempts to gain deeper understanding of the complex world of teaching and learning, with the advantage of teaching future teachers using methods and approaches that they themselves can use in their practice. Among the various meanings that *self-study* encompasses, in our model we are interested in the *investigation of one's own practice*, which, as Loughran (2004) ponders, "contributes to the focus on improving knowledge about teaching and student learning" (p. 9).

In an article addresses the *examination of one's own practice*, Ponte (2002) highlights that this research approach emphasizes the notion that it involves an advantageous process of knowledge construction which:

[it] is, therefore, a fundamental process of construction of knowledge regarding this same practice and, as a result, a highly valuable activity for professional development of teachers who are actively engaged in it (Ponte, 2002, p. 3).

In this sense, the investigation conducted by teachers using their own practices as a context for research has been identified as a legitimate process of knowledge production (Anderson & Herr, 2016; Lüdke, 2001). In line with the understanding of Lunenberg and Korthagen (2009) about *self-study*, we consider it as a means to foster *practical wisdom* in our model which includes *guiding principles for researching one's own practice* (Figure 2).

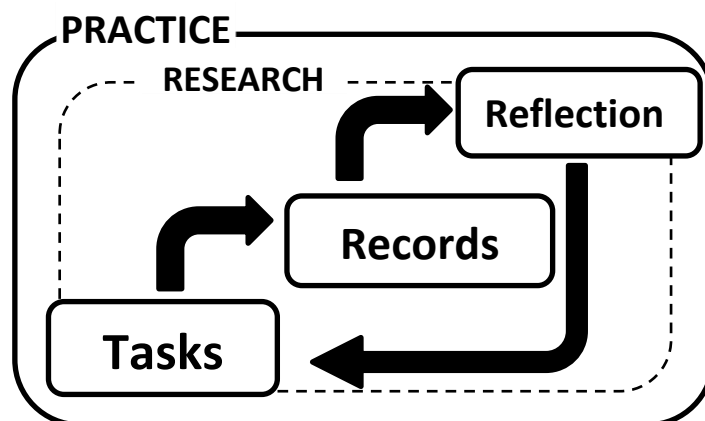


Figure 2

Model of guiding principles for researching one's own practice (The authors, 2023)

Given the objective of this article, which is to propose a model incorporating research into practice of Basic Education teachers, considering the various demands of professionals already overburdened by an intense workload, it is important to highlight guiding principles that prioritize conducting research within the classroom rather than simply using research findings in the classroom. This approach is based on an investigative methodology (Cochran-Smith & Lytle, 1999; 2009). The aim is to incorporate research into the classroom practices of Basic Education teachers, as shown in Figure 2, as steps that lead from practice to reflection, in order to provide opportunities for professional learning (Webster-Wright, 2009; Opfer & Pedder, 2011).

Although there is a distinction in the literature between the knowledge and purposes of research carried out by academics and research carried out by teachers in their classrooms, authors such as Ball (2000) and Loughran (2019) emphasize the significance of practical knowledge that is unique to teachers, which is distinct (but equally important) from academic knowledge, while recognizing the role of classroom research in developing this knowledge (Lima & Nacarato, 2009). From this perspective, we outline the essential components necessary to incorporate research principles into classroom investigative practice.

As Alarcão (2001) points out, the idea of teachers investigating their own practices had already been proposed in the 1960s, but the "teacher-researcher" term became widespread with the work of the English educationalist Stenhouse (1975 - 1981), who considered the perceptions

and experiences of teachers in order to reflect on a curriculum that met the needs of young students at the time. Conversely, according to Fagundes (2016), the concept of *reflection-in-action* and *reflection-on-action* (Schön, 1983;1992) which, although it did not necessarily deal with teachers, would gain prominence as a consequence of being widely accepted by other researchers, including Nóvoa (1992), when discussing the reflective teacher. In this regard, we incorporated the *reflection* component in our model (Figure 2), as an element of classroom practice which, in line with Lunenberg and Korthagen's (2009) perspective, contributes to the construction of *practical wisdom*.

However, as Ponte (2002) emphasizes, when dealing with the investigation of one's own practice, the mere act of being reflective is insufficient to qualify as a researcher when investigating of one's own practice. This understanding informs the manner in which reflection is implemented in an investigative practice in the classroom, where the focus is on teacher learning in order to enhance their practice. Thus, we seek to highlight the elements that provide opportunities for this reflection for research, and we emphasize the role of *classroom records* as data to be analyzed to facilitate reflection *about / from* teaching (Ball, Ben-Peretz & Cohen, 2014; Doerr, 2006).

In this context, the classroom presents itself as a rich environment that enables the teacher to produce records that are integral to their practice, and encompass a broad range of information, including the manner which teaching occurs, the students' perception of it, and the knowledge teachers acquire, thereby enabling them to re-signify their knowledge (Gonçalves, Ribeiro & Aguiar, 2022). Consequently, students' productions, teachers' lesson plans and possible video recordings can reconstitute various teaching cases, which Lunenberg and Korthagen (2009) regard as promising to develop *practical wisdom*. They are included in our model as the *records* component among the classroom elements of Basic Education for the construction of investigative practice.

As highlighted above, when contemplating the routine of Basic Education teachers and how such data collection could be promoted, we found that the *Tasks* given by teachers to their students are a natural way to subsidize this data collection, and the third component of our model (Figure 2). Through tasks, students are invited to express their ideas (Ponte, 2005); both

teachers and students are offered different opportunities to learn the content (Stein & Smith, 1998) (Arbaugh & Brown, 2006; Boston & Smith, 2009). However, the task alone does not guarantee discussions or even learning; the role of the teacher at the forefront of teaching is fundamental, hence the importance of intentions regarding tasks, from lesson planning to its use throughout teaching (Stein et al., 2008; Serrazina, 2017).

Our model of *guiding principles for research on one's own practice* (Figure 2) suggests a distinct intentionality to utilize elements that are already a part of the teacher's practice, but with the intention of conducting research, as tools that comprise *investigative practices*, by combining the three components of Task, Records, and Reflection. The objective is to show that such elements, as well as being resources with pedagogical intentions, are also powerful data collection tools with significant potential to include research into the classroom and thus subsidize research on one's own practice.

The subsequent section will address the theoretical refinement of each component of the model and its practical application in a classroom environment that prioritizes research.

Theoretical basis of the model and indicators

References and discussions about Tasks

The first component of our *model of guiding principles for research on one's own practice* (Figure 2) is *Tasks*. This component refers to the role of tasks as tool within classroom teaching practices and their potential for researching one's own practice as an *investigative practice*. In this regard, we share the understanding of Serrazina (2017) who highlights the role of tasks in classroom teaching practices as the elements around which a lesson develops. According to Serrazina (2017), lesson planning begins with the teacher selecting or preparing a task. It is from this choice or preparation that the objectives of the lesson and the intended learning to be achieved by students is determined. In this sense, selecting the task is a critical moment in which teachers must anticipate students' and their own actions, the activities students can get involved in throughout the lesson, as well as how the content will be made available in relation to other topics and content.

In this context, according to Ponte (2005), choosing tasks for lessons is a critically important moment for student learning, as a task appropriate to the context of the lesson, the particularities of the students and the content, can give teachers deeper insights into the students' ideas about the content, and involve the students in activities that lead to reflection on their own learning. However, in this respect, Ponte (2005) points out that for learning to take place just selecting a good task is not enough; he ponders that:

The process of construction of knowledge is influenced by the role assigned to students: either to acquire knowledge in a structured and ordered manner, or to independently explore and discover, with guidance from the teacher and in collaboration with their peers. (Ponte, 2005, page 23)

When discussing the various configurations that a task may have, Ponte (2005) suggests two dimensions, namely the degree of challenge and the degree of structure. The *degree of challenge* involves the perceived difficulty with which the questions in a task can be gauged. These can vary from a low level of challenge to a high level of challenge. The *degree of structure* refers to the amount of information students have in order to complete the task and the ways in which the result can be reached, varying between closed and open.

Ponte (2005) states that closed tasks are exercises and problems. Exercises are considered low-level, generally used to train rules or formulae, while problems present a higher level of challenge, requiring students to employ strategies beyond formulas or rules to solve them. On the other hand, exploration and investigation tasks are considered open-ended tasks because of the variety of possibilities that students can use to solve them, using different strategies and not simply applying algorithms.

As stated by Ponte (2005), exploration tasks involve a low-level of challenge whereas investigation tasks involve a high-level of challenge. In this regard, Boston and Smith (2009) agree on the significance of tasks, highlighting their impact on student learning by underscoring that students are frequently engaged in task-based activities during lessons. Those authors emphasize the importance of tasks that are highly challenging in order to provide students with a genuine opportunity to demonstrate their knowledge and the methods by which they acquired it. To this end, the tasks should afford students contact with the concepts they are expected to

learn about, and teachers should lead the discussions on the tasks so that the challenge level is maintained throughout the lesson.

From this perspective, Arbaugh and Brown (2006) emphasize that involving teachers in the selection of tasks that are cognitively challenging contributes to both the professional development of teachers and to the improvement of student learning. For these authors, it is crucial that teachers increase their knowledge about the levels of challenge of tasks, their configurations and implementation in the classroom, so that this provides teachers with greater knowledge about teaching and its particularities and serves as a catalyst for the transition from traditional practices into a student-centered teaching and learning process.

Thus, in addition to its pedagogical use and teaching intentions, we underscore the role of the Task (T) component as an element that is an integral part of the classroom and its development within teachers' routines. We also consider research intentions as an investigative practice in an investigation of one's own practice. We highlight the potential of selecting challenging tasks (Arbaugh & Brown, 2006) and the use of exploratory tasks (PONTE, 2005), which maintain their cognitive demand (Boston & Smith, 2009), in classroom discussions and which can provide the teacher with greater feedback on classroom learning when using our *model of guiding principles for teacher research*.

References and discussion about Records

Far beyond being a resource for assessment, the notes and resolution strategies with which students respond to the tasks proposed can reveal a lot about what students think about the content and how they understand the teaching conducted by teachers. Similarly, the teachers' strategies for teaching the content, the way in which they propose tasks, and the notes in their lesson plans can be records of how classroom practices have been conducted in different contexts, at different locations. Shulman (1987) had already pointed out that teaching, as a professional occupation, lacks a collective memory of effective teacher practices in the classroom that can serve as guide for other teachers, just as case records in medicine guide doctors in their diagnoses, or the best creations in architecture which are recorded in the architects' own productions.

Shulman (1987) states that there is a lot of knowledge in the practices of teachers in their lessons and this knowledge, when recorded through tasks, strategies and actions, significantly contributes to compendium of cases which, in turn, can provide deeper insights regarding the wisdom of practice. According to Ball, Ben-Peretz and Cohen (2014), improved teacher learning is linked to the need to develop knowledge that can be used in practice and reinforce the role of records of practice as a means of preserving and disseminating such knowledge, so that it can contribute to the professional learning and education of teachers.

Ball et al. (2014) point out that keeping records has always been part of teachers' work, whether about student participation, lessons, teaching strategies or the students' own productions. Nevertheless, the authors emphasize such records are created primarily for the purpose of documenting work and are not intended to serve as a source of professional development. Therefore, it should be emphasized that the teacher's choices, preparation or adaptation of tasks, the way in which they decide to implement the tasks in their classes according to their lesson plans, the students' responses, among others, constitute rich records that can inform the teachers themselves about the strategies that might work or not in their practices, contributing to learning more about the profession.

It is crucial to acknowledge that while recordings of practice closely resemble what the teacher does in the classroom, Ball et al. (2014) emphasize that each record is still partial, capturing only a portion of the practice and excluding other aspects. In this context, the use of video offers significant possibilities for capturing classroom activities and has been increasingly utilized in educational research, as highlighted by Chan, Mesiti and Clarke (2019) in a study discussing the potential of this resource. For these authors, video recordings of classroom practices can provide different perspectives, which are represented by Chan et al. (2019) as metaphors of a window, lens or mirror. Concerning the window metaphor, the authors highlight the use of video as a resource for researchers to observe the activities taking place inside teachers' classrooms. The lens metaphor symbolizes the amplification of a particular aspect of the lesson that is being emphasized, while the use of video as a mirror aims to prompt teachers to contemplate their teaching methods by watching videos of their own courses.

Sharing this understanding, Gonçalves, Ribeiro and Aguiar (in press) used video recordings made with a teacher-researcher's own cell phone to record their intentions and perceptions both before and after exploratory classes, constituting a set of data the authors called "self-recordings". From that set of video recordings, the teacher-researcher created a virtual diary which, together with the students' tasks and productions, allowed them to revisit their teaching experience and reflect on the actions recorded on video, thus providing an opportunity to learn about their own practice.

Finally, the *Record* component reveals its place in our *model of guiding principles for research on one's own practice* (Figure 2), highlighting that the intentional use of this resource, present in teachers' daily lives and included as an *investigative practice*, can significantly contribute to teachers' professional development through investigation of their own practice.

References and discussion about Reflection

The Reflection component in our *model of guiding principles for research on one's own practice* (Figure 2) might be interpreted as the final stage of a staircase, representing the objective of our model: to provide teachers with the opportunity to contemplate their own practice. However, even though we use the metaphor of a stairway in our model, our intention is to propose a greater familiarity with a cycle, considering that in providing opportunities for reflection we must return to the beginning of the process and reformulate it, thus increasingly refining practice in cycles of learning and reflection, in a society increasingly immersed in information but lacking in guidance. This constant reformulation is in line with what Alarcão (2022) describes as the information society characterized by a shift in the role of teachers. Instead of being the exclusive holders of knowledge, they now function as "helmsmen" who aid students in navigating the vast amount of information they encounter.

Although the capacity for reflection is something inherent to individuals, Alarcão (2022) points out that developing this capacity requires "contexts, freedom, dialog and responsibility" (p. 38). In line with this understanding, we use the *model of guiding principles for research on one's own practice* (Figure 2) to help ensure that the classroom context is also an environment that fosters reflection through the use of tasks and records with the intention of researching the practice of Basic Education teachers.

In contrast, Lunenberg and Korthagen (2009) acknowledge the importance of contemplation in acquiring *practical wisdom* and its connections with theory and classroom

experience. The authors argue that reflection should be thorough, focusing on specific elements and aspects, in order to enable teachers to cultivate *practical wisdom* and a keen awareness of the unique characteristics of educational situations. Simultaneously, Alarcão (2022) emphasizes that learning through reflective practice is a transformative process that begins with a specific experience and facilitates reflection, leading to conceptualization and new experimentation.

In this sense, the work of Schön (1983) pioneered in identifying the importance of considering the knowledge constructed in action shaping what the author called the reflective practitioner. Schön further developed this notion by introducing the concepts of "reflection in action" and "reflection about action" in his later work.⁴ According to Schön (1992), there is a tacit, intuitive knowledge that guides the actions of professionals. When faced with conflicting or complex situations that require new insights, professionals engage in reflection on their actions and find resolution. This type of reflection, which arises in the immediacy of the action, was identified by Schön (1992) as *reflection-in-action* and can be associated with the times when a teacher is faced with an unexpected solution proposed by a student or even a question the teacher had not thought of, i.e., involving the element of surprise.

Additionally, reflection can occur in circumstances that are farther distant from the immediate occurrence of acts. These contexts can be derived, for example, by the examination of the records of a task, or even by planning a lesson that considers the actions that have taken place in previous lessons. In this case, Schön (1992) calls the act of reflecting about times removed from the immediacy of action, *reflection on the action*. This process can contribute to finding solutions to problems in practice by drawing on experience from lessons learned from a conflicting situation, for example.

At the same time, Lunenberg and Korthagen (2009) distinguish this type of practical knowledge teachers employ in the classroom from formal, more abstract and generalized knowledge that is systematized by researchers. They define *practical wisdom* as "the sensitivity and awareness of the fundamentals of a particular practical situation that shape our perception of such situation and help us find possible courses of action" (Lunenberg & Korthagen, 2009, p. 227). According to these authors, theoretical knowledge is important for fostering practical wisdom; however, however, they emphasize that this knowledge needs to be articulated with experience in order that educators comprehend the significance of theory in their practice and can thus develop practical wisdom. This way, the authors envision the connections between

⁴ There is a third "type" of reflection, the "reflection about the reflection in action," which will not be analyzed herein because it is beyond the scope of this article.

these three elements in a triangular relationship (Figure 1) in which teachers, at the center, are able to unify them or not, contingent upon their professional development.

From this standpoint, the significance of records (Ball et al., 2014) to encourage reflection on action is underscored, as it contributes to a more comprehensive understanding of the specifics of teaching and, as a result, the cultivation of practical wisdom, as noted by Lunenberg and Korthagen (2009). It is also crucial to emphasize the significance of using tasks that provide greater detail on students' responses to the content being studied in order to acquire more elements for subsequent reflection. In this regard, Arbaugh and Brown (2006) contribute to this understanding by pointing out that teachers can enhance their knowledge and modify their teaching practices by acquiring a deeper understanding of the cognitive challenge levels of tasks and utilizing this knowledge to select and implement tasks in a manner that maintains a high level of challenge.

Similarly, Doerr (2006) observes that teachers can have more profound understanding with the students' reasoning by using tasks that give students the opportunity to express their ideas. This, in turn, enables teachers to reflect on their assessment practices. Doerr emphasizes that the teachers' greater engagement with the strategies and reasoning demonstrated by students contributes to the development of teaching and assessment practices that are based on guidelines that prioritize the interpretation of the students' ideas and negotiation of meaning, rather than practices that focus on mere identification and correction of student error.

Thus, the *Reflection* component in our model of *guiding principles for research on one's own practice* (Figure 2) considers that *reflection-on-action* (Schön, 1992) can benefit from practice records (Ball et al., 2014), while *reflection-in-action*, by considering the tasks that teachers use (Arbaugh & Brown, 2006), contributes to a greater diversity of student responses and, as a consequence, more contact between teachers and their students' thinking (Doerr, 2006), leading to reflections about their practices and about teaching.

Methodology

The manner the use of tasks, student records and reflection can be used in an investigative practice in the classroom motivated us to explore these three elements based on the review of the literature described in the previous section, and with a view to systematizing a model of guiding principles for research in the classroom. The model was organized by means of Table 01, in which we present indicators on the use of Tasks, Records and Reflection as *investigative practices within an investigation of one's own practice*, considering these elements

in the routine of Basic Education teachers and investigation that promotes *practical wisdom* (Shulman, 1987; Lunenberg & Korthagen; 2009).

The indicators are designed to assist the teacher-researcher in conducting classroom investigations by directing the use of tasks, records, and reflection with intentions that extend beyond pedagogical purposes.

Table 1

Indicators of the model of guiding principles for research on one's own practice (authors, 2023)

Investigative practices	Uses of the Task (Ta)	Uses of the Record (Rc)	Uses of Reflection (Rf)
What we are attempting to identify	How the task can spark discussions that support the understanding of contextualized mathematics in challenging problems	What vestiges of the various dimensions of practice can be provided by the records of tasks in the classroom	How reflection allows confrontation of the teacher's expectations before and after classes.
Indicators	<p><i>The elaboration, adaptation or selection of tasks considers:</i></p> <ul style="list-style-type: none"> - <i>The cognitive demand that considers the level of challenge to the student.</i> - <i>The exploration of content in its diversity of representations.</i> - <i>Students' prior knowledge.</i> 	<p>The records can show:</p> <ul style="list-style-type: none"> - <i>The teacher's intentions in designing and implementing the lesson.</i> - <i>The students' thinking in the face of the challenge of the task.</i> - <i>The complexity of the content.</i> 	<p>Teachers in their reflections:</p> <ul style="list-style-type: none"> - <i>Consider the student's abilities and difficulties</i> - <i>Consider the content in its diversity and depth.</i> - <i>Consider their actions in the face of the particularities of teaching.</i> - <i>Consider the effectiveness of their practices and understanding of teaching.</i>

To illustrate the mapping of how such indicators can be present in an investigation of one's own practice, we will present records of *genuine practice* conducted by the first author of this article. The teacher-researcher, whom we will call TR, conducted the research in a municipal public school in the city of Praia Grande, on the coast of the state of São Paulo, where he taught in 2019. The research was conducted in one of TR's 9th grade classes, for which exploratory activities were created and implemented to emphasize the connection between algebra and geometry through the notion of symmetry. The primary focus of the tasks was on functions and how they are represented.

For these lessons, the TR adopted exploratory teaching for the first time in their teaching practice and utilized more open-ended tasks instead of exercises. The research process involved three lessons, each of which encompassed of three stages: (i) task and lesson planning stage,

(ii) lesson development stage, involving the implementation of the tasks with the students in classroom, and (iii) post-class reflection stage. For each lesson, an exploratory mathematical task was prepared, called MT1, MT2 and MT3. These tasks explored, respectively, the concepts of the *real number line* (MT1 - Appendix A), the *law of formation of functions* (MT2 - Appendix B) and the *graphic representation of functions* (MT3 - Appendix C).

Each stage of the lessons had different types of recordings consisting of (a) *video recordings* made with cameras in the classroom and on the TR's mobile phone (in the planning and reflection stages); (b) *audio recordings* made in the student groups in the classroom, as well as the students' own (c) resolutions to the tasks proposed (both during the lesson development stage). It is crucial to outline that the recordings on the mobile phone of the TR constituted a set of records that we call *self-recordings* (SR); these were critical to understand his intentions in planning and reflecting on the lesson. The *corpus* of data evaluated consists of many types of content, including movies, audios, student creations, and self-recordings.

Table 1 was used as a reference for the analyses proposed here. The table summarizes the discussions on the components of the *model of guiding principles for investigation on one's own practice* (Figure 2). Next, to illustrate the use of the model, we will present excerpts from the research undertaken by TR with which we mapped the *investigative practices* identified while conducting the *investigation on one's own practice*.

Mapping indicators of investigative practices using the guiding principles model in a Basic Education classroom

The following section is divided into three episodes, each dedicated to one of the components that comprise the model of guiding principles for conducting research on one's own practice, namely Reflection, Records, and Tasks. The objective is to elucidate the investigative methodologies employed during the investigation conducted by the TR in their 9th grade elementary school class.

Episode 1: Model investigative practices and task planning

MT1 was designed during the initial planning phase of the first class with the objective of facilitating a meaningful learning sequence. The TR carefully analyzed how the content of the tasks would be interconnected. The indicator "Exploration of content in its diversity of representations" was selected with the purpose of using tasks as a resource to foster discussions and promote the intended learning outcomes. The intentionality of the TR's work is evident in the transcription of the self-recording (SR) which outlines their intentions:

TR: the objective of the first task is to work on the number line. Why? In the list of topics I must work on with my 9th grade classes, I am supposed to work on the graph that has to do with functions and the Cartesian plane. I believe they have to revisit the real number line to understand the Cartesian plane well. (...) I'm also going to take a look at the content for grades before the 9th, "to try to rescue" some idea that could be potentializing, enhanced with symmetry. – **SR. MT1 Planning**

It noteworthy that the TR also proposed to revisit previous content in order to identify students' prior knowledge that could contribute to intended learning. In this intention, the indicator of the use of the task is designated as a way of considering *the students' prior knowledge* (Table 1) in the discussions that the TR would conduct in the classroom.

Although MT1 and MT2 were prepared before the implementation of the first lesson, the self-recording conducted while planning the second lesson (MT2) revealed new intentions regarding the use of the task on the part of the TR. The following transcript illustrates this event:

TR: I modified certain components of the task; however, I maintained the theme. (...) Rather than employing two graphs, I elected to use only one. The objective was to improve the students' ability to articulate their thoughts and give them more time to do so. Additionally, I wanted to allow them to demonstrate their comprehension of the concept we had been working on, which was symmetry in algebraic contexts. **SR. MT2 Planning**

It is crucial to emphasize that the TR's account in the excerpt above demonstrates that the experience with MT1 led them to examine the indicator identified as cognitive demand which takes into consideration the level of challenge to students (Table 1). Even though MT2 (Appendix B) had already been prepared, the TR contemplated modifications to the proposed challenge that could promote learning without creating superfluous obstacles due to the time required to complete the task, considering the discussions they intended to have. Similarly, the TR also provides evidence of the refinement of their intentions toward the tasks, which was influenced by the experience derived from the lesson. This is evident when the TR expresses their choices for the third task (MT3):

TR: I always used this [task] option for them [students] to exercise, (...) this time I will use this option of creating the rhombus as a challenge so that they can discover, through practice, the meaning of the line going up and the line going down; as well as the coefficients. **SR. MT3 Planning**

The intentionality in the use of the task represented by the indicator "*exploration of the content in its diversity of representations*" is revealed in this excerpt from the self-recording (SR) when the TR demonstrates a new view of the task that had already been used on other opportunities as an exercise, which the TR considered adapting for an exploratory approach.

This excerpt examines the particularities of MT3. Additionally, it reveals that the majority of their attention was directed toward the task's specifics, suggesting that they were concerned with the *cognitive demands that consider the level of challenge for students* (Table 1). This is particularly noteworthy in light of the TR's deliberate effort to put themselves in the students' place and predict how they would solve the task.

Episode 2: Model investigative practices and class records

While we emphasize the significance of tasks in acquiring classroom records, it is worth noting that teacher's notes, lesson plans, and self-recordings (SR) also provide equally valuable sources of data for reconstructing the dynamics of the lesson. The use of self-recordings (SR) enabled the identification of how the objectives of the TR were honed through classroom encounters with students. The self-recorded videos using mobile phones, known as self-recordings, constituted a collection of experiences, which resembled a virtual diary. Such recordings provided valuable insights into the role of this recording method as an *investigative practice*, shedding light onto the *teacher's intentions during the development and implementation of the lesson*, as indicated by TR's statements.

The lesson plans and student productions arising from the tasks had a substantial impact on altering the TR's opinion of the direction they could provide for the classes. From the numerous records created in the three classes conducted by the TR, we chose the one featured below as it effectively demonstrates the significant potential of records as *investigative practice* methods.

Questão C: Jandysvaldo, Valtycrêia e Lambarildo foram orientados a praticar exercícios e fazer uma dieta mais saudável tendo com objetivo atingirem até o final do ano um valor de IMC próximo de 22, devendo calcular seus índices (IMC) a cada perda ou ganho de 5kg até atingirem a meta estabelecida. Eles aceitaram o desafio e agora precisam calcular quanto cada um deve ganhar ou perder nesse período e como o IMC evolui até atingir a meta. Ajude-os nestes cálculos.

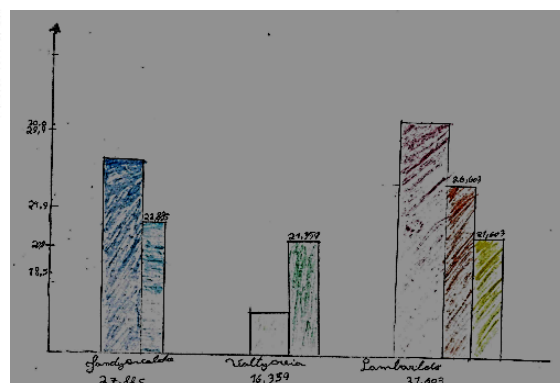


Figure 3

The records presented in Figure 3 compare the solution for MT1 regarding the real number line as anticipated by the TR (on the left), and one of the recurring solutions presented by the students (on the right). The MT1 challenge required a graphical representation of the problem as a solution. It is important to mention that when comparing the lesson plan with the students' work, the TR expected a solution that utilized the real number line, however the students created column charts. This discrepancy in interpretations highlights the depth of these records by exposing the measure of students' cognition in face of the difficulty of the task (Table 1), which influenced the TR's focus on *students' cognitive processes related to the challenge*. In a self-recording, the TR expressed surprise with the unexpected result:

TR: I asked [in the task] the students to represent the situation graphically. Then, some variations emerged. But I had not anticipated that the most evident would be the representation through a column chart, as that is what they had already worked on in previous years. **SR Reflection MT1**

It is significant in this transcript that, despite the students' solution deviating from the projected outcome, the TR's record implies that the solution should be regarded as valuable feedback regarding their teaching, particularly in relation to the expectations surrounding the thought process of students. Therefore, the analysis of the TR demonstrates a deliberate focus on the *content complexity indicator* (Table 1) as a result of the comprehensive recording of student solutions. This enabled the TR to gain a deeper understanding of the content of MT1, in comparison to the previous solution anticipated in the lesson plan. Thus, the indicators identified in the production records of students and the lesson plan work in tandem to illustrate the potential of these records to inform about the unique aspects of teaching as *investigative practice* and to reveal themselves as much more than mere bureaucratic tasks in the classroom.

Episode 3: Model investigative practices and reflections regarding the lesson

The set of tasks prepared by the TR yielded several records derived from the students' productions. Such records were fundamental for the reflection phase of each lesson. The

⁵ Jandysvaldo, Valtycrêia and Lambarildo were instructed to exercise and follow a healthier diet with the aim of reaching a BMI value close to 22 by the end of that year. They were also required to calculate their BMI for each 5kg increase or decrease in weight until they achieved the predetermined objective. They have accepted the challenge and are currently in the process of determining the amount of weight gain or loss each individual should have during the period, as well as the evolution of their body mass index (BMI) until they achieve their objective. Please, help them in performing these calculations.

d) using the representation resulting from item b, demonstrate the progress of our friends in the challenge to improve their health.

students' production shown in Figure 3, and discussed in the previous episode, is a compelling illustration of how thorough reflection may facilitate fresh perspectives on teaching and drive changes in practice. Now, let's examine another excerpt from TR's self-recording regarding the resolution proposed by the students for MT1 (Figure 3):

TR: I had not foreseen the representation of a bar chart... of columns, which is what they have worked on in previous years (...) During the planning process, it is necessary to repeat and revisit the task to explore more possibilities and to put ourselves in place of students. We must contemplate how to optimize the functionality of the lesson by thoroughly considering the students' viewpoints. **SR Reflection MT1**

The discrepancy between the TR's expectations and actual outcomes observed in the students' work in this situation led to a reflection regarding actions the TR may implement to facilitate improvements in the aforementioned outcomes. It is our understanding, based on Table 1, that such reflection benefited from what is shown in the indicator of *how reflection contemplates actions in light of the particularities of teaching*. It is important to highlight that it was reflection that led the TR to modify MT2, reconsidering the challenge level and time management, as previously discussed in Episode 1 on the role of tasks as an *investigative practice*. Hence, in this reflection, we also highlight the criterion by which the teacher evaluates the efficacy of their methods and their understanding of teaching (Table 1), which had a crucial role in the modifications observed for MT2.

Another highly notable event concerning reflections involves MT3, which, as seen in Episode 1, was employed by the TR with exploratory objectives, diverging from their customary approach to this particular assignment in prior lessons. The TR documents their experience with the implementation of technologies in MT3 during the phase of class development. They expressed astonishment at the students' collaborative debate about a solution that had not occurred to the TR.

TR : When they worked with the figures [with the Geogebra software, as part of MT3], there were difficulties, especially with algebraic language. Maybe... I don't know, if it's their difficulty in expressing algebraic language or, maybe it's me [mine] in understanding how they express generalities. They use the words, but not as I was use them, or as I expected them to do. **SR Reflection MT3**

Once again, the disparity between what the teacher predicted and how the students' responses can be observed. Nevertheless, it can be inferred that, in this context, reflection arises from the process of negotiating meanings during the group discussion among students. The emphasis is on how students articulate generalizations compared to the expectations of the TR

regarding the students' language. In this reflection, the TR examines the obstacles of teaching and highlights the reflection indicator, which involves *considering the student's strengths and difficulties* (Table 1). The TR also explores the process of identifying the root cause of such issues within the negotiation of meanings.

It is crucial to emphasize the extent to which the change in intentionality toward MT3, as demonstrated in Episode 1, resulted in the TR achieving a greater understanding of the students' perspectives on the content of the task challenge through the implementation of an exploratory approach. The following excerpt shows that the TR was able to further their reflections on the assignments as a result:

TR: Other forms of resolution must be made [referring to that anticipated in the lesson plan], trying to put yourself in the students' shoes to be able to predict this [referring to the different possible answers] and, this way, being prepared. If errors or innovative ideas arise, which I may not be able to grasp through the way the student is speaking, but which contemplates the same concept. **SR Reflection MT3**

When considering the need to diversify predictions regarding the ways in which students can respond to the task, this self-recording excerpt allows us to point to the indicator of *considering the content in its diversity and depth* (Table 1) in the TR's reflection regarding MT3 and the lesson developed. Furthermore, when proposing to put oneself in the student's place in an effort to anticipate the possibilities for solving the task, the reflection of the TR points to the indicator of *considering students' capabilities and difficulties* (Table 1), also considering the effectiveness of their practices and their understanding of teaching (Table 1), when contemplating how to improve the experience with MT3.

Discussion of Results

When examining the TR's objectives in creating or altering tasks, we aimed to ascertain how the task can foster discussions that enhance comprehension of mathematics within the settings of difficult problems (Table 1). The indicators identified during the development of MT1 and the restructuring of MT2, in Episode 1, demonstrated that the TR was becoming more centered on addressing the difficulties presented by the tasks (Boston; Smith, 2009) and the suitability of an investigative approach (Ponte, 2005) that considers the various ways in which students engage with tasks.

Within this context, it is evident that the use of an exploratory approach for tasks, aimed at fostering discussions and recognizing the diversity of strategies employed by students, facilitated the creation of records that enhanced the teacher-researcher's understanding of the

students' ideas (Doerr, 2006). TR's openness to various strategies and increased interaction with diverse approaches and solutions prompted them to reevaluate their understanding of teaching and students. This, in turn, influenced their decision-making regarding the experimental use of MT3, as evidenced by their choices. The TR's investigative intentions regarding the use of tasks extended beyond the initial challenge based on which the lesson was developed (Serrazina, 2017). This approach transformed tasks into valuable resources for gaining insights into students' strategies, the complexity of the content, and the teacher's own practice. Consequently, the use of tasks can be characterized as an *investigative practice*.

Therefore, it can be inferred that the records generated by the tasks, as well as the video recordings of the TR's *self-recordings* (SR), played a role in reconstructing the events of the lessons and comprehension of the evolutions of the TR's perceptions as the lessons progressed. The objective was to determine *which traces of the different dimensions of practice can be provided by recording tasks in the classroom* (Table 1). Based on the analysis, the indicators mentioned in Episode 2 helped us determine that the TR examined the students' responses in order to assess their understanding of the concepts, rather than simply looking for failure or success (Ball et al., 2014). The self-recordings (SR) not only provide dynamic records of classroom activities from the teacher's perspective, but also increase the use of video resources as a tool (Chan et al., 2009) that enables us to concentrate on specific moments during planning or reflection. In addition, by enhancing the comprehension of the use of records as *investigative techniques*, the TR analysis, which involved examining the records of students' work, created instances of discord with the learning objectives. The TR's research aims highlight that such conflicts offer supportive evidence for the redefinition (Gonçalves et al., 2022) of the TR's understanding of teaching content while considering the students' existing knowledge. The indicators of this behavior were evident in how the TR utilized the actions of prior lessons as a parameter for subsequent ones, not just in their methods, but also in the choices and modifications made to tasks in MT2 and MT3, for instance.

Regarding the reflections that occurred during the investigation of the practice conducted by the TR, our objective was to ascertain how reflection enables the teacher to confront their expectations before and after lessons. (Table 1). Within this particular context, it was noted that the exploratory approach employed in the tasks resulted in a wide range of student responses. Such responses, in turn, prompted the teacher's reflections, particularly when they revealed discrepancies between the expected solutions and the actual outcomes. The use of self-recordings (SR) facilitated the separation of the TR, acting as a researcher, from the TR as a teacher, providing a reflection tool (Chan et al. 2019) for observing classroom practice.

This separation between the roles of teacher and researcher enabled the TR to examine and contemplate the significance of their acts, thus embodying the concept of reflection on action (Schön, 1992).

In addition, the TR utilized student production records to gain insights into ideas and strategies, which transformed their experience (Alarcão, 2022). This process enhanced learning about the content, students, and teaching methods from one lesson to another. From this standpoint, the tasks resulted in the creation of records, which in turn stimulated contemplation and prompted the TR to use their knowledge to reevaluate aspects of their teaching. This is evident in the shifts in perception concerning the recognition of students' capabilities, the nuances of content, and the criteria employed in the selection of tasks.

The TR's attitudes regarding the reflections conducted provide evidence that the use of reflection as an *investigative practice*, along with the cycles of using tasks, records, and reflections as research elements, facilitated the development of *practical wisdom* (Shulman, 1987). Such *practical wisdom* was observed in their attitudes of perceiving the situations experienced as a means to find solutions to the problems that arose during the lessons (Lunenberg & Korthagen, 2009).

Conclusion and final remarks

Existing literature on the importance of teacher research emphasizes the need for creating communities of practice (Cochran-Smith & Lytle, 2009; Fiorentini & Creci, 2017). These communities provide teachers with opportunities to share and discuss their practices and knowledge with their colleagues (Ponte, 2002). By doing so, teachers can exchange ideas and learn from practices that differ from their own. (Alarcão, 2022). Based on the findings of our study, we advocate for the integration of investigative practices into the daily routine of Basic Education teachers. By incorporating elements that are already present in the classroom, teachers can enhance their understanding of their craft and rely on such elements to share and analyze their results.

Therefore, the goal of the present article was *to identify and map the investigative practices of a teacher in order to develop a model that can support and guide the investigative practices of Basic Education teachers*. We focused on adopting an investigative stance from TR, as we explored tasks, records, and reflection. We examined how these elements, which are present in everyday classroom life, are crucial in addressing the question of *which strategies can be utilized and what obstacles are encountered by Basic Education teachers when conducting investigations in their own practice*.

By examining tasks, records, and reflection in relation to each other, we have determined how a *model of guiding principles for investigating one's practice* can enhance the ongoing education and professional development of Basic Education teachers. The results of our research indicate that taking an investigative approach results in a variety of viewpoints on the use of tasks in teaching (Boston; Smith, 2009), assessing students' work with a focus on comprehension (Doerr, 2006), and employing reflective thinking in their actions (Schön, 2000). Furthermore, it is important to mention that these factors prompted the TR to redefine their knowledge (Gonçalves et al., 2022), which was put into action and improved through research. This, in turn, served as a means to foster the growth of *practical wisdom* (Shulman, 1987; Lunnenberg & Korthagen, 2009).

We acknowledge that the model has constraints and requires assessment and improvement through the examination and analyses by other researchers, teachers, and teacher-researchers. We also encourage teachers to incorporate research into their activities and take an inquisitive stance. From this perspective, the model aims to encourage Basic Education teachers to transform their classrooms into laboratories, where each new lesson becomes an opportunity for research, evaluation, problem-solving, comprehension, and improvement.

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APPENDIX A

Mathematical Task 1 – The role of food on health

Friends Jandysvaldo, Valtycreia, and Lambarildo had shared harmful habits for a long time, and over the school break they indulged in even greater lethargy, overeating. They did not eat properly. When they returned to class, their teacher emphasized the significance of a healthy diet and physical activity. To this end, the teacher introduced the concept of **BMI**, which means **body mass index** which is used to know whether a person's weight is within normal range, as we can see in the reference table below:

BMI	Lower than 18,5	From 18,5 to 24,9	From 25 to 29,9	Higher than 30
Classification	Underweight	Normal	Overweight	Obese

Reference: http://bvsmms.saude.gov.br/bvs/dicas/215_obesidade.html

How can we calculate BMI? We must divide body mass (in kilograms) by (height)². A better visual is:

$$BMI = \frac{weight}{height \cdot height}$$

a) The three friends were curious to know how they fit into the table above. Knowing that Jandysvaldo weighs 75kg, Valtycreia weighs 44kg, Lambarildo weighs 85kg and that the three friends have the same height of 1.64m, how can they be classified according to their BMI?

b) in addition to the table, represent the BMI scale in another way, so that you can indicate the classifications and also where each of our characters are classified in the representation according to the previous calculation.

c) Jandysvaldo, Valtycreia and Lambarildo were instructed to exercise and follow a healthier diet with the aim of reaching a BMI value close to 22 by the end of that year. They were also required to calculate their BMI for each 5kg increase or decrease in weight until they achieved the predetermined objective. They have accepted the challenge and are currently in the process of determining the amount of weight gain or loss each individual should have during the period, as well as the evolution of their body mass index (BMI) until they achieve their objective. Please, help them in performing these calculations.

d) using the representation resulting from *item b*, demonstrate the progress of our friends in the challenge to improve their health

Adapted from: Associação Nova Escola (2017)

APPENDIX B

Mathematical Task 2 – Lambarildo’s Challenge

Enantiomorphism consists of the symmetry of objects that cannot be superimposed and is a characteristic of images formed in mirrors.

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One of its applications is writing the word “ambulance” backwards on emergency vehicles, allowing drivers to see such vehicles in their car's rear-view mirror to read the identification more quickly and give way in urgent situations.

While exploring the concept of enantiomorphism during a lesson, a teacher called Lambarildo presented the following figure that correlates the number on the line with the number of squares on a bar.

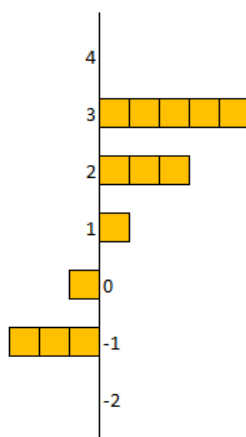


Fig.01 –Lambarildo

Then, the teacher asked his student Jandysvaldo to complete the image and build another figure that was enantiomorphic to his. Let’s help Jandysvaldo with this task by answering the questions below:

- observing the sequence of squares shown, how many squares will the bar in position 4 have? And in position -2?
- what will the number of squares in position 50 be ?
- write a rule that enables you to calculate the number of squares in the teacher's figure in any position.
- to fulfill the task given by the teacher, Jandysvaldo must create a rule for a new figure that must be enantiomorphic to the teacher's figure. What should this rule be?
- using the rule you helped Jandysvaldo create in the previous item, represent the figure generated by this rule next to the teacher's figure and answer: are they enantiomorphic?

APPENDIX C

Mathematical Task 3 –Marticleyde’s Deliveries

Marticleyde, the manager of a cake shop, decided to hire a distribution company to make deliveries within a 30 km radius. To this end, she asked for a quote from 4 distributors which use a fixed value plus a variable value predicated on the number of kilometers driven to calculate costs.

The table below shows quotes of distribution companies A, B, C and D:

Distribution Company	Fixed value (R\$)	Surcharge per Km (R\$)
A	12	5
B	25	2
C	3	12
D	40	1



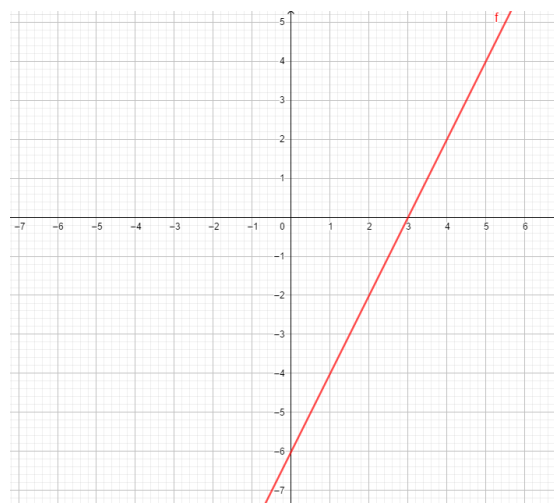
PART A – Help Marticleyde analyze the distribution costs by answering the questions below:

- Representing the distance traveled (km) by x and the final amount charged by the distributor (R\$) by y , write the functions that represent the cost of each company.
- Create the graph of the functions using Geogebra.
- By analyzing the graphs created, justify the best choice(s) for Marticleyde.

Adapted from Associação Nova Escola (2017)

PART B – The graph below was generated from the function $y = 2x - 6$.

Based on what was discussed about 1st degree polynomial function coefficients, what other functions should be incorporated into the program so that we can generate a RHOMBUS from the graph below?



Graph generated using Geogebra

- What is the significance of the location where each graph intersects the x-axis of the plane?
- What common trait can be seen regarding the coefficient of the variable x in the function's expression? How does this impact the graph?
- What feature does the fixed term of the function have in reference to the graph?
- Summarize your observations on the graph of the function $f(x) = ax + b$.