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Proposal for a reference didactic model for teaching financial mathematics in youth and adult education

Propuesta de un modelo didáctico de referencia para la enseñanza de matemática financiera en la educación de jóvenes y adultos

Proposition d'un modèle didactique de référence pour l'enseignement des mathématiques financières dans l'éducation des jeunes et des adultes

Proposição de um modelo didático de referência para o ensino de matemática financeira na educação de jovens e adultos

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Abstract

This study, part of a doctoral dissertation in Science and Mathematics Education, aimed to present a Reference Didactic Model (MDR) for teaching Financial Mathematics (MF) in secondary education for young adults and adults (EJA). The qualitative research was based on a formative study session with EJA Mathematics teachers at a state school in Carpina, Pernambuco, affiliated with the Mata Norte Regional Management Office. Based on an analysis of official documents and associated praxeologies, the authors sought to develop an MDR focused on percentages, linking curriculum organizers with

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teaching situations proposed by the teachers themselves. The following stand out as results: reflection on the rationale for MF knowledge in EJA, which allows us to understand that this knowledge, when appropriately developed, contributes to personal and professional development, as well as to the inclusion and autonomy of individuals as conscious consumers; identification of conditions and constraints related to the teaching object in the form of personal relationships, beyond knowledge; The active participation of teachers as co-participants in the process allowed for the development of a model aligned with the specificities of the modality, fostering more informed pedagogical choices and strengthening the educational process in schools. The developed MDR can not only promote effective coordination between the skills outlined in the modality's official documents and the established praxeological frameworks, but can also enhance the development of contextualized pedagogical practices, evaluating the praxeological dimension of teaching for EJA.

Keywords: Financial mathematics, Youth and adult education, Anthropological theory of didactics, Didactic reference model.

Resumen

Este estudio, parte de una tesis doctoral en Educación en Ciencias y Matemáticas, tuvo como objetivo presentar un Modelo Didáctico de Referencia (MDR) para la enseñanza de Matemática Financiera (MF) en educación secundaria para jóvenes adultos y adultos (EJA). La investigación cualitativa se basó en una sesión de estudio formativo con profesores de Matemática de EJA en una escuela estatal en Carpina, Pernambuco, afiliada a la Gerencia Regional de Mata Norte. Con base en un análisis de documentos oficiales y praxeologías asociadas, los autores buscaron desarrollar un MDR centrado en porcentajes, vinculando los organizadores curriculares con situaciones de enseñanza propuestas por los propios profesores. Se destacan como resultados: reflexión sobre la justificación del conocimiento de MF en EJA, que permite comprender que este conocimiento, cuando se desarrolla adecuadamente, contribuye al desarrollo personal y profesional, así como a la inclusión y autonomía de los individuos como consumidores conscientes; identificación de condiciones y restricciones relacionadas con el objeto de enseñanza en forma de relaciones personales, más allá del conocimiento; La participación activa del profesorado en el proceso permitió desarrollar un modelo alineado con las especificidades de la modalidad, fomentando decisiones pedagógicas más informadas y fortaleciendo el proceso educativo en las escuelas. El MDR desarrollado no solo promueve una coordinación efectiva entre las habilidades descritas

en los documentos oficiales de la modalidad y los marcos praxeológicos establecidos, sino que también potencia el desarrollo de prácticas pedagógicas contextualizadas, valorando la dimensión praxeológica de la enseñanza para la EJA.

Palabras clave: Matemáticas financieras, Educación de jóvenes y adultos, Teoría antropológica de lo didáctico, Modelo didáctico de referencia.

Résumé

Cette étude, qui fait partie d'une thèse de doctorat en didactique des sciences et des mathématiques, vise à présenter un modèle didactique de référence (MDR) pour l'enseignement des mathématiques financières (MF) dans l'enseignement secondaire pour jeunes adultes et adultes (EJA). Cette recherche qualitative s'appuie sur une séance d'étude formative menée auprès d'enseignants de mathématiques de l'EJA dans une école publique de Carpina, dans l'État de Pernambouc, affiliée à la Direction régionale de la Mata Norte. À partir d'une analyse de documents officiels et des praxéologies associées, les auteurs ont cherché à élaborer un MDR axé sur les pourcentages, en reliant les organisateurs du programme aux situations d'enseignement proposées par les enseignants eux-mêmes. Les résultats suivants ressortent : une réflexion sur la justification des connaissances en MF dans l'EJA, qui permet de comprendre que ces connaissances, lorsqu'elles sont développées de manière appropriée, contribuent au développement personnel et professionnel, ainsi qu'à l'inclusion et à l'autonomie des individus en tant que consommateurs conscients ; l'identification des conditions et des contraintes liées à l'objet d'enseignement sous la forme de relations personnelles, au-delà de la connaissance ; La participation active des enseignants au processus a permis l'élaboration d'un modèle adapté aux spécificités de la modalité, favorisant des choix pédagogiques plus éclairés et renforçant le processus éducatif dans les écoles. Le MDR ainsi développé peut non seulement favoriser une coordination efficace entre les compétences décrites dans les documents officiels de la modalité et les cadres praxéologiques établis, mais aussi favoriser le développement de pratiques pédagogiques contextualisées, valorisant la dimension praxéologique de l'enseignement pour l'EJA.

Mots-clés : Mathématiques financières, Éducation des jeunes et des adultes, Théorie anthropologique du didactique, Modèle didactique de référence.

Resumo

Este estudo, recorte de uma tese de doutorado em Ensino de Ciências e Matemática, teve como objetivo apresentar um Modelo Didático de Referência (MDR) para o ensino de Matemática Financeira (MF) no Ensino Médio da Educação de Jovens e Adultos (EJA). A pesquisa, de abordagem qualitativa, tomou como base um Momento de Estudo Formativo com docentes de Matemática da EJA em uma escola estadual de Carpina–PE, vinculada à Gerência Regional da Mata Norte. A partir da análise dos documentos oficiais e das praxeologias associadas, buscou-se construir um MDR com foco no conteúdo de Porcentagem, articulando os organizadores curriculares com situações de ensino propostas pelos próprios docentes. Destacam-se como resultados: a reflexão sobre a razão de ser do saber MF na EJA, que possibilita entender que esse conhecimento, quando trabalhado de forma adequada, contribui para o desenvolvimento pessoal e profissional, bem como, para a inclusão e na autonomia dos indivíduos como consumidores conscientes; a identificação de condições e restrições relacionadas ao objeto de ensino na forma de relação pessoal, para além do saber; a participação ativa dos docentes como coparticipantes do processo, que permitiu a elaboração de um modelo alinhado às especificidades da modalidade, favorecendo escolhas pedagógicas mais conscientes e o fortalecimento do processo formativo na escola. O MDR elaborado pode promover não apenas uma articulação entre as habilidades previstas nos documentos oficiais da modalidade com as estruturas praxeológicas construídas, mas também pode potencializar o desenvolvimento de práticas pedagógicas contextualizadas, valorizando a dimensão praxeológica de ensino para a EJA.

Palavras-chave: Matemática financeira, Educação de jovens e adultos, Teoria antropológica do didático, Modelo didático de referência.

Proposal for a reference didactic model for teaching financial mathematics in youth and adult education

Introduction

Teaching Financial Mathematics (MF) in Youth and Adult Education (EJA) plays a crucial role in equipping students with essential tools to understand mathematical concepts such as interest, discounts, and percentages. This knowledge not only facilitates financial decision-making but also promotes practical application in everyday life, allowing mathematical learning to be integrated into complex social and economic issues.

It is understood that the institutional environment and educational practices profoundly influence the learning processes in this field, and in this study, we delve into its study from the perspective of the Anthropological Theory of Didactics (TAD) , developed by Yves Chevallard (1982, 1991a , 2018). When considering the various levels of co-determination proposed in the TAD, from the school to the broader dimensions of Humanity and Civilization, it becomes evident how the teaching of Mathematics permeates these varied levels, shaping and being shaped by the specificities of the object, people, and institutions.

The Theory of Didactics (TAD) considers mathematics as a human cultural production (anthropological dimension), traversed by time and the history of a given civilization, in relation to activities involving mathematical knowledge (didactic dimension). It is emphasized that it is not a theory specifically of Mathematics, but rather of Didactics, encompassing a theorization that can be considered in various scientific fields, not just mathematics.

In the composition of its own name, derived from the words Anthropological and Didactic, it is possible to understand that TAD (Theory of Didactics) brings an important perspective to the educational process. The term "anthropological[4]," according to 7Graus, is defined as relating "[...] to anthropology, the science that studies the human species, taking into account its origin, development (physical, social, cultural), way of acting, racial peculiarities, customs, beliefs, etc." (Anthropological, 2024). The anthropological approach consists of the description and analysis of the human being, based on the biological and sociocultural characteristics of different groups, highlighting the variations and differences between them.

[4] Available at: https://www.dicio.com.br/antropologico/. Accessed on: November 20, 2024.

The etymology of the term "didactic[5]," according to 7Graus, is defined as relating "[...] to didactics, to teaching, to the art of teaching, of transmitting knowledge through teaching: textbook. Capable of facilitating learning or suitable for teaching: didactic processes." (Didactic, 2024)

Based on this understanding, TAD (Theory of Didactic Activity) provides an opportunity to comprehend how teaching is organized, since it involves the articulation between ecology[6], considering the notions of *habitat*[7], *niche*[8] or ecosystem[9], and investigates how the object (O), the people (X) and the institutions (I) relate and constitute themselves over time.

Based on this understanding, this article aims to present the Reference Didactic Model (MDR) for teaching Financial Mathematics in High School Adult Education (EJA), developed in collaboration with two EJA teachers from the state network in the municipality of Carpina. The work presented here constitutes an excerpt from the first author's doctoral thesis, carried out under the guidance of the second author and co-guidance of the third author.

Reference Teaching Model based on praxeologies

The analyses established from TAD make it possible to reflect on teaching, particularly on the interactions between subjects, institution, and knowledge. In this direction, Cavalcante (2018) emphasizes that:

> The term "ecology" is used by Chevallard as a reference to the relational nature between different forms of knowledge, the institutions and you your subjects. Taken borrowed from the Ecology, and possible to speak in others terms derivatives niche, habitat and ecosystem. In TAD one ecosystem would correspond to the set of conditions and restrictions institutional what allows the "life" of a certain knowledge. (Cavalcante, 2018, p. 45, our translation)

This includes investigating the relationship between the didactic subject – whether the teacher or the student – and mathematical knowledge, as well as the (mathematical) situations proposed and the conditions and constraints that surround them.

[5] Available at: https://www.dicio.com.br/didatico/ . Accessed on: 20/11/2024.
[6] Science characterized by the study of the relationships between living beings; study of the relationships of living beings with the organic or inorganic environment (in which they live). (Ecology, 2024)
[7] The combination of characteristics of a place inhabited by human beings: urban, rural, artificial, and natural habitats. (Habitat, 2024)
[8] A limited region of a habitat where the necessary conditions exist for a species, or organism, to survive and exist. (Nicho, 2024)
[9] Ecological system that encompasses the set of interdependent relationships that organisms maintain with each other and with the environment in which they live and which surrounds them. (Ecosystem, 2025)

The concept of Praxeology is one of the best known in TAD (Theory of Discourse). It is formed from the Greek roots *praxis* (practice) and *logos.* (knowledge), analyzes its structural organization based on practices within a given institution, bringing forth elements that allow for the revelation and description of the institutional relationship. Conceptually, Chevallard highlights the praxeological structure based on the type of tasks (T), technique (τ), technology (θ) and theory (Θ), as follows:

> The simplest praxeological structure (which we might call "atomic," but we actually call "point-based") consists of a *type of task T* , a technique τ, a way of performing tasks *t* of type *T*, a technology θ, a reasoned discourse (*logos*) about the technique (*tekhnê*) that is supposed to make *t* intelligible as a means to perform tasks of type *T* , and finally – last but not least – a *theoretical component* Θ, which governs the technology itself (and therefore all the components of praxeology). A specific, point-specific praxeology (the "point" here is the type of tasks T) is noted $[T/\tau/\theta\ /\Theta]$. It includes a practical- Θtechnical Πcomponent = $[T/\tau]$, or *praxis* (which may, if appropriate, be called "know-how") and a technological-theoretical part $\Lambda = [\theta/\Theta]$, or *logos* (which we can identify as "knowledge" in the usual sense of the term). (Chevallard, 2018, p. 34, our translation)

Thus, a praxeology is established from two interconnected blocks, *praxis* and *logos* , respectively: the practical-technical block $[T/\tau]$, where certain types of tasks (T) are performed – this is a practice of the "anthropological principle" expressed by a verb, which presents a relative precision – through a technique (τ)– way of doing –, and the technological-theoretical block $[\theta/\Theta]$, composed of technology (θ)– an argumentative discourse that allows thinking about and/or producing the technique – and theory (Θ)– justification of the technology – , which allows modeling social practices in general and mathematical activity in particular, "[...] an abstract speculation of technology, a theorization constituted of comprehensive notions that serve to explain, justify and produce new technologies." (Pantoja, 2017, p. 65)

It is worth noting that the organization can present itself in its most particular format – a point-in-time organization – or it can be presented in the format of a local, regional, or global organization:

> Point organizations will then aggregate first into local organizations $[T_i / \tau_i / \theta/ \Theta]$, centered on a θspecific technology, then into regional organizations $[T_{ij} / \tau_{ij} / \theta_j / \Theta]$, formed around a theory Θ(Furthermore, let us call the praxeological complex $[T_{ijk} / \tau_{ijk} / \theta_{jk} / \Theta_k]$ obtained in a given institution by the aggregation of several regional organizations corresponding to the various theories Θ_k a global organization .) Moreover, the transition from a point praxeology $[T / \tau/ \theta/ \Theta]$ to a local praxeology $[T_i / \tau_i / \theta/ \Theta]$ emphasizes technology θ, just as the subsequent

> transition to a regional praxeology [T_{ij} / τ_{ij} / θ_j / Θ] will place theory in the foreground Θ.[10] (Chevallard, 1998, p. 5, our translation)

Based praxeology is developed based on a single type of task. Local praxeology is represented by several point-based organizations, with different types of tasks, and the shift from point-based to local highlights technology. Regional praxeology, in turn, presents local praxeologies together around the same theory. Finally, the grouping of various regional organizations related to different theories corresponds to a global organization.

The way knowledge is lived within a given institution is traversed – and, in a certain sense, subordinated – by situations that enable/condition its existence and by those that restrict it. In this regard, Chevallard (2018, p. 35) posits that: "a restriction is an observed condition, of a certain institutional position at a certain instant, as unmodifiable, immutable (relatively and provisionally); similarly, a condition is a modifiable restriction in this same sense." Thus, a restriction is something that is expected to be more permanent. A condition, on the other hand, allows for flexibility within the context, permitting adjustments and consideration of circumstances that interfere with the dynamics between institutional organizations and developmental organizations.

According to Gonçalves and Bittar (2018, p. 100), "The ecology of a praxeological organization is associated with the conditions that weigh on its construction and its 'life,' normalized both in educational institutions and in those of production, use, and transposition of content." This describes the conditions that impact the functioning of processes, their relationships, and their organization within the institution.

In the school setting, specifically, a condition is anything that favors the relationship with a particular body of knowledge, such as how the teacher organizes knowledge in relation to the student in the classroom, while a restriction is anything that, even without the teacher realizing it, acts as a condition that limits teaching. According to dos Santos and de Freitas (2017):

> [...] understanding the school environment and the conditions and restrictions present in school practice is the starting point for developing continuing

[10] Les organisations ponctuelles vont ainsi s'agréger, d'abord en organisations locales, [Ti/τi/θ/Θ], centrées sur une technologie θ déterminée, ensuite en organisations régionales, [Tij/τij/θj/Θ], formées autour d'une théorie Θ. (Au-delà, on nommera organisation globale le complexe praxéologique [Tijk/τijk/θjk/Θk] obtenu, dans une institution donnée, par l'agrégation de plusieurs organisations régionales correspondant à plusieurs théories Θk.) Or le passage d'une praxéologie ponctuelle [T/τ/θ/Θ] à une praxéologie locale [Ti/τi/θ/Θ] met en avant la technologie θ, de la même façon que le passage ultérieur à une praxéologie régionale [Tij/τij/θj/Θ] portera au premier plan la théorie Θ.

> education, understanding first and foremost that the teacher's mathematical praxeological equipment should not be limited to what he or she should teach. (Santos and de Freitas, 2017, p. 54, our translation)

An ecological approach, considering the notion of *niche* or *habitat,* makes it possible to compare how the object of study behaves in a specific institution. It is possible to understand that the object of study behaves differently in each institution where it is present, considering its raison d'être and the conditions and restrictions (also called constraints) of the knowledge subordinated to the institution.

Regarding the idea of *raison d'être* Chevallard states: "all human production having – or having had – a purpose, that is, conceived and thought out to have some utility, which constitutes the reason for the work's existence [11]." (Chevallard, 1889, p. 65, our translation) The reason for being is linked to the purpose and justification of a particular knowledge or practice, the reason for which it exists.

Chevallard (2011) highlights the need to consider the conditions and restrictions that may interfere with the treatment of an object (of study), which may be from the institution itself, or from the relationship between the subject. and the object, or even the praxeologies evidenced. Bosch and Gascón (2007) state that, from the point of view of TAD, every didactic problem is a problem of praxeological ecology or, in other words, that, ultimately, didactics deals with the study of the institutional ecology of mathematical-didactic praxeologies , since it includes, in a certain sense, the epistemological and economic dimensions in the ecological dimension of a didactic problem.

The teaching process involves not only the content of the curricular components, but also relates to the practices and contexts in which they are taught, being organized and structured based on the conditions that the school environment allows.

Chevallard 's use of the terms , a given body of knowledge presents a hierarchical structure, in which each level refers to a reality and determines the ecology of these organizations: its niche (the functions that each level performs) and its *habitat* (the context in which mathematical objects representing a body of knowledge are found) for investigating the relationships between the objects and their study. Thus:

> A given knowledge **S** is found in various types of institutions **I,** which, in terms of the ecology of knowledge, are its different habitats [7.] If we consider these habitats, we will immediately realize that the knowledge in question regularly occupies very different niches. Or, in other words, that the institutional

[11] "On appelle œuvre, en TAD, toute production humaine ayant – ou ayant eu – une finalité, c'est-à-dire conçue et réalisée pour avoir quelque utilité, laquelle constitue la raison d'être de oeuvre". (Chevallard, 1889, p. 65)

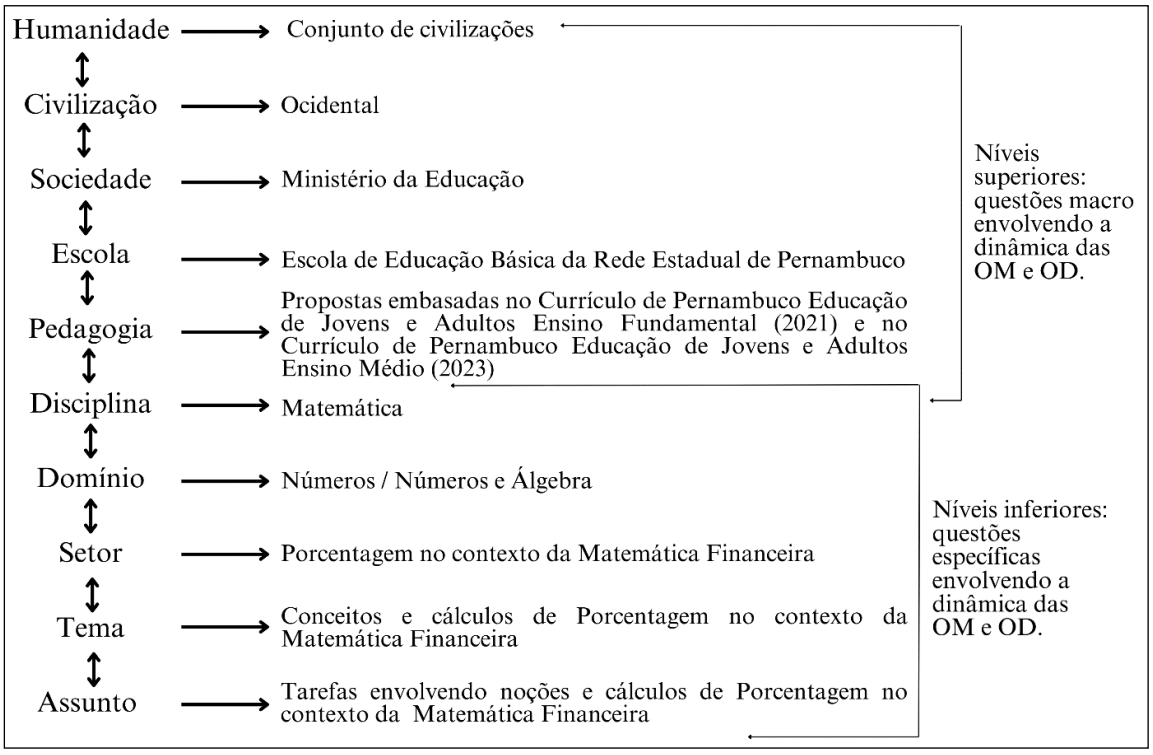
> relationship of **I** with **S,** R I (S), which I will call the problematic of **I** in relation to **S** , can occur in several different ways. (Chevallard, 1991b, p. 153, our translation)

Thus, locating Pedagogy as level zero (0), Chevallard (2014) proposes that there are levels of co-determination, subdivided into two sublevels: superior and inferior, in which knowledge lives in a particular way, influencing and being influenced by institutions.

To conclude, we present Figure 1, which allows for a more adequate visualization of the co-determination levels related to this investigation, in addition to highlighting the higher levels of co-determination, since it is based on the analysis of official documents aimed at teaching Financial Mathematics in Adult Education:

Figure 1

Location of research in the Levels of Co-determination



Note. *Chiappetta, 2025, p. 115*

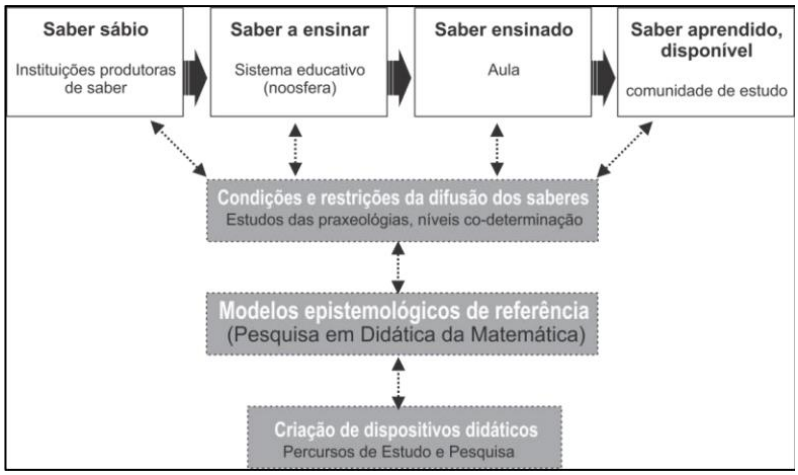
It is worth noting that higher levels, more specifically Society, School and Pedagogy, aid the study by enabling the identification of conditions and restrictions imposed by situations both inside and outside the school context.

Co-determination Levels must be understood by considering its ascending and descending movements. The knowledge and objects involved not only interact and influence each other, but also open space for different perspectives, broadly shaping the practices, values, and skills that individuals must develop.

According to Chevallard (1998, p. 92), the theorization proposed in TAD should "[...] be seen as a development and articulation of notions whose elaboration aims to allow for a unified way of thinking about a large number of didactic phenomena, which emerge at the end of multiple analyses." Some of these phenomena are represented in Figure 2, which shows the evolution of TAD and the notion of the didactic transposition process of Bosch and Gascón (2006):

Figure 2

Evolution of the theoretical notions of TAD



Note. *Cavalcante, 2018, p. 103*

Figure 2 makes it possible to observe the role of agents and the adopted praxeologies, considering that expert knowledge is transformed into knowledge to be taught and, finally, into taught knowledge, and highlights elements of knowledge construction related to TAD, as well as the existence of conditions and limitations that allow its transformation as an institutional object.

The teaching modality system, in the guiding curricula and in the exercises frequently used to address specific knowledge or skills in realistic situations, leads us to the Dominant Didactic Model (MDD) in the respective modality/level of education, which encompasses the processes of the teaching approach that prevails in various institutions and integrates a similar educational context.

When considering the MDD (Methodology of Didactic Development) as a starting point, the aim is also to understand the Reference Didactic Model (MDR). The MDR systematizes mathematical activities to promote the study of a specific area of knowledge within an institution. This, in turn, can facilitate the development of teaching resources that promote the dissemination of this knowledge, as it presents techniques and teaching situations designed to guide the teaching of mathematical knowledge.

Since these understandings are still being constructed by the mathematical community, few texts specifically address the Reference Didactic Model and how to build it.

Herbartian scheme (Chevallard, 2009), for example, proposes the consideration of a general reference didactic model, which allows for the construction of other models based on the elements of the scheme and the didactic environment.

> Herbartian scheme that allows us to represent the different possible forms of any course of study and research [...]
> It can initially be considered as a possible reference system that the teacher uses to observe, describe, analyze, and evaluate existing teaching systems in social institutions or theoretically feasible systems. We can also consider it, therefore, as a reference teaching model (RTM) that provides its own point of view and a general model of what is understood in TAD by "studying a question" and, more generally, by "studying a work." [12](Ruiz-Olarría, 2015, p. 134, our translation).

Thus, it is possible to establish that the Herbartian scheme, understood as a Didactic Reference Model (MDR), is realized through didactic systems oriented towards investigation and the production of knowledge.

> Study and Research Pathways (SRRPs) are a type of didactic device defined within the framework of the Anthropological Theory of Didactics (TAD) (Chevallard, 1999, 2004, 2009). SRRPs, as already mentioned, pose questions Q as the starting point of knowledge. [...] This leads to the emergence of a didactic system of the form S(X;Y ;Q). The functioning of this didactic system then produces an answer to question Q, that is, a fragment of a knowledge organization under construction. It is said that knowledge arises as an answer to a question, with a meaning and a reason for being. [13] (Parra; Rita Otero; Ángeles Fanaro, 2013, p. 850, our translation)

It is evident that the construction of knowledge — represented by a response R♥ — does not occur directly or spontaneously, but presupposes the mediation of a didactic means M. It is precisely the articulation between this means and the response that reveals the complexity of the didactic process, highlighting the centrality of the

[12] El esquema herbartiano más general que permite representar las distintas formas posibles de cualquier recorrido de estudio e investigación [...]
Puede considerarse de entrada como un sistema de referencia que utiliza el didacta para observar, describir, analizar y evaluar los sistemas didácticos existentes en las instituciones sociales o los sistemas teóricamente posibles. Lo podemos también considerar, por tanto, como un modelo didáctico de referencia (MDR) que proporciona un punto de vista propio y un modelo general de lo que se entiende en la TAD por «estudiar una cuestión» y, más en general, por «estudiar una obra».

[13] Los Recorridos de Estudio e Investigación (REI) son un tipo de dispositivo didáctico definidos en el marco de la Teoría Antropológica de lo Didáctico (TAD) (CHEVALLARD, 1999, 2004, 2009). Los REI, como ya lo mencionamos, colocan preguntas Q como punto de partida del saber. El estudio de Q debe ser realizado por un equipo de alumnos X dirigidos por un equipo de profesores Y. Esto provoca la emergencia de un sistema didáctico de la forma S(X;Y;Q). El funcionamiento de este sistema didáctico produce entonces una respuesta R a la pregunta Q, esto es, un fragmento de una organización de saber en construcción. Es decir, el saber surge como respuesta a una pregunta, con un sentido y una razón de ser.

mediation work in the production of knowledge in the context of Study and Research Paths [14].

> The elaboration of $R^{\bullet}$ from question Q presupposes the fabrication of the didactic medium, M. This is expressed in the Herbatian scheme. semi-developed: S(X; Y; Q) $\rightarrow$M] $\rightarrow R^{\bullet}$. It is said that the didactic system constructs and organizes ($\rightarrow$) the medium M with which it will generate or produce ($\rightarrow$) a response $R^{\bullet}$. This scheme indicates that the elaboration of the medium M is articulated in a complex way with the elaboration of the response $R^{\bullet}$. This observation applies to the developed Herbartian scheme , which is described as follows: $[S(X;Y;Q) \rightarrow \{R_1^{\diamond}, R_2^{\diamond},..., R_n^{\diamond}, O_{n+1},..., O_m\}] \rightarrow R^{\bullet}$. Where $M = \{ R_1^{\diamond}, R_2^{\diamond},..., R_n^{\diamond}, O_{n+1},..., O_m \}$. The organizations named as R_i for i= 1,… , n are responses made, for example, by a book, the Web, a teacher's course, etc.; Organizations O_j for j=n+1,…,m are other works, for example, theories, experimental setups, praxeologies , etc., considered useful for deconstructing the responses $R^{\diamond}$ and extracting from them what is necessary to construct the response $R^{\bullet}$.[15] (Parra; Rita Otero; Ángeles Fanaro , 2013, pp. 851-852, our translation)

The diagram illustrates the teaching process in a study community that aims to address a question with the support of a team of teachers. This collaboration allows for the construction of specific answers, appropriate to a particular context, based on praxeological components that may be more or less integrated.

Bosch and Gascón (2010) reinforce the importance of multidimensionality, which can influence the dynamics of Didactic Reference Models (MDRs), since they are organized and function according to a general teaching model. This general model is specifically designed for the subject/Curricular Component – in this case, Mathematics – and takes into account several broader influences, considering the conditions and constraints arising from the most generic levels of co-determination, such as the pedagogical, school, social, and civilizational levels.

The development of the MDR (Methodological Development Review) enables the description and interpretation of techniques that facilitate educational processes. This approach allows for a deeper understanding of the didactic priorities that are highlighted as necessary, regardless of the mathematical objects being worked on, valuing the experiences and culture of the students (anthropological aspect) and

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[14] O termo “Recorridos de Estudio e Investigación” (REI) pode ser entendido em Português como jornadas de estudo e pesquisa.

[15] La elaboración de $R^{\bullet}$ a partir de la cuestión Q supone la fabricación del medio didáctico, M. Esto se expresa en el esquema herbatiano semi desarrollado: $[S(X; Y; Q) \rightarrow M] \rightarrow R^{\bullet}$. Es decir, el sistema didáctico construye y organiza ($\rightarrow$) el medio M con el cuál engendrará o producirá ($\rightarrow$) una respuesta $R^{\bullet}$. Este esquema indica que la elaboración del medio M se articula de modo complejo con la elaboración de la respuesta $R^{\bullet}$. Esta observación se aplica el esquema herbartiano desarrollado, que se escribe así: $[S(X; Y; Q) \rightarrow \{R_1^{\diamond}, R_2^{\diamond},..., R_n^{\diamond}, O_{n+1},..., O_m\}] \rightarrow R^{\bullet}$. Onde $M = \{R_1^{\diamond}, R_2^{\diamond},..., R_n^{\diamond}, O_{n+1},..., O_m\}$. Donde $M = \{R_1^{\diamond}, R_2^{\diamond},..., R_n^{\diamond}, O_{n+1},..., O_m\}$. Las entidades nombradas como R_i para i=1,…, n son respuestas hechas, por ejemplo, un libro, la Web, el curso de un profesor, etc.; las entidades O_j para j=n+1,…,m son otras obras, por ejemplo, teorías, montajes experimentales, praxeologías, etc. consideradas útiles para deconstruir las respuestas $R^{\diamond}$ y extraer de ellas lo necesario para construir la respuesta $R^{\bullet}$.

articulating them with mathematical knowledge, the techniques involved, and the specific context.

As previously mentioned, seeking to understand the didactic demands of EJA (Youth and Adult Education), and based on an ecological perspective that considers the higher levels of Society, School, and Pedagogy, the construction of a MDR (Modular Didactic Reference) for teaching MF (Modular Mathematics) in this educational modality was proposed. To this end, the school niche was taken into account – considering the official documents that guide the content to be covered in each Module – and the common *habitat* of the students in the locality – characterized as a predominantly commercial city, which is the commercial center of the region.

These two elements highlight the importance of linking classroom content with Financial Mathematics, enabling students to better understand its relevance by considering its role in making more informed financial decisions, developing their careers, and contributing to the sustainable development of their communities. Thus, considering this social context, it is understood that adult education students, mostly workers in the commercial sector, already possess some practical knowledge – albeit incipient – on topics such as investment evaluation, personal budget management, negotiating better terms, conscious consumption, and entrepreneurship. Many of these students seek to deepen this knowledge, broadening their perceptions of growth opportunities in the commercial sector.

Methodological procedures

This research is characterized by a qualitative approach. From this, it was possible to develop a Formative Study Moment focused on Financial Education and Financial Mathematics, together with mathematics teachers working in the EJA (Youth and Adult Education) program at a state school in the municipality of Carpina, Zona da Mata Norte, Pernambuco State, approximately 58 km from Recife, the state capital. This moment was based on the analysis of official documents related to EJA and the proposition of teaching situations that, by articulating these guidelines with the experience of the participating teachers, can be explored with students in this educational modality.

For the purposes of this article, we have chosen to highlight some actions developed during the so-called Formative Study Period, in order to facilitate

understanding of the methodological approach adopted. Although the complete study involves a broader set of meetings and stages, in this excerpt we emphasize some specific moments that are more significant for the proposition of the Reference Didactic Model (MDR) aimed at teaching Financial Mathematics in High School for Youth and Adult Education (EJA).

Currently, the municipality of Carpina is recognized for its diversified commerce, which not only meets local demand but also attracts residents from neighboring cities, such as Lagoa do Carro, Paudalho, Tracunhaém, Nazaré da Mata, Buenos Aires, and others in the region. This dynamic significantly contributes to job and income generation, both for the population of Carpina and for the surrounding cities. In this context, Financial Mathematics presents itself as a particularly relevant field of knowledge, considering that a large part of the citizens are involved in commercial activities, either as entrepreneurs or as workers in the sector.

Based on this reality, a Formative Study Moment was developed, consisting of ten meetings with mathematics teachers working in Adult Education at the aforementioned school in the municipality. This moment enabled the production of data and the construction of the MDR (Model of Development and Relevance), based on the reflections and contributions of the participating teachers. The table summarizing the actions is presented below:

Table 1

Detailed breakdown of the distribution of shares in relation to the stages of the research

Research stages	Parts	Meetings	Details
Step 1 - Document analysis	Part 1	Meeting 1	Presentation of the research to the teachers; interview with the teachers; discussion with the teachers about teaching practices and the teaching materials used.
Step 2 - Analysis of the discussions produced by the research participants on MF	Part 2	Meeting 2	Identifying how teachers EJA (Youth and Adult Education) organizes the teaching of Physical Education and Physical Education in EJA .
	Part 3	Meeting 3	Construction of the Dominant Didactic Model for teaching Mathematics in Adult Education.
	Part 4	Meeting 4	Organization of the study in light of the initial notions of mathematics teachers regarding Physical Education and Mathematical Intelligence.
Step 3 - Building the MDR	Part 5	Meeting 5	A discussion session with participating teachers about the official recommendations for teaching Physical Education and Physical Education in Youth and Adult Education, compared to the practices they presented in Part 2.

		Meeting 6	An approach to the Pernambuco Curriculum for Youth and Adult Education in Elementary School regarding the teaching of Physical Education and Mathematics, comparing it with the classroom practices of teachers.
		Meeting 7	Proposal for teachers to develop a lesson plan with a focus on teaching Physical Education and Physical Education, as discussed in Stage 2.
		Meeting 8	Presentation of the elements that make up the praxeological structures of the situations proposed by the teachers in Meeting 7. The approach considered the prior knowledge of Physical Education and/or Financial Management in Youth and Adult Education, articulated with the experiences brought by the students, such as discounts, interest, financial organization and inflation.
		Meeting 9	Observing one of the professors' classes in order to note the contributions made.
	Part 6	Meeting 10	Construction of a Mathematical Development Model (MDR) for teaching Mathematics in Adult Education (EJA), developed with the two Mathematics teachers from an Adult Education program at one of the state schools in the municipality of Carpina, based on the analysis of official documents.

Note. Chiappetta, 2025, p. 134

The development of the MDR (Methodological Development Review) enables the description and interpretation of techniques that facilitate educational processes. This approach allows for a deeper understanding of the didactic priorities that are highlighted as necessary, regardless of the mathematical objects being studied, valuing the experiences and culture of the students (anthropological aspect).

The constructed model, presented in the following section, articulates these experiences with mathematical knowledge and techniques that teachers commonly use in their approaches, serving as a starting point for linking the skills foreseen in the official documents of the modality with the constructed praxeological structures. Furthermore, this MDR (Model of Development and Relevance) can enhance the development of other contextualized pedagogical practices, valuing the praxeological dimension of teaching for EJA (Youth and Adult Education).

Construction of the Reference Didactic Model from the Formative Study Moment

The first point we would like to highlight is Meeting 2, which sought to identify how teachers ... EJA (Youth and Adult Education) organized the teaching of Physical Education and Physical Education in EJA. to construct a Dominant Didactic Model (MDD) for teaching

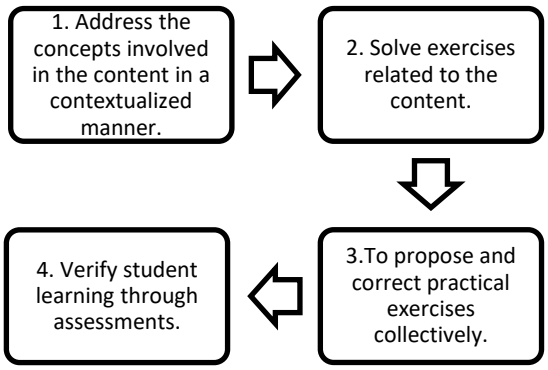
Mathematics in Youth and Adult Education in Meeting 3 , highlighting the sequence of the four actions listed by the teachers, which were discussed in relation to classroom observations.

We presented the MDD construction to the teachers so that they could identify r The four actions they discussed in the previous meeting. The actions mentioned in their speeches, as well as the observations of their classes made by the researcher in her role as a Support Educator, confirmed their usual classroom actions, demonstrating that the MDD emerged from their practices.

Thus, the MDD, highlighted in Figure 3, represents the didactic organization adopted by the teachers participating in this research when planning the development of their classes on MF, regardless of the Knowledge Object addressed:

Figure 3

Dominant Didactic Model (MDD) for teaching MF in EJA in Carpina/PE



Note. Chiappetta, 2025, p.159

The teachers highlighted that this proposed teaching organization can be carried out over two weeks or more for each Knowledge Object / topic covered, considering five or six math classes per week.

The next highlight was Part 5 - Meeting 7, which presented the redirection given to the skills presented in the Lesson Plan constructed by the teachers, in order to consider the skills present in the official documents for teaching Mathematics in Youth and Adult Education.

Table 2 compares the praxeological structures associated with the skill EFEJAAFMA19PE (Solving and creating problems involving percentage calculations in financial education contexts) , articulated with the Skill EMEJAMAT203M2MA05PE [Use

mathematical concepts in planning, executing, and analyzing actions for the use of applications and creating spreadsheets (for example, in activities involving family budget control, simple and compound interest calculation simulators, among others), for decision-making in diverse situations, with or without the use of digital technologies] highlighted, respectively, from the Curricular Organizers of Mathematics for Elementary Education (Pernambuco, 2021) and the Curricular Organizers of Mathematics for High School (Pernambuco, 2023).

Table 2

Coordination between EFEJAAFMA19PE and EMEJAMAT203M2MA05PE

Hab.	EFEJAAFMA19PE	EMEJAMAT203M2MA05PE
Type of tasks	**H 4 -T 1** – To solve and develop problems involving percentage calculations in financial education contexts.	**H 9 -T 1** – Use mathematical concepts in the planning, execution, and analysis of actions for the use of applications and the creation of spreadsheets (for example, in activities involving family budget control).
Technique	τ_5 – Personal calculation strategies based on contextualizing the problem.	
	τ_6 – Modeling with objects or visual representations (graphics) .	
		τ_7 – Modeling with objects or visual representations (graphics) .
	τ_{10} – Digital technologies: Spreadsheets (Excel, Google Sheets), financial applications, educational platforms (Kahoot or GeoGebra), calculator.	
		τ_{11} – Digital technologies: Spreadsheets (Excel, Google Sheets), financial applications, educational platforms (Kahoot or GeoGebra), calculator.
		τ_{13} Symbolic resolution, graph analysis.
		τ_{14} – Symbolic construction of budget spreadsheets.
Technology	θ_5 – Percentage: is the ratio between a number and 100, and we represent this ratio with the symbol %. We use this ratio to represent parts of a whole. The percentage is a centesimal ratio, that is, based on 100.	
	θ_6 – Converting a percentage to a fraction with a denominator of 100.	
	θ_7 – Converting a percentage to a decimal number.	
		θ_8 Simple interest is calculated based on the initial value, known as capital, the interest rate, and the time. The formula for simple interest is...

		J = C · i · t, where J is the interest, C is the principal, i is the interest rate, and t is the time.
		θ_9 – Compound interest is when interest is calculated on interest. Interest is used to make monetary corrections, for late payments, or for investments.
		θ_{12} – THE financial budget It is a plan that forecasts and organizes the income and expenses of a person or company, aiming to enable organization for adjustments and improvements. sustainable and strategic financial plan.
Theory	**Θ_1** – Numbers	
		Θ_2 Numbers and Algebra

Note. *Chiappetta, 2025, p. 211*

These two skills, despite being from different educational levels – Elementary and High School – manage to encompass the tasks and techniques proposed in the three situations presented by the teachers, in addition to being able to relate to the lesson plan constructed by them. In general, only two Techniques are common to both skills: τ_5 and τ_6, however, Techniques τ_{10} (from H_4 - T_1), τ_7 , τ_{11}, τ_{13} and τ_{14} (from H_9 -T_1). And, the presence of Theories Θ_1 (from H_4 -T_1), Θ_2 (from H_9 -T_1) and Technologies θ_5 , θ_6 and θ_7 (from the H_4 -T_1), θ_8 , θ_9 and θ_{12} (from H_9 -T_1) that are related in the planned teaching situations.

The first teaching situation involves simulating a store with a promotion, where the environment is prepared with images of household appliances or product packaging, including labels with fictitious prices and discounts (τ_6). Students, observing the images and promotions, should be encouraged to discuss purchase options and are invited to calculate the final discounted price, comparing cash *versus* installment purchase options (τ_5). The discussion is geared towards provoking reflection on what is financially more advantageous, encouraging the calculation of discounts and understanding of the impact on the personal budget.

The second teaching situation, focused on financial planning with spreadsheets, should begin with an explanation of what a financial budget is, highlighting the importance of financial planning through the creation of a simple spreadsheet. Each participant then creates a personal or family budget spreadsheet (describing income, expenses, and their values) based on a fictitious income, detailing their expenses and

available budget (τ_6 , τ_7 , τ_{11} , τ_{13} and τ_{14}), followed by a discussion and reflection comparing different budgeting approaches, and exploring strategies for more efficient financial management (τ_5).

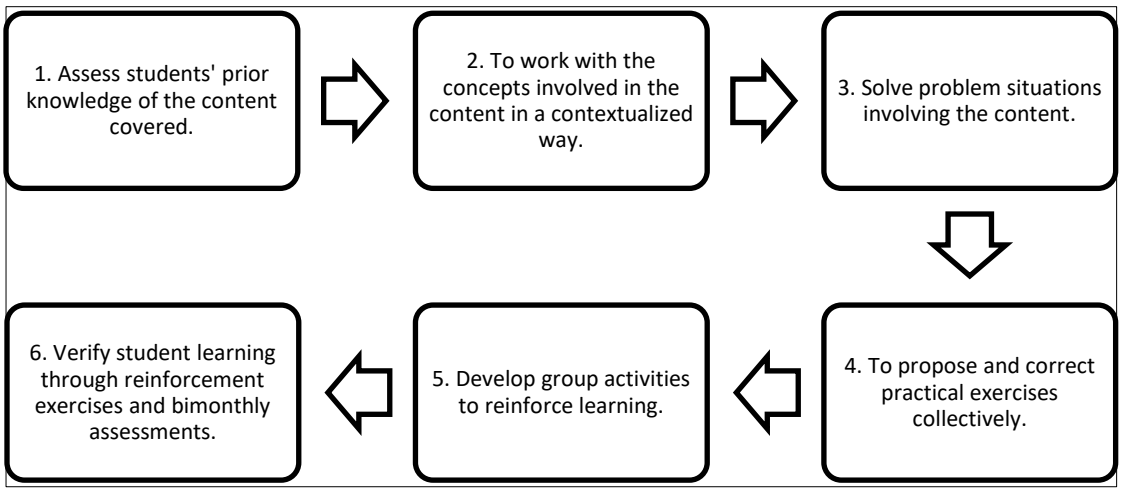
The third teaching situation, on simple interest, begins with contextualization through the exploration of examples of common loans, such as those made through credit card limits compared to bank loans (τ_5 , τ_6 and τ_{10}), and aims to perform simulations of simple interest calculations, highlighting the differences in costs over time. Following this, real-world cases are discussed that illustrate the use of different forms of credit, such as cash purchases *versus* installment purchases, culminating in an analysis activity where calculation challenges are proposed so that students better understand the financial impacts of credit-related decisions.

These three proposed teaching situations were designed to be interactive, educational, and practical, in order to provide students with a learning experience that is contextualized and meaningful to them. By incorporating everyday situations, the activities not only encourage active participation but also facilitate the internalization of financial concepts that are fundamental to students' daily lives.

We also consider Part 6 - Meeting 10, in which, taking as a reference the specific instructions of the teachers outlined in the Dominant Didactic Model (MDD) for teaching MF in EJA in Carpina/PE (Figure 3), we improved the aforementioned model in order to make it a Reference Didactic Model (MDR) for teaching in EJA. Some modifications were made based on reflection on the teachers' statements for the construction of the MDR.

Figure 4

Reference Didactic Model (MDR) for teaching in EJA



Note. Chiappetta, 2025, p. 227

In this MDR (Methodological Development Report), we improved the four actions of the MDD (Methodological Development Document) and added two other actions, actions 1 and 5, respectively: Assessing students' prior knowledge of the content covered; Developing group activities to reinforce learning. The detailed description of the MDR is presented later, to support the didactic organization of teachers.

Since the MDR constructed in this study prioritizes aspects related to teaching percentages in EJA, we decided to offer a brief consideration of the rationale behind the concept of Percentages in EJA: understanding the social and professional issues of students' daily lives, considering that many of them are in the job market and deal with financial matters such as calculating discounts, surcharges, interest rates, taxes, and even budget planning.

Thus, the teachers considered that mathematics that addresses concepts related to the students' context/daily lives, such as percentages, offers tools for these students to make more informed and participatory decisions in society, improving their ability to understand and act in situations involving money, consumption, and even health. They considered, therefore, that this is knowledge that goes beyond the classroom, since it is reflected in daily life, in the student's interactions with the world around them, and in their social responsibilities.

It can be said that teaching percentages in adult education, therefore, goes beyond the application of mathematical formulas (which is also true for any mathematical knowledge). It plays a fundamental role in developing students' autonomy and critical thinking skills, enabling them to make more informed decisions and better understand the economic environment in which they operate.

In a survey conducted with teachers about what students can do with percentages or how they will be useful in their lives, it is possible to see that with percentages students can:

- Make more informed decisions about your purchases by calculating how much you will pay with a given discount applied;

- Understanding the fundamentals of taxes, such as the Tax on the Circulation of Goods and Services (ICMS), Income Tax, Taxes on Products and Services (PIS/COFINS), and others applied as percentages of values;
- To understand how financing, loans, credit cards, and interest rates work, which are also expressed as percentages;
- Knowing how percentages impact the final amount to be paid over time is essential to understanding the true extent of a debt and making informed decisions about loans and financing.
- To make adjustments (such as doubling or reducing the amount of ingredients) to the portion sizes of culinary recipes;
- To interpret the results of electoral processes and understand the distribution of political support;
- to understand the economic situation and the changes that occur over time, based on economic and social data, such as inflation, unemployment rates, economic growth and other indicators, presented as percentages;
- Calculate the body mass index (BMI), which indicates whether a person is within the recommended weight range according to their height;
- Measuring the effectiveness rates of medications or vaccines is used in many healthcare settings, as well as in many other situations and contexts.

Regarding aspects related to teaching percentages, we constructed Figure 5[16], which seeks to synthesize the elements that influence the teaching of percentages and that should be taken into account by teachers in the construction of their teaching practice. Initially, we listed, for the teaching of percentages, reflection on the Epistemological, Didactic, and Psychological dimensions; however, we perceived the need to highlight the Institutional dimension, considering that the theoretical core of our research is the Theory of Didactic Analysis (TDA), and that one of Chevallard 's basic premises is that all knowledge is the result of human production and its functioning depends on the institution in which it is found; knowledge does not exist in isolation.

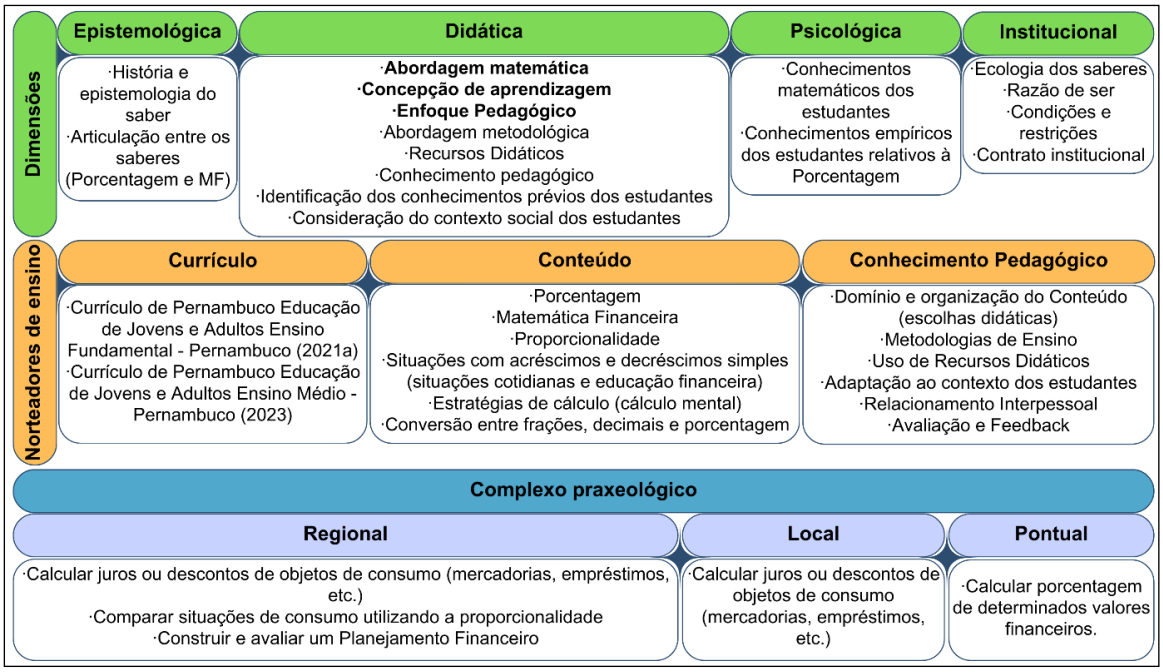
[16] The elements presented in the figure are dynamically interconnected, since the curriculum encompasses epistemological, didactic, psychological, and institutional dimensions. Similarly, teaching practice depends directly on teaching guidelines, such as the curriculum, content, and pedagogical knowledge, which also influence the Praxeological Complex.

The institutional dimension makes it possible to affirm how knowledge is constructed and how it lives within the institution, what the reason for knowledge is for the subjects within the institution, and what conditions and restrictions exist in the environment for the promotion of knowledge.

In addition to these four dimensions, emphasis was also placed on the guiding principles of teaching – Curriculum, Content, and Pedagogical Knowledge – and on the praxeological complex – Regional, Local, and Specific – relating to the teaching of Percentages in Adult Education, as shown in the figure:

Figure 5

Elements related to teaching Percentage



Note. Chiappetta, 2025, p. 230

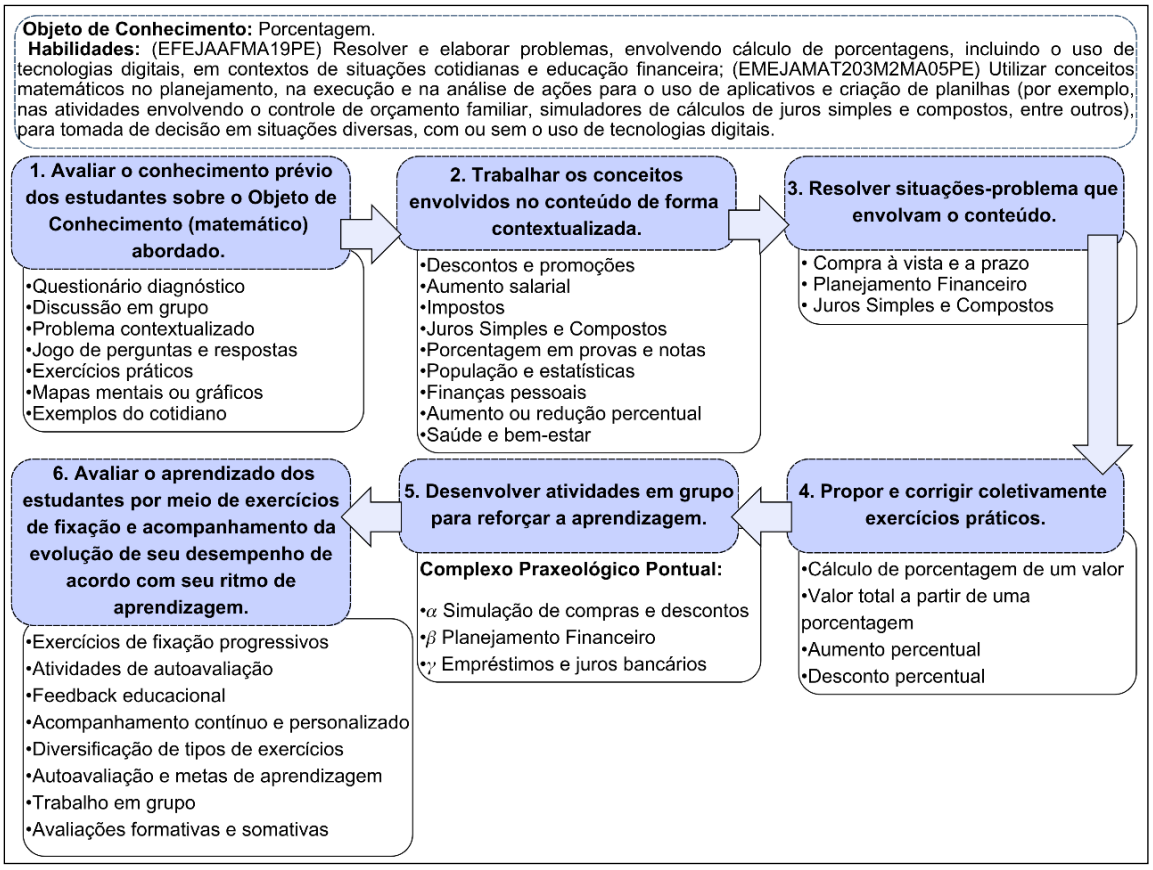
For this organization to make sense, there is a need for adaptation to the students' context, developing materials that are in accordance with the students' level of knowledge and their specific needs. Strengthening interpersonal relationships with students also promotes greater interaction and communication, encouraging participation and dialogue during classes. Finally, assessment and feedback allow for verification of students' understanding, offering constructive feedback to help them improve.

Regarding the praxeological complex, we present points ranging from broader (Regional) to those more specifically directed to the audience (Specific). Thus, the

points presented in the Regional topic – Calculating interest or discounts on consumer goods (merchandise, loans, etc.); Comparing consumption situations using proportionality ; Building and evaluating a Financial Plan – are presented according to the Curriculum; the Local topic – Calculating interest or discounts on consumer goods (merchandise, loans, etc.) – presents approaches that can be followed for learning the aforementioned content; and the Specific topic – Calculating percentages of certain financial values – represents the teaching situations constructed in this research for students.

Figure 6

Reference Didactic Model (MDR) for Teaching Percentages in EJA



Note. Chiappetta, 2025, p. 231

Overall, regarding the emphasis we place on the Knowledge Object (mathematical) and Skills mentioned, taking into account the Table 2, which presents the articulation between the praxeological structure of the EFEJAAFMA19PE and EMEJAMAT203M2MA05PE skills, we highlight six essential actions for a teaching path in the Reference Didactic Model.

The following are six tables describing each action based on the points highlighted for each one, including some elements that form the praxeological structures related

to these skills. In general, only two Techniques are common to both skills: τ_5 and τ_6. However, the presence of Theory Θ_1 (from H_4 - T_1) and Θ_2 (from H_9 - $T_{1)}$ and Technologies θ_5, θ_6 and θ_7 (from H_4 -T_1), θ_8 , θ_9 and θ_{12} (from H_9 -T_1) that are related during the planned teaching situations.

Table 3

Assess students' prior knowledge of the subject matter being addressed (mathematical)

To assess students' prior knowledge of the subject matter of percentages, several interactive strategies can be used, as presented below:	
Diagnostic questionnaire	This could be a questionnaire with some basic tasks about the subject of Percentages. Based on the students' answers to the questionnaire, the teacher can identify gaps in understanding and adjust the teaching as needed. Examples of tasks: What is the definition of percentage? (H_9 -T_1) How to calculate 10% of a value? (H_4 -T_1) What is the 20% increase on R$100? ($H_4$ -T_1)
Group discussion	The initial discussion can promote reflection on everyday situations (τ_5 and τ_6), such as when students use percentages, such as: discounts, price increases, school grades, among others. This allows the teacher to observe how students understand the concept and what their difficulties are.
Contextualized problem	The teacher can present a real-world problem and ask students to solve it individually or in groups, justifying their reasoning. Example task (H_4 - T_1) : A store is offering a 30% discount on a product that costs R$500. What will be the final price of the product with this discount?
Question and answer game	The teacher can organize a quick game for students to answer simple Percentage questions. The teacher can use question cards or digital tools such as Kahoot (τ_{11}) to assess the level of understanding.
Practical exercises	The teacher can propose simple exercises and ask students to explain how they arrived at the answer, in order to understand how they think about Percentage, based on the resolution process (τ_5) . Example task (H_4 - T_1): If a cell phone that costs R$1,200 is on sale with a 15% discount, what will be the final sale price after the discount is applied?
Mind maps or charts	The teacher can ask students to draw mind maps or diagrams (τ_7) explaining what they know about Percentage. This allows them to clearly visualize their ideas and the concepts they have already mastered.
Everyday examples	There are strategies that can help teachers identify students' prior knowledge levels, which allows them to personalize their lessons according to the needs and difficulties observed. Example of technique (τ_5): By asking students how they calculate a discount in a promotion or a salary increase, the teacher can check if the students' answers reveal whether they already apply the concept in their daily lives.

Note. *Adapted from Chiappetta, 2025*

Table 4.

Working with the concepts involved in the content in a contextualized way

Working with percentage concepts in a contextualized way helps students relate the content to everyday situations, making learning more meaningful. Here are some topics and examples of techniques for contextualizing the teaching of percentages.	
Discounts and promotions (H_4 -T_1)	Context: Offers and sales in stores. Task: A store offers a 30% discount on a product that costs R$ 200. What will be the final sale price after the discount is applied? This can be solved by students τ_5 and τ_6, who then think of a way to calculate it without using a formula. This type of example task allows students to visualize how to calculate discounts on real purchases, something common in their lives.

Salary increase (H_4 -T_1)	Context: Salary adjustments and personal finances. Task: If a person's salary is R$ 2,000 and they receive an 8% raise, what will their new salary be? Their actual salary levels, or even their career planning, help to illustrate the relevance of percentage calculations.
Taxes	Context: Taxes on products or services. Task: If a product costs R$ 1,000 and there is an 18% tax to be paid, which is not included in the product price, what will be the total amount to be paid by the consumer? Contextualizing the application of taxes is a way to prepare students for understanding domestic and business economics.
Simple and compound interest	Context: Bank loans and financial investments. Task: If you invest R$1,000 with a 5% monthly return, how much will you have at the end of 6 months? By introducing the concept of interest, students can begin to understand how savings yields and borrowing costs work.
Percentage in tests and grades	Context: Calculation of school grades and performance evaluation. Task: If a test is worth 100 points and a student answered 70 questions correctly, what is their percentage of correct answers? Relating the percentage to the calculation of the grades themselves is a direct way to provide context.
Population and statistics	Context: Population, health, and research data. Task: If a survey reveals that 25% of a city's population owns a car, and the city has 200,000 inhabitants, how many people own a car? Using real statistics (such as data from the IBGE - Brazilian Institute of Geography and Statistics) makes the concept more concrete, especially in discussions about society and citizenship.
Personal finances	Context: Financial organization. Task: If a person spends 40% of their salary on rent and their salary is R$ 2,500, how much do they spend on rent and how much is left over for other expenses? Relating percentages to personal financial planning allows you to build this skill, which is important for life.
Percentage increase or decrease	Context: Inflation and price adjustments. Task: If a product cost R$ 50 and now costs R$ 60, what was the percentage increase? Understanding price increases and decreases helps in the critical analysis of phenomena such as inflation.
Health and well-being	Context: Percentage calculation in diets or physical activities. Task: If a person needs to consume 2,000 calories per day and wants to reduce their daily intake by 25%, how many calories should they consume? Relating percentages to health teaches the importance of controlling and adjusting eating and physical habits.

Note. *Adapted from Chiappetta, 2025*

Table 5

Solving problem situations involving the content

Solving problem situations involving a given subject allows students to apply their knowledge in practical contexts, making it more relevant. This helps consolidate learning, developing logical reasoning, autonomy, and confidence when facing real-world challenges.	
Cash and installment purchases	When teachers engage students in comparing the cost of paying in cash versus paying in installments, taking into account potential discounts or interest charges, they can develop students' skills to make more informed financial decisions.
Financial Planning	By explaining how financial planning can be done, the teacher promotes in students an understanding of how to distribute and manage money over time, considering expenses and savings, which enables the development of financial autonomy.
Simple and Compound Interest	As the instructor solves problems involving interest, students learn to calculate how much a loan or investment can grow over time, developing logical reasoning and the ability to project both short-term and long-term financial scenarios.

Note. *Adapted from Chiappetta, 2025*

Table 6

Propose and correct practical exercises collectively

These exercises can be corrected collectively, which encourages students to explain their processes, promoting a collaborative learning environment. The teacher can also propose variations of the problems, with contexts closer to the students' reality, through debate and reflection, group activities, and... research.	
Calculating the percentage of a value.	When teachers propose exercises that involve calculating the percentage of a value, they help students understand how to quantify parts of a whole. By solving these problems together, students can share their approaches, which facilitates the understanding and application of this concept in everyday situations.
Total value as a percentage	This exercise allows students to practice determining the total value based on a known percentage. Collective correction promotes dialogue about different techniques and strategies, and the teacher can present variations that better contextualize the exercise, making it more relevant to the students.
Percentage increase	When working with percentage increases, students learn to calculate how much a value grows in relation to its original value. Exercises on this topic can be discussed in groups, encouraging the exchange of ideas and reflection on real-life situations, such as salary increases or price adjustments.
Percentage discount	By proposing exercises involving percentage discounts, the teacher allows students to practice subtracting a portion of the original value. Correcting the work together not only clarifies doubts but also allows the teacher to introduce variations that allude to store promotions or service discounts.

Note. *Adapted from Chiappetta, 2025*

Table 7

Develop group activities to reinforce learning

Praxeological Complex presented in Figure 5 on Aspects Related to the Teaching of Percentages, three situations stand out, detailed in this section:	
α **Purchase**	In a simulated supermarket or store setting, students can handle play money while performing calculations related to the value of purchases and the

and discount simulation	application of discounts, exploring everyday financial situations in practice. The teacher should guide the calculations and discuss the advantages of paying in cash or by card.
b **Financial Planning**	The teacher should begin with an explanation of Financial Planning and how it can be applied in daily life. Then, they should encourage students to create a spreadsheet of their income and expenses, real or fictitious, of their choice, indicating their fixed and/or variable income and expenses such as food, housing, and transportation. The task should allow for reflection on financial organization, and the teacher should propose techniques to discuss possible adjustments to deal with limited incomes. The situation can be structured to connect the students' financial realities with the use of simple mathematical tools, such as spreadsheets.
y **Bank loans and interest rates**	The instructor should present the basic concepts of how bank loans and interest rates work and facilitate a discussion about their impact on personal finances. By dividing the students into groups, the instructor should guide each group to simulate different types of loans, such as bank loans and credit card loans, comparing interest rates. After the calculations, a collective reflection should be held on the results and the importance of understanding interest rates before taking on debt.

Note. *Adapted from Chiappetta, 2025*

Table 8

To assess student learning through reinforcement exercises and monitoring the evolution of their performance according to their learning pace.

Assessing students' learning about percentages, or any other content, involves creating reinforcement exercises and strategies to monitor individual progress at each student's pace, such as:	
Progressive reinforcement exercises	To structure the difficulty levels, the teacher should start with simple exercises (basic percentage calculations) and gradually move on to more complex problems (such as percentages applied to real-life situations, interest, and percentage increases). Task in progress: Level 1: Calculate 15% of R$ 300. Level 2: If a product costs R$ 500 and has a 10% discount, what is the final price? Level 3: A product that cost R$ 400 was increased to R$ 460. What was the percentage increase? By observing successes and errors at different difficulty levels, it is possible to identify areas where students have more difficulty and adjust the teaching accordingly.
Self-assessment activities	The teacher should offer students the opportunity to correct their own exercises using answer keys, explaining the reasoning behind each answer. This practice encourages reflection on their own learning and allows students to identify their mistakes. Example: After solving the problem, compare your answer with the answer key and explain why your solution is correct or incorrect.
Educational feedback	In grading, the teacher should comment on the questions instead of just giving a grade, as explanatory feedback at each stage of the reasoning process helps to highlight the correct points and indicate how to improve based on the errors. Example: You correctly calculated a 10% discount, but in the final step, you forgot to subtract the discount amount from the original price.
Continuous and personalized support	The teacher should keep individual records for each student, with information about which concepts they have mastered and which ones they find most difficult. This helps in planning personalized activities.

	Example: If a student shows difficulty with percentage increase problems, you can suggest specific extra exercises on that topic. It is necessary for the teacher to have a Progression Plan, in which they can divide the content into stages and monitor whether students are progressing in each one. Thus, by adjusting the pace of activities for those who are advancing more quickly, they can provide reinforcement to those who need more time. Furthermore, the teacher should periodically assign review exercises that include previously studied content. This reinforces learning and allows for the identification of persistent difficulties. Review of concepts – Task: Calculate the percentage increase of a product that went from R$ 150 to R$ 180 and then apply a 15% discount.
Diversification of exercise types	The teacher should diversify the exercises by including: Contextualized problems and gamified exercises. For the latter example, educational games, online quizzes , or other online platforms that involve solving problems with percentages can be used, offering an interactive way to track performance; students accumulate points for correctly solving percentage problems.
Self-assessment and learning goals	The teacher should encourage students to reflect on their own progress and to set goals for improvement. They can do this based on their self-assessments and the feedback they receive.
Group Work	The teacher can provide collaborative lessons by organizing students into groups according to their levels of understanding, allowing those who already master the content to help their classmates. This reinforces learning on both sides.
Formative and summative assessments	The teacher can conduct formative assessment and summative assessment. The first is Short and frequent, it can be used to assess continuous progress without the weight of a final assessment, helping to adjust teaching based on the student's needs; the second combines different types of assessments (exercises, tests, practical work) to measure learning over a period, always emphasizing individual progress.

Nota. *Adapted from Chiappetta, 2025*

The presented MDR (Model of Didactic Reference) allows for the observation of practices that can be adopted when teaching Mathematics, with an emphasis on the Percentage Knowledge Object, in Adult Education (EJA). By articulating the skills EFEJAAFMA19PE and EMEJAMAT203M2MA05PE, respectively, present in the Curricular Organizers of Mathematics for Elementary and High School, the model is based on six actions that trigger a pedagogical path. Furthermore, this model contributes to reflecting on and enhancing the development of other possible teaching approaches and strategies for Adult Education.

Final considerations

In this study, we present a section of the development of a Didactic Reference Model (MDR), an object of the Anthropological Theory of Didactics (TAD), articulating the teaching of Financial Mathematics (MF) in the modality of Youth and Adult Education

(EJA) based on a more in-depth analysis of the skills foreseen in the EJA curricula, contemplating the praxeological dimension , with regard to the teaching of MF.

Thus, from the perspective of TAD, we recognize that the curricula themselves play a fundamental role in guiding teaching work. This is because each skill described in the curricular documents can encompass a wide variety of task types. Therefore, by choosing to identify a task type (T) representative of each selected skill, teachers were able to discuss some technique(s) (τ) τthat make its resolution possible.

It is important to highlight that, when considering TAD (Theory of Didactic Activity) in the context of EJA (Youth and Adult Education), a formal explanation or in-depth study of the theory was not conducted with the participating teachers, as we understood that the study time would be insufficient to address such a complex theorization as that proposed by Chevallard . However, we considered the initial notions of task type and technique, in a sense closer to the everyday understanding of these terms in teaching practice, relating them to classroom teaching situations. Even so, this approach contributed to encouraging teachers to critically reflect on their pedagogical actions, promoting the construction of more consistent didactic knowledge aligned with the demands of EJA.

After the teachers identified, for each of the skills highlighted in the material, a type of task (T) and the techniques (τ) involved in its resolution, without explicitly referring to the concepts and praxeological elements of TAD, it was possible to delve into its analysis and also identify the technology(ies) (θ) and theory(ies) (Θ) underlying the practices mentioned.

It is worth noting that, in the development of this research, we were able to identify conditions and restrictions modeled also in the form of personal or institutional relationships to an object, which can be associated with the promotion of work with Mathematical Physics (MP) in the Youth and Adult Education (EJA) modality, offering a perspective that does not appear in other studies. In general terms, regarding the levels of didactic co-determination of Mathematical Physics (TDI), which go beyond the classroom space, two conditions for teaching MP in EJA can be considered common to EJA classes – the contextualization of content and adaptation to the profiles of EJA

teachers – and two restrictions of the subject – difficulties with basic mathematical concepts and lack of interest.

Furthermore, it is important for teachers to seek ways to adapt to the diverse profiles of students, taking into account that, in EJA (Youth and Adult Education), they have varying ages, life experiences, and educational levels. This requires adapting the content so that it is accessible and meaningful to everyone, respecting the pace and learning conditions of each individual.

Regarding limitations, it is common for many adult education students to struggle with the basic mathematical concepts necessary to learn mathematical concepts, such as fundamental operations (addition, subtraction, multiplication, division) and fractions. This can make teaching more challenging and require more time dedicated to mathematical skills before moving on to more complex concepts. Furthermore, some mathematical concepts, such as compound interest, amortization, and investments, can be difficult to understand without a solid foundation in basic mathematics. This requires a careful approach, with many practical and simple examples, and the use of methodologies that actively involve the student, which returns to the need to provide contextualization of the content.

One of the highlights of this study is precisely the emphasis on the importance of the teacher's active participation in reflecting on their own practice. By listing the skills and highlighting the types of tasks to be worked on directly with the students, the teacher moves from being a mere executor of content to a developer of techniques that give new meaning to the Objects of Knowledge, analyzing, questioning, and adapting their pedagogical actions to the audience they teach. By reflecting on their practice, they not only identify the challenges of daily school life, but also articulate teaching by taking into account practical experiences that can be used in the students' daily lives or even in the professional environment in which they are involved. This reflective stance is fundamental to promoting a more conscious, contextualized education committed to student learning.

The Reference Didactic Model for teaching Financial Education and Financial Mathematics in Youth and Adult Education (EJA) can promote not only an articulation between the skills foreseen in the official documents of the modality with the

constructed praxeological structures , but can also enhance the development of pedagogical practices that take into account the context of the students, in addition to being a starting point for the development of praxeologies that meet the demands of teaching Mathematics in EJA.

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