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The act of planning school mathematics through universal design for learning: a formative episode in initial teacher education

El acto de planificar la matemática escolar a través del diseño universal para el aprendizaje: episodio formativo en la formación inicial docente

L'acte de planifier les mathématiques scolaires à travers la conception universelle pour l'apprentissage : épisode formatif dans la formation initiale des enseignants

O ato de planejar a matemática escolar através do Desenho Universal para Aprendizagem: episódio formativo na formação inicial do professor

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Abstract

Teacher training spaces need to foster reflective dialogues that establish a close relationship between their training and the school curriculum from the perspective of inclusive education. We highlight Universal Design for Learning (UDL) as a strategy for promoting innovative and inclusive training contexts. This research was developed in the locus of initial training for Mathematics teachers and aimed to implement a training episode guided by the assumptions of UDL that favors student immersion, through the competence to plan Mathematics teaching, and can contribute to the promotion of critical, reflective, creative and authorial processes that meet the principles of inclusive education. To this end, qualitative research of the collaborative action research type was used in a federal institution of basic, technical and technological education. As results, we present the action of the planning guided by the UDL; the pedagogical intentions for school Mathematics based on the UDL; some of the similarities present between the UDL guidelines and the specific competencies of the Mathematics area described in the National Common Curricular Base; and a practical framework that contextualizes the learning experiences of the participants of this research. We can conclude that the theoretical and

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practical basis of the UDL is a fertile repertoire for the elaboration of flexible, personalized and differentiated curricular proposals and for the improvement of the dialogue about pedagogical practice in the inclusive perspective, this guided by the promotion of learning environments committed to the formation of intentional and reflective, resourceful and authentic, and strategic and action-oriented learners.

Keywords: Universal design for learning, Teacher training, Mathematics inclusive, Curricular accessibility, Collaborative action research.

Resumen

Los espacios de formación docente necesitan propiciar diálogos reflexivos que establezcan una estrecha relación entre su formación y el currículo escolar desde la perspectiva de la educación inclusiva. Destacamos el Diseño Universal para el Aprendizaje (DUA) como estrategia para promover contextos de formación innovadores e inclusivos. Esta investigación se desarrolló en el locus de la formación inicial de profesores de Matemáticas, que tuvo como objetivo implementar un episodio formativo guiado por los presupuestos de la DUA que favorezca la inmersión de los estudiantes, a través de la competencia en la planificación de la enseñanza de las Matemáticas, y pueda contribuir a la promoción de procesos críticos, reflexivos, creativos y autorales y que atienda a los principios de la educación inclusiva. Para ello se utilizó una investigación cualitativa del tipo investigación acción colaborativa en una institución federal de educación básica, técnica y tecnológica. Como resultados presentamos la acción de planificación guiada por la DUA; las intenciones pedagógicas para la Matemática escolar basadas en la DUA; algunas de las similitudes presentes entre los lineamientos de la DUA y las competencias específicas en el área de Matemáticas descritas en la Base Curricular Común Nacional y un marco práctico que contextualiza las experiencias de aprendizaje de los participantes en esta investigación. Podemos concluir que la base teórica y práctica de DUA es un repertorio fértil para desarrollar propuestas curriculares flexibles, personalizadas y diferenciadas y para mejorar el diálogo sobre la práctica pedagógica desde una perspectiva inclusiva, guiada por la promoción de ambientes de aprendizaje comprometidos con la formación de educandos intencionales y reflexivos, ingeniosos y auténticos, estratégicos y orientados a la acción.

Palabras clave: Diseño universal para el aprendizaje, Formación docente, Matemáticas inclusivas, Accesibilidad curricular, Investigación-acción colaborativa.

Résumé

Les espaces de formation des enseignants doivent favoriser des dialogues réflexifs qui établissent une relation étroite entre leur formation et le programme scolaire dans la perspective d'une éducation inclusive. Nous mettons en avant la Conception Universelle pour L'apprentissage (l'CUA) comme stratégie de promotion de contextes de formation innovants et inclusifs. Cette recherche a été développée dans le cadre de la formation initiale des professeurs de mathématiques, qui visait à mettre en œuvre un épisode de formation guidé par les hypothèses de l'CUA qui favorise l'immersion des étudiants, à travers la compétence de planification de l'enseignement des mathématiques, et peut contribuer à la promotion de processus critiques, réflexifs, créatifs et auteurs et qui répond aux principes de l'éducation inclusive. À cette fin, une recherche qualitative de type recherche-action collaborative a été utilisée dans une institution fédérale d'enseignement de base, technique et technologique. En guise de résultats, nous présentons l'action de planification guidée par le l'CUA; les intentions pédagogiques pour les mathématiques scolaires basées sur le l'CUA; certaines des similitudes présentes entre les lignes directrices du l'CUA et les compétences spécifiques dans le domaine des mathématiques décrites dans la base pédagogique nationale commune et un cadre pratique qui contextualise les expériences d'apprentissage des participants à cette recherche. Nous pouvons conclure que la base théorique et pratique du l'CUA constitue un répertoire fertile pour développer des propositions curriculaires flexibles, personnalisées et différenciées et pour améliorer le dialogue sur la pratique pédagogique dans une perspective inclusive, guidée par la promotion d'environnements d'apprentissage engagés dans la formation d'apprenants intentionnels et réfléchis, ingénieux et authentiques, stratégiques et orientés vers l'action.

Mots-clés : Conception universelle pour l'apprentissage, Formation des enseignants, Mathématiques inclusives, Accessibilité des programmes, Recherche-action collaborative.

Resumo

Os espaços formativos de professores carecem ascender diálogos reflexivos que estabeleçam uma relação de proximidade entre a sua formação e o currículo escolar na perspectiva da educação inclusiva. Destaca-se, no Desenho Universal para Aprendizagem (DUA), uma estratégica para a promoção de contextos formativos inovadores e inclusivos. Esta pesquisa desenvolveu-se no lócus da formação inicial do professor de matemática e teve como objetivo implementar um episódio formativo orientado pelos pressupostos do DUA para favorecer a imersão dos estudantes, através da competência em planejar o ensino da matemática, de modo a

contribuir para o fomento de processos críticos, reflexivos, criativos e autorais, além de atender os princípios da educação inclusiva. Para isso, foi empregada uma pesquisa qualitativa do tipo pesquisa-ação colaborativa em uma instituição federal de educação básica, técnica e tecnológica. Os resultados mostram a ação do planejamento orientado pelo DUA; as intencionalidades pedagógicas para a matemática escolar com base no DUA; algumas das similaridades presentes entre as diretrizes do DUA e as competências específicas da área da Matemática descritas na Base Nacional Comum Curricular e um quadro prático que contextualiza as experiências de aprendizagem dos participantes desta pesquisa. Conclui-se que a base teórico-prática do DUA é um repertório fértil para a elaboração de propostas curriculares flexíveis, personalizadas e diferenciadas. Ele serve para o aprimoramento do diálogo acerca da prática pedagógica na perspectiva inclusiva, orientado pela promoção de ambientes de aprendizagem comprometidos com a formação de aprendizes intencionais, reflexivos, engenhosos, autênticos, estratégicos e orientados para a ação.

Palavras-chave: Desenho universal para aprendizagem, Formação docente, Matemática inclusiva, Acessibilidade curricular, Pesquisa-ação colaborativa.

The act of planning school mathematics through universal design for learning: a formative episode in initial teacher education

School mathematics can be viewed as a social instrument that represents fundamental information that is essential for human development through its daily application in life. Consequently, it must be taught in a way that ensures all students learn for life. In this perspective, teachers assume a legitimate role in the students' educational journey, cultivating complex skills through the facilitation and fostering of an inclusive education that honors diversity. However, the absence of appropriate education for teachers can be one of the elements that contribute to students' failure to exhibit essential abilities in the classroom, hence hindering their engagement and learning.

The issue of teacher education, irrespective of the instruction methodology employed, has often been the focus of research and analysis. Furthermore, the inclusive education paradigm has emerged as a priority goal in recent decades, garnering attention at both national and international levels. Notwithstanding the acknowledgment of the need for inclusion, to date, the initiatives undertaken in teacher education have been inadequate in fostering and achieving more inclusive and effective educational institutions.

Lima (2016) identifies the education of teachers to operate in diverse environments and with a diverse student demographic as a critical challenge for institutions. Nevertheless, in the field of school mathematics, teachers often lack sufficient education to develop inclusive pedagogical practices for students who qualify for special education within mainstream classrooms. Such education is necessary to ensure that learning opportunities are provided to a diverse range of students (Silva, 2023).

This study emphasizes the domain of pre-service teacher education. As asserted by Ambrosetti and Calil (2016, p. 215) "teacher education have not equipped teachers with the required expertise to meet the contemporary demands and responsibilities of the teaching profession," a subject of contention in recent years due to critiques concerning the insufficient preparation and suitability of these individuals for professional practice (Sandeski & Nora, 2017). Furthermore, we emphasize that the initial education of educators must establish a foundation that ensures formative processes designed to foster the development of conditions for the establishment of inclusive education, characterized by respect for differences and the recognition and appreciation of ethnic-racial, gender, sexual, religious, and age diversity (Brasil, 2024).

In light of the above, it is presumed that the institutional dimension of teacher education is the setting for an intricate interpretative process, in which theoretical and practical knowledge are essential for learning, and guided by political, economic, and social influences that directly affect it. Therefore, from the standpoint of inclusive education, initial teacher education introduces novel issues due to the diversity stemming from the democratization of educational access, which is crucial for enhancing inclusive teaching practices. This study focuses on Universal Design for Learning (UDL) as a theoretical and practical framework effective in promoting inclusive education and recognized by Sebastián-Heredero (2020) as one of the most widely disseminated findings in educational research. UDL originated in the field of architecture, and its concept was soon extended to other areas — notably education — in an effort to make learning accessible to all students. This domain includes three fundamental principles: multiple means of engagement (the rationale for learning), different means of representation (the learning content), and multiple means of action and expression (the learning methodology) (Rose & Meyer, 2002).

Consequently, teacher education processes should be structured as contexts for contextualized, reflective, critical, humanistic, and independent learning. Regarding initial teacher education, it is essential to view it as "a project structured around the competencies and knowledge required for professional efficacy" (Roldão, 2005, p. 107). Therefore, we identify UDL as a strategy for promoting innovative and inclusive educational contexts. This study employs UDL as a framework for the creation of a didactic and pedagogical intervention within a curricular component of the mathematics program, offered at a federal institution of basic, technical, and technology education, in the second semester of 2023.

> The pre-service education of mathematics teachers is a topic of growing interest and relevance in educational research, particularly in light of the contemporary challenges involved in teaching the subject. The need for a curriculum with a distinct identity for Mathematics teacher education – one that not only delivers mathematical content but also equips future teachers for creative, reflective, and innovative pedagogical practice – is essential to ensuring quality education (Costa et al., 2023, p. 2).

Thus, the central question underlying this project is: How might the UDL approach contribute to the formative process of prospective mathematics teachers? The primary objective is to create a formative episode based on the theoretical and methodological principles of Universal Design for Learning (UDL) that enhances student engagement by cultivating competencies for teaching mathematics, thereby promoting critical, reflective, creative, and autonomous processes while adhering to the tenets of inclusive education.

The interface between mathematics education and UDL

M. C. Santos (2023) asserts that contemplating education from an inclusive standpoint requires the provision of quality instruction for all students. However, the implementation of inclusion in schools has often faced significant challenges — particularly the difficulty of adopting inclusive pedagogical practices in meaningful ways. The author underscores the viability of implementing diverse activities within the school setting, fostering student inclusion and enriching experiences that promote learning opportunities for all. In this context, UDL can serve as a facilitator of school inclusion, "enhancing the teaching and learning processes, by enabling educators to develop the competencies needed to address diversity and create inclusive learning environments through strategies that support the process" (M.C. Santos, 2023b, p. 26).

Stellfeld (2023) affirms that to advance inclusive mathematics education, it is essential to adopt new paradigms that eliminate barriers and improve inclusive pedagogical practices. He emphasizes that "teaching mathematics from an inclusive perspective requires overcoming daily obstacles, cultivating a in-depth awareness of individual diversity, and seeking stimuli to engage the remaining senses, thereby facilitating the natural assimilation of content" (Stellfeld, 2023, p. 50). Furthermore, UDL is presented as a methodological framework associated with the inclusion process for equitable education, illustrating the removal of attitudinal and pedagogical obstacles; it is described as "not rigid, inflexible, or closed, but guiding, (...) in the pursuit of strategies that facilitate meaningful learning for all" (Stellfeld, 2023, p. 30).

According to Barros et al. (2023), mathematics is a field of knowledge that enables critical reflection on societal problems, therefore rendering it essential for the practice of citizenship. Nonetheless, they point to deficiencies in mathematics teaching, which are evident in the inadequate proficiency of Brazilian basic education. In this context, UDL is "a significant methodology for contemplating strategies applicable to diverse student populations, specifically approaches to address their needs." (Barros et al., 2023, p. 6).

Velasco and Barbosa (2022) also state that fulfilling the needs of all students requires understanding them and ensuring accessibility, which entails removing obstacles that impede or obstruct the enjoyment of their rights. The authors' definition of accessibility extends beyond physical and architectural aspects to encompass access to information, communication, pedagogical methods, and resources tailored to the unique needs of each student. To this end, UDL seeks to uphold the right to education for all students, offering significant advantages such as the development of inclusive practices and adaptations that remove barriers and enhance access to the teaching and learning processes. A key benefit is the utilization of diverse stimuli

that afford flexibility in the presentation of information, aiming for universal learning and moving beyond outdated practices in mathematics teaching within regular schools (Velasco & Barbosa, 2022, p. 17).

In this sense, Cristovam (2021, p. 51) advocates for UDL as an method for enhancing curricular accessibility and implementing inclusive pedagogical practices, asserting that "It is not merely a matter of differentiation, but rather a dynamic curricular process focused on differentiating to include everyone." Cristovam (2021, p. 47-48) generally defined accessibility "as the absence of any factors or barriers that may exclude, hinder, or restrict the participation of any individuals, including those with disabilities, in any process." Silva (2021, p. 51) states that the principles and guidelines of UDL can contribute to the strategies adopted "which are built, within the practice of teachers, in order to develop learning under equitable conditions." Consequently, teachers must endeavor to enhance the students' potential in everyday academic activities. The principles and strategies of UDL empower educators to assume a pivotal role in cultivating inclusive pedagogical practices that promote different learning opportunities and harness the cognitive potential of all students" (Silva, 2023, p. 59).

Muzzio (2022, p. 53) outlines that inclusive mathematics education, viewed through the lens of UDL, "requires that mathematics teachers possess the acumen to recognize differences and comprehend the diversity of students, thereby facilitating curriculum accessibility for all, irrespective of their conditions, characteristics, and talents." Sodré (2022) reinforces the importance of educating teachers who can work collaboratively and inclusively, recognizing diverse forms of knowledge and learning styles, thus fostering a democratic learning process that promotes student autonomy. Thus, UDL in teacher education represents "a promising method for enhancing inclusive pedagogical practices." Its strategies are specifically formulated on a more effective model for knowledge construction, reflection, and innovation in teaching practice" (Muzzio et al. 2022, p. 10).

In summary, UDL plays the critical role of "offering mathematics educators differentiated and accessible methodologies, while inclusive planning enables them to reevaluate their teaching approach by employing methods that have a beneficial effect on their students" (Silva, 2023, p. 121). Given this, we underscore the necessity of a pause in the mathematics teacher education program to counteract the standardization of school models that prioritize exclusion.

Collaborative action research

This investigation's approach to the object of research directed it towards a primarily qualitative study, conducted in a natural setting, abundant in descriptive data, characterized by an open and flexible design, and representing reality in a complex and contextualized manner (Lüdke & André, 2018). Nevertheless, considering that the research highlights foundational educational processes and the implementation of pedagogical practices among mathematics educators in primary education, we adhered to exploratory conceptual frameworks that facilitate "a more nuanced problem, one that can be examined through systematic methodologies" (Gil, 2010, p. 27).

We also conducted action research, which is a method that integrates research and practical action to address real-world issues in specific contexts. Vieira and Melo (2024) highlight the significance of collaborative action research in Brazilian educational scientific production, noting its unique attributes and its contribution to formative processes that nurture “autonomy, recognition of otherness, collective engagement, dialogical approaches, and democratic practices that foster transformative change within the educational contexts researched" (Vieira & Melo, 2024, p. 73). The selection of collaborative action research is predicated on the need for self-reflection in practice, serving as a suitable approach for enhancing the performance of both in-service and pre-service teachers; “it effectively integrates two facets of educational research: knowledge construction and ongoing teacher development (Ibiapina, 2008, p. 21).

Ghedin and Franco (2011, p. 238) contend that the pedagogy of action research encompasses "the complexity, unpredictability, opportunities stemming from unforeseen events, and the wealth of potential inherent in moments that emerge from praxis." Therefore, we examine the intermediate pedagogical processes delineated by the authors, which include the establishment of collective dynamics aimed at fostering a culture of cooperation within the practice group; the recontextualization of cyclical spirals that requires ongoing reflection on action, germane to the pedagogical essence of this investigative endeavor; the generation and dissemination of knowledge as interrelated and complementary tasks aimed at fostering collaborative initiatives; the analysis, redirection, and evaluation of practices that demand sustained engagement, enabling participants to engage in self-observation and observation of peers; and the recognition of new comprehensive dynamics that require the reconstruction of the individual as a reflective self.

This study examines a formative episode developed within a curricular component of the bachelor's program in mathematics at a Federal Institute offering basic, technical, and technological education. The episode centers on a formative immersion activity designed to cultivate professional identity and deepen engagement with the teaching profession, mediated through the structured process of lesson planning. Such formative episodes constitute educational instances that illustrate the relationship between the elements of a teacher education activity. According to + they are characterized by "written or spoken phrases, gestures, or actions that constitute scenes that can reveal the interdependence among the elements of a formative action."

Thus, in the episode entitled *"The Interface Between Inclusive Mathematics Education and UDL,"* we proposed the use of the underlying principles of UDL as both a theoretical and practical framework for planning inclusive mathematics instruction. As part of the study, we suggested the formulation of curricular accessibility proposals for mathematics education at the basic education level. We adopted the UDL 2.2 framework (Center for Applied Special Technologies) as a general reference instrument, understood as "a general reference tool (...) that can assist any educator or administrator in planning didactic units or developing curricula (objectives, methods, materials, and assessments) to reduce barriers and optimize levels of challenge and support" (Sebastián-Heredero, 2020, p. 4).

For ethical reasons, the identities of the participants are not disclosed in this document. In this case, it was necessary to develop a method for representing their responses. Each participant was assigned the designation "P," followed by a number ranging from 01 to 28. Consequently, participants were designated as P01, P02, P03, ..., P28. The participants were organized into ten Study Groups (SG), designated as SG1, SG2, ..., SG10.

Formative episode based on UDL

We consider that the "professional of the future must consistently anticipate trends, boldly engage with novel challenges and technologies, within the perpetual evolution of knowledge" (Bettio, 2023, p. 74). Therefore, in this formative context, we presented a proposal guided by the *maker movement.* Brockveld et al. (2017) assert that the fundamental concept of the maker movement is the appropriation of experimentation which in the teaching and learning process enhances collaborative practices and problem-solving skills — an effect observed in this study through formative teaching episodes. Furthermore, it is evident that "it not only impacts theoretical learning (...), but also induces a transformation in students' disposition, rendering them more inquisitive and adept at questioning, innovating, and creating." It hones

their perception, questioning abilities, logical reasoning, and creativity" (Oliveira et al., 2019, p. 276).

Raabe (2016) observes that the adoption of maker activities in educational settings has become a growing trend in various nations, including Brazil. According to the author, "the maker approach is associated with experiential learning, wherein the student is the protagonist in the process of constructing their own knowledge, acting as the architect of problem solution and the learning context itself" (Raabe, 2016, p. 10). (Raabe, 2016, p. 10). In line with this perspective Blikstein (2013, p. 19) interprets the maker movement as a practice in which students lead in the construction of knowledge by exploring topics of personal interest and relevance. In such practice, learners' experiences are recognized and valued.

According to a study by Casagrande and Vieira's (2024) - *Universal Design for Learning in Maker Practice*: *promoting inclusion and diversity*, educational environments are enhanced by the diversity of students' experiences, abilities, and comprehensions, which promotes more extensive and meaningful learning. Maker practices can therefore offer a beneficial opportunity to provide inclusive learning environments.

However, for these practices to be legitimately inclusive and address the needs of all individuals, it is essential that they are accessible, acknowledge differences, accommodate diverse learning styles and paces, and consider the sociocultural contexts of students, thereby facilitating the integration of UDL principles into maker practices (Casagrande & Vieira, 2024):

> The integration of UDL principles into maker-based practices enables the creation of educational environments that are more accessible, adaptable, and inclusive — ones that value and respond to the individuality of each student. Casagrande and Vieira (2024, p. 133) argue that examining the relationship between UDL and maker culture reveals a powerful pedagogical alignment: thus their integration supports the development of learning contexts that address learner variability while simultaneously fostering creativity, exploration, and hands-on creation.

In light of the above, we consider the maker method as a potent educational framework that may invigorate educators and foster innovative, engaging practices, facilitating the implementation of novel teaching strategies. Thus, the maker culture emerges as a repertoire for students to take ownership of their learning, promoting critical thinking and reflection, while the teacher's role shifts towards facilitating such processes. Furthermore, fostering connections between students and teachers catalyzes changes in relationships, encouraging a proactive teacher stance that resists complacency and pursues transformation. Such teachers participate in dialogues to redefine their pedagogical approach, articulate and examine unique concepts, and diligently monitor reality while perpetually innovating in their profession.

This study examines the **pedagogical mediation** process, focusing on four essential components (goals, techniques, materials, and assessment) that inform planning in accordance with UDL principles. The **goals** pertain to the teachers' expectancies concerning student learning, which, as noted by Sebastián-Heredero (2020, p. 738), "embody the knowledge, concepts, and skills that all students ought to acquire and are typically aligned with specific standards." Thus, in the formative episode regarding immersion, the objective was to incorporate disciplinary, pedagogical, curricular, technological, experiential, and socio-emotional knowledge into the planning of inclusive school mathematics classes, guided by the principles of UDL. According to Costa et al. (2022, p. 3), "during pre-service education, it is important that undergraduate students face scenarios that facilitate understanding and reflection regarding learning and teaching, enabling the application of techniques and didactic resources in the teaching of mathematics."

Methods are the pedagogical tools employed by educators to promote the teaching and learning process, which Sebastián-Heredero (2020, p. 739) defines as "decisions, approaches, procedures, or teaching routines that teachers utilize to expedite or enhance learning." In this sense, the primary strategies employed in the educational process included collaborative learning, mediation through technology, the dialectical method of knowing, and metacognition.

Materials refers to the resources used to present learning objects. This episode examines students' learning styles, which augment their diversity and adaptability, offering multiple avenues for learning. Regarding the production of accessible didactic materials (analog resources), in their planning, they sought to meet the minimum attributes proposed by Mól and Dutra (2020), such as: educational efficacy, ergonomic design, safety, tactile pleasantness, visual and tactile contrasts, durability and resilience, use of familiar materials, appropriate sizing and portability, suitable textual characteristics, fidelity to representation, multisensory engagement, economic viability, simplicity, suitability for collective use, and evaluation of the didactic materials.

It is worth noting that the above-mentioned course is offered in-person each semester, utilizing *Google Classroom* to enhance the curricular component of this pedagogical intervention. The platform serves to document guidance referrals (pathway scripts), provide access to references for creating accessible instructional and didactic materials (media library), and facilitate asynchronous communication (discussion forums) for debate and assessment. Pimentel (2009, p. 31) describes the forum as a "mechanism conducive to the development of debates (...) it is organized in a tree structure where topics are hierarchically arranged, preserving the relationship between the initial topic, responses, and counter-responses." We

also utilized Padlet, an innovative framework for organizing hypertextual content that "facilitates the creation of a shared environment where text, images, sounds, and other materials can be collaboratively associated" (Oliveira et al., 2024, p. 16) to compile a virtual inventory of the artifacts produced during the formative episode.

Evaluation is concerned with the process of monitoring and providing feedback on student performance which, according to Sebastián-Heredero et al. (2022, p. 1918), "is designed to be flexible, varied, and address the many realities and needs of students (...) only in this manner will it ensure equitable assessment of students and facilitate opportunities for them to exhibit the knowledge acquired." In this sense, the main processes and instruments used in the formative journey were: learning styles, prior and constructed knowledge, and self-assessment.

Identification of the planning of school mathematics

The legal and pedagogical assumption that all students have the right to mathematical learning is the base for the implementation of the formative episode regarding the immersion action concerning the planning of school mathematics. This stems from the fact that "mathematical knowledge is necessary for all students in basic education, either due to its widespread application in contemporary society, or its potential for developing critical citizens, aware of their social responsibilities." (Brasil, 2018, p. 265). Thus, we consider the National Common Curriculum (BNCC), which is a legal instrument with a normative significance that encompasses a repertoire of essential learning objectives for the development of school curricula for Brazilian basic education, policies for teacher education, in the planning and implementation of educational materials, and in evaluation processes, all guided by the principle of equity through a comprehensive approach to student education (Brasil, 2018).

Nevertheless, from the paradigm of inclusive education, we point to one of the controversial aspects of the National Common Curriculum which is that "educational systems and networks and educational institutions must plan with a clear focus on equity, which presupposes recognizing that the needs of students are different" (Brasil, 2018, p. 15). Its intentionality is emphasized concerning individuals benefiting from special education, aimed at ensuring the legal right to educational inclusion. More precisely, "It also necessitates a commitment to students with disabilities, acknowledging the necessity for inclusive pedagogical practices and curricular differentiation, as stipulated in the Brazilian Law of Inclusion of Persons with Disabilities" (Brasil, 2018, p. 16).

However, we must emphasize the exclusionary nature of the term "*curricular differentiation*" as it separates, compensates, distinguishes, and divides. This term corresponds

to the "promotion of closed and parallel curricula, that is, a substitute curriculum from the larger curriculum" (Costa-Renders et al, 2021, p. 719) and the contradiction evidenced by the use of two distinct terms. The Brazilian Inclusion Act (LBI) cites "reasonable accommodation" as a strategy aimed at minimizing curricular obstacles, in alignment with the principles of UDL. Furthermore, Costa-Renders et al. (2020, p. 8) raise the issue by stating that:

> We have not yet overcome the tension between the dominant paradigm (education based on the imposition of a universal and common standard for all) and the emerging paradigm in schools (teaching that emerges within the dialectic of the universal and the singular, insofar as it respects the singularity of learners).

During the design phase of this research, we presented the following guiding question: How to teach everyone respecting and valuing human diversity?

Next, some of the results, derived from the formative (immersion) episode, during the planning process, which is governed by the principles of UDL and the specific mathematics competencies outlined in the BNCC are presented.

Initially, Table 1 delineates the identification details pertinent to the planning of each study group (SG). The subsequent section presents the available original and/or modified instructional materials. The possibilities of the planning of content pertaining to the concepts of UDL, are delineated and exemplified by records from participants, generated via asynchronous communication within a virtual learning environment. We conclude with reflections on the DUA method advocating particular competences in school mathematics.

Table 1.

Identification of school mathematics planning (Santos, 2024, p. 134)

ID	**Step**
GEA	Elementary School (6th grade)
Thematic Unit	**Objects of Knowledge**
Magnitudes and Measurements	Problems regarding measurements involving quantities such as length, mass, time, temperature, area, capacity, and volume.
Abilities	
(EF06MA24) Solve and formulate problems involving the quantities length, mass, time, temperature, area (triangles and rectangles), capacity, and volume (solids formed by rectangular blocks), without using formulas, inserted, whenever possible, in contexts originating from real situations and/or related to other areas of knowledge.	
ID	**Step**
GEB	Elementary School (8th grade)
Thematic Unit	**Objects of Knowledge**
Geometry	Area of planar figures, congruence of triangles, and demonstrations of quadrilateral properties.
Abilities	

(EF08MA19) Solve and formulate problems related to area measurements of geometric forms by employing area calculation formulas for quadrilaterals, triangles, and circles, particularly in contexts such as assessing land dimensions.
(EF08MA14) Demonstrate properties of quadrilaterals through the identification of triangle congruence.

ID	**Step**
GEC	High School (11th grade)
Thematic Unit	**Objects of Knowledge**
Geometry and measurements	Geometric Solids: Prisms, Pyramids, Cylinders, Cones, and Round Bodies.

Abilities

(EM13MAT504) Examine procedures for determining the volume of prisms, pyramids, cylinders, and cones, incorporating Cavalieri's principle, to formulate the equations for computing the volumes of these geometric shapes.

ID	**Step**
GED	Elementary School (6th grade)
Thematic Unit	**Objects of Knowledge**
Numbers	Operations (addition, subtraction, multiplication, division, and exponentiation) with natural numbers.

Abilities

(EF06MA03) Solve and formulate problems that involve calculations (mental or written, precise or approximate) with natural numbers, employing diverse methodologies, both with and without a calculator. Demonstrate an understanding of the processes involved.

ID	**Step**
GEE	Elementary School (6th grade)
Thematic Unit	**Objects of Knowledge**
Numbers	Operations (addition, subtraction, multiplication, division, and exponentiation) with natural numbers.

Abilities

(EF06MA03) Solve and formulate problems that involve calculations (mental or written, precise or approximate) with natural numbers, employing diverse methodologies, both with and without a calculator. Demonstrate an understanding of the processes involved.

ID	**Step**
GEF	Elementary School (6th grade)
Thematic Unit	**Objects of Knowledge**
Numbers	Operations (addition, subtraction, multiplication, division, and exponentiation) with natural numbers.

Abilities

(EF06MA03) Solve and formulate problems that involve calculations (mental or written, precise or approximate) with natural numbers, employing diverse methodologies, both with and without a calculator. Demonstrate an understanding of the processes involved.

ID	**Step**
GEG	Elementary School (6th and 9th grade)
Thematic Unit	**Objects of Knowledge**
Numbers	Calculation of percentages through multiple methods, without using the "rule of three." Percentages: problems involving the calculation of successive percentages.

Abilities

(EF06MA13) Solve and formulate problems that involve percentages, based on the idea of proportionality, without using the "rule of three," employing personal strategies, mental calculation, and calculators, in contexts of financial education, among other areas.

(EF09MA05) In the context of financial education, solve and formulate problems that involve percentages, with the objective of implementing successive percentages and determining percentage rates, preferably using digital technologies.

ID	**Step**
GEH	Elementary School (6th grade)
Thematic Unit	**Objects of Knowledge**
Numbers	Operations (addition, subtraction, multiplication, division, and exponentiation) with natural numbers.
Abilities	
(EF06MA03) Use a variety of strategies to solve and formulate problems that involve calculations with natural numbers, whether they are mental or written, exact or approximate, and with or without the use of a calculator. Demonstrate an understanding of the processes involved.	
ID	**Step**
GEI	Elementary School (7th)
Thematic Unit	**Objects of Knowledge**
Algebra	First-degree polynomial equations.
Abilities	
(EF07MA18) Solve and formulate problems that can be represented by first-degree polynomial equations, reducible to the form ax + b = c, using the properties of equality.	
ID	**Step**
GEJ	Elementary School (8th grade)
Thematic Unit	**Objects of Knowledge**
Geometry	Geometric constructions: 90°, 60°, 45°, and 30° angles and regular polygons.
Abilities	
(EF08MA15) Construct, using drawing instruments or dynamic geometry software, the perpendicular bisector, angle bisector, angles of 90°, 60°, 45°, and 30°, and regular polygons.	

In summary, nine plans were presented for Elementary Education, which include the last four years of this stage. Except for the "Statistics and Probability" thematic unit, the subsequent four units were primarily focused on "Numbers" which was the subject of four SGs. This was followed by "Geometry" with three SGs, and "Algebra" with one SG. The strategies and didactic resources characterized well-diversified and flexible proposals, despite the fact that the plans were concentrated to a significant extent, with 90% of the plans being in Elementary Education and 40% in a particular area of knowledge. Another notable aspect is that only one SG has been assigned across both the early and final years of Elementary Education.. In High School, only the thematic units "Geometry and Magnitudes" were designated for the 11th grade, and it is important to note that these units are condensed.

SGA suggested utilizing a board game that students can print or create on card stock during class. Each team has an approximate timeframe to finish the planned activity and computations. In classrooms with visually impaired students, measurement materials should feature elevated markings. It is advisable to use scales with tactile marks for weight measurements, enabling the visually impaired learner to perceive the markings and do a weight

assessment. These scales may feature a tactile interface or be fitted with a device that produces an auditory signal corresponding to the weight applied. The adaptation suggested to the game for visually impaired students can be accomplished using a *slate* and *stylus* to transcribe the textual information from the table and the game rules into Braille. The circles and the table can be constructed in a raised format using diverse materials, such as string or paper, and the dice should feature elevated marks as well.

BSG recommended the use of the Tangram manipulation material to explore and compare the area of planar figures, through cooperation and teamwork. Initially, the use of accessible infographics with audio description (AD) was suggested. At this juncture, students should be asked whether they are already acquainted with the subject matter. If they are, a discussion should be conducted to enable them to contribute their knowledge to the class. Methods and opportunities for problem-solving should also be investigated. Subsequently, each student should be provided with tangible materials, and a preparation period should be conducted to facilitate its use by reviewing certain mathematical properties that have been previously identified. It was also suggested that pairs be formed by drawing lots. Once the pairs were formed, students should be instructed to assist their classmates throughout the activity; bringing the Tangram pieces closer together if one member of the pair is visually impaired. Lastly, a Tangram-based problem-solving activity was proposed. Upon completion, partners should collaboratively begin the solution process.

In addition to digital visualization, SGC recommended the use of Styrofoam, cardboard, paper, EVA boards, adhesives, and scissors for physical visualization. At this stage, the teacher should foster an interactive environment to address any questions that may arise during the explanation of the topic and familiarization with the material. The digital presentation should investigate the use of analogies with real-world scenarios. Additionally, a dynamic activity that includes questions and answers should be implemented, which can be accessed through a game on the *Word Wall* platform. The activity should be presented in Braille. Additionally, the use of an infographic is suggested so that the solids are color-coded and, when printed, display the projections of the solids in high relief, as well as the transcription of the ink writing into Braille. As a complementary activity, a measuring device could be used to simulate the calculation of the volume of spatial figures.

SGD recommended a practical activity with the theme "*Exploring Basic Operations*," based on a series of everyday situations. Students should be organized into pairs, use the *Golden Material* and/or *Soroban* for calculations, and discuss their answers and arguments with their peers. Lastly, the game "*Sum Bingo*" should be introduced. In this game, students are

consistently required to resist their immediate impulses. Additionally, they are afforded the opportunity to assess their performance, as well as strategies for their specific circumstances. The game is comprised by cards (in ink and Braille) with the numbers 2 to 12 and two dice (ranging from 1 to 6) with enlarged numbers in ink, Braille, Brazilian sign language, and markers.

SGE conducted an activity using a board game called "*Trilha das Quatro Operações*" (Four Operations Trail), which should be made available to students so they can have direct contact with the game and its rules. This resource can be played by up to four participants. The game contains colored cards, each identified in ink and Braille and a QR Code for Brazilian sign language and AD; a die to determine the order of the participants at each turn and to determine how many spaces players should move; four pegs, each colored to represent the operation; and four types of cards, with six or more cards available in red, yellow, green, and purple.

SGF proposed an activity based on the game "*Uno*." Students should be granted access to the game cards in order to interact directly with the principles of the game "Uno". Mathematical Uno is a tactile and visual resource that actively engages students with a variety of learning techniques. The material was developed with accessibility in mind, incorporating tactile components and other modifications. The game cards were designed to be user-friendly for all individuals, using Braille and Brazilian sign language, contrasting colors to facilitate viewing and distinguishing the cards and operations. Additionally, technological resources, such as QR codes, were employed to enhance comprehension of the game rules, which are presented in Brazilian sign language and audio.

SGG suggested an activity based on an adaptation of the classic board game "*Monopoly*" that simulates real estate transactions and financial strategies. Groups should be formed and the game rules presented. In this version, each card is designated in Braille, and a QR code included for Brazilian sign language and AD. The game includes two pairs of each of three types of dice: die one, numbers one through six in ink; die two, numbers one through six in Braille; and die three, numbers one through six in Brazilian sign language. It also includes five pieces shaped like spheres, cubes, cones, cylinders, and pentagonal prisms; 59 cards: 15 cards to receive, 12 cards to pay, 24 cards to buy, and eight protection cards; 240 fictitious banknotes with the following denominations: 50; 100.00; 200.00; 500.00; 1,000.00; 2,000.00; 47 purchase cards: 15 plots of land, 15 houses, 15 apartments, and two businesses. An instruction manual with a QR code. The game includes images or symbols on the cards that help explain the action or

event described, allowing players to understand the information without relying on audio. The game pieces have distinct shapes so that visually impaired players can easily identify them.

SGH created the activity "*Tic Tac Toe of Operations*". Initially, the concept of *tic tac toe* and basic rules is introduced, incorporating the idea of arithmetic operations into the game to emphasize its educational nature. Then, it is recommended that a brief review of the arithmetic operations that comprise the game (addition, subtraction, multiplication, and division) be conducted. A board with X and O symbol elements and randomly selected cards containing the operations should be provided to each pair. Before starting the game, a simulated round should be played so that the players can familiarize themselves with the rules, which will also be printed and address any questions. Subsequently, students play and solve the operations in different ways, primarily mentally, with the objective of promoting rapid calculations. Regarding accessibility, the board lines are delineated with a skewer, thus projecting relief; each square on the board has double-sided tape to make it easier for the player to feel each square without moving the pieces, as they are fixed with tape. The X and O pieces exhibit relief when the cardboard is covered with EVA, making them rigid; each card containing the operations is accurately transcribed into Braille.

SGI recommended the educational card game "*Inclusive Equations of the First Degree*." The game is comprised of 20 cards: 10 with equations and 10 with the respective answers. The content of each card is represented with mathematical symbols in Brazilian sign language and Braille. The game is played as follows: the cards are shuffled, and players receive six cards. The remaining cards are available for players to combine with one of their cards. The winner is the player who forms three pairs. Pairs consist of one card with an equation and another card with the corresponding answer.

SGJ suggested using a Geoplane, which aims to introduce students to spatial concepts related to geometric knowledge. The dotted plane provides sensory representations that facilitate the heuristic process and comprehension of regular polygons, providing a practical understanding of shapes, patterns, symmetry, and spatial coordination. The game, designed in Canva, titled "*Geoaranha*," features dotted lines that outline an octagon, with three highlighted points on each equally divided line segment corresponding to a grid. This Geoplane uniquely generates line segments that correspond to the figure's diagonals, based on its specified origin, resulting in a triangular grid.

Players are required to travel from one point to another, either horizontally or vertically (not diagonally). Only one player can occupy a given location at any given time. The objective of the game is to form as many regular polygons as possible (repeatable) using the webs. This

material can be constructed according to the available resources, as long as it maintains its essence; the main elements: the Geoplane, the lines, the spiders, and the dots (not two-dimensional), so that the lines can be fixed. The material will contain a QR code with the AD for reading the cards and the game plan, requiring the use of technological devices to scan the codes. The material has different textures and thicknesses of threads, one for each participant.

Considerations on Planning Based on UDL

Cruz and Panossian (2021, p. 8) assert that it is the teachers' duty to provide education that fosters "new possibilities for the appropriation of school knowledge." In line with this view Muzzio (2022) highlights the importance of developing innovative pedagogical approaches and strategies, aligned with UDL, by integrating appropriate tools, technologies, and methods. Thes measures aim to structure a curriculum that serves all students, thereby guaranteeing equity and universal education.

> (...) based on the adaptable and inclusive framework of UDL, a minor modification in teaching style frequently yields rewards for both teaching and learning, benefiting all parties involved. This approach emphasizes several critical suggestions for implementing the proposal and enhancing the feasibility of the solution, or mitigating educational barriers: (i) assess prior knowledge; (ii) employ language that is accessible to the target audience; (iii) diversify content presentation methods; (iv) maintain effort and persistence throughout the process; (v) acknowledge the individual learning experiences of students, from the introduction of new concepts related to inclusion to the design and development of games, recognizing that each student has a unique comprehension style. (Muzzio, 2022, pp. 144-145)

The participants' engagement in the school planning initiative highlighted the pedagogical objectives for teaching mathematics in basic education, grounded in the three principles of UDL. And while some experiences yielded modest outcomes, others demonstrated more substantial processes.

Velasco and Barbosa (2022, p. 16) contend that "Practices built around concrete materials and adapted for the participation of all students must consider the three different networks used in the learning process: recognition, strategy, and affective, under a conception of inclusion for all." Furthermore, according to Bachmann and Sell (2023, p. 8), "activities that involve structured planning in the principles of UDL enable such points of accessibility and inclusion. In addition to the knowledge acquired through practical and sensory activities." In this regard, Stellfeld (2023, p. 210) underscores the importance of UDL in:

> The development of students' mathematical learning, contributing to the construction of a solid foundation of mathematical knowledge, the development of fundamental skills,

> and the strengthening of transversal competencies necessary for success in mathematics and beyond, such as promoting accessibility and inclusion.

The **principle of engagement** was substantiated through various proposals aimed at enhancing student participation, encompassing the delivery of learning objectives, methodologies for their attainment, relevant contextual topics of social urgency and interest, available resources (both digital and analog), and accessibility supports, and opportunities for fostering self-confidence, satisfaction, and autonomy (empowerment during activities).

When the acknowledgement of the significance of information and activities as valuable, authentic, and/or meaningful is promoted through diverse pedagogical strategies (contextualization, interdisciplinarity, transversality, and others), the interests and goals of the participants can be achieved. Additionally, when safe, interactive, and dynamic environments are proposed, they should include increased predictability of activities (presentation of learning pathways); varied sensory stimulations; collaborative and cooperative culture (game dynamics); association of content with the realities of those involved; the degree of difficulty or complexity with which fundamental activities can be completed (proposed activity stages); and encouragement of the process, effort, and improvement in achieving results (use of games and review activities).

> This project seeks to foster the inclusion of all pupils, irrespective of their talents or learning levels. The game enhances the enjoyment and engagement of learning, hence augmenting students' interest and motivation. In summary, it was an innovative and efficient method to facilitate mathematical learning in a practical, enjoyable, and inclusive manner. (SGB/P05) The use of UNO, a widely favored game among students, is quite intriguing. When this occurs, integrating an activity that students already appreciate with essential content enhances the learning experience, hence facilitating deeper retention of knowledge, particularly when it promotes mental calculations, as suggested by the group. (GSI/P05)

Velasco and Barbosa (2022, p. 16) argue that to render activities engaging and spark students' interest in learning, it is essential to contextualize the practice and integrate real-world problem scenarios. The content must be made more practical for all individuals. To enhance the accessibility of education, it is essential to establish "a flexible and innovative educational environment that accommodates many solutions, tools, activities, and methodologies, hence influencing and augmenting students' active engagement." (Velasco & Barbosa, 2022, p. 14).

The **principle of representation** was exemplified by the diverse methods of conveying information, which included interactive activities, manipulative teaching materials, and instructional games. These included the use of audiovisual resources; texts printed in ink and Braille; tactile materials with different textures, sizes, and shapes; color codes; digital resources ranging from media consultation and QR codes to accessibility tools (automatic captioning, screen readers, transcription applications for Brazilian sign language and Braille); imagery resources with AD; teaching resources (Tangram, Soroban, geometric solids, Gold Material, measuring instruments); low-cost materials (meters, packaging, among others); and simulation and analogy of commonplace objects to mathematical concepts. This also occurred through the appropriation of certain methodological approaches, such as contextualization and interdisciplinarity, which facilitate the establishment of internal and interconceptual connections.

> The use of classroom-made materials, such as physical models of solids, provides a tactile and visual experience that can benefit students with varying sensory abilities. Furthermore, the use of digital resources, such as a multimedia projector and infographics, can facilitate the comprehension of concepts through visual stimuli. (GEA/P03)
> It offers a thought-provoking, compact, and creative project, demonstrating that it doesn't take a lot of money to produce a comprehensive game. The rules are clear, and the gameplay intuitive. Accessibility is represented by tactile resources and the use of sign language, which will foster inclusive interaction among players. (GEG/P19)

G. S. Santos (2023) states that information and communication technologies, along with manipulable concrete materials facilitate the accessibility of mathematical content to all students, serving as potent resources in mathematics education; consequently, enhancing universal practices that improve teaching quality for everyone.

As noted by Barros et al. (2023), digital information and communication technologies offer novel opportunities for teaching and learning dynamics, serving as "auxiliary tools in the development of rich learning experiences, aiding in alleviating specific deficiencies in the teaching and learning relationships in mathematics." (Barros et al., 2023, p. 4).

According to Cruz and Panossian (2021), game ideas informed by the UDL guidelines can be developed in regular classrooms, thus accommodating students with other specific

needs; however, it is essential to comprehend the characteristics of the respective courses. According to the principles of UDL, activities with Tangram, utilized as instructional materials, "are delivered in diverse formats (...) that, due to their dynamic nature, cater to the interests of the student as an active participant, facilitating the analysis of concepts (...) through visualization and interactivity, thereby enhancing engagement in the learning process" (Almeida & Dandara, 2021, p. 34).

The **principle of action and expression** was demonstrated through various methods proposed for conveying knowledge, including writing (documenting game strategy procedures), oral communication (discussing and debating the strategies employed in activities), and the use of digital and analog resources as well as alternative languages (infographics, playfulness). It was also evident when incremental support was integrated to facilitate the establishment of challenging and specific personal goals (daily concerns), alongside recommendations (guidelines, codes of conduct, strategic sequencing, and educational pathways) to structure these into attainable short-term objectives (pedagogical duration of the proposed activities).

Furthermore, this principle can be validated through the implementation of strategies and practices that employ suitably configured materials (with accessibility) and the necessary support (teacher supervision) to ensure efficacy. These also include alternative methods of representing knowledge; varied strategies for addressing diverse challenges (including contemporary cross-cutting issues, like financial education); and the expansion of knowledge repertoires — both prior and newly constructed — aligned with the richness of available resources.

Additionally, the provision of choices regarding autonomy, structure, sequencing, and support opportunities was evident. The ability to measure progress emerged through the use of guiding and reflective questions, representations and models that facilitated self-assessment, and strategies that encourage reflection on the quality of anticipated outcomes.

> Geometry embodies an expansive realm of imagination for the construction of geometric figures, which Study Group J achieved through the game GEOARANHA. The vivid colors and thematic components of the game will stimulate curiosity and

> encourage engagement. Furthermore, it fosters logical reasoning and active participation among pupils. (SGJ/P24)
> The importance of acquiring basic financial knowledge is undeniable in today's culture, and as we rapidly progress, the sooner we obtain this information, the more beneficial it becomes. Addressing this important topic in a playful and engaging way greatly enhances the understanding and implementation of this project. (SGF/P15)

Cruz and Panossian (2021, p. 5) contend that "a teaching plan created with didactic resources must be formulated with the objective of facilitating the acquisition of scientific concepts." Taking games as an example, the authors affirm that games can serve as an educational instrument, wherein the teacher must effectively facilitate their integration to transform them into a stimulating, innovative, and creative tool for mathematics instruction that enhances students' cognitive development. In this context, G. S. Santos (2023) emphasizes UDL as an educational framework aimed at enhancing knowledge acquisition and skill development, including problem-solving and logical reasoning. The strategies associated with UDL facilitate "the appropriation of mathematical knowledge and broaden students' perspectives on the possibilities for inclusion" (G. S. Santos, 2023, p. 100).

According to Sodré (2022, p. 39), the UDL approach is a repertoire of "perspectives, materials, strategies, and adaptable techniques designed to enhance students' learning, regardless of disabilities." through comprehensive instructional planning, together with the utilization of digital media." However, we underscore the notion of UDL as a framework designed to eradicate barriers and boost curricular discussions that extend beyond socially constructed knowledge, allowing students to understand and engage with their sense of belonging, specifically within the context of their personal experiences.

Nonetheless, we recognize that the National Common Curriculum (BNCC) embraces the concepts of respect and regard for diversity. Thus, it is evident that students' requirements are diverse and, therefore, must be acknowledged. Consequently, we ask: how might Universal Design for Learning and the requisites for mathematics prescribed by the National Common Curriculum be interconnected?

To answer this question, based on the planning and execution of this formative episode and its outcomes, we highlight the parallels between the concepts of UDL and the specific abilities within the field of mathematics,

- When the retrieval of prior knowledge is stimulated, the appropriation of skills is self-regulated, planning and strategy development are monitored, information and resource management is supported, and the transferability and generalization of learning are enhanced, **mathematical knowledge** that underlies reasoning, investigation, and argumentation promotes understanding, explanation, and action in response to real-world demands.

- When the processing, visualization, and manipulation of information is targeted, relevance, value, and utility are maximized; the capacity to assess progress is enhanced; and feelings of insecurity and distractions are diminished. The application of **mathematical knowledge**, historically constituted and derived from the interconnections between concepts and procedures across various mathematical domains and other fields of knowledge, fosters perseverance in the pursuit of solutions to diverse problems, including those in scientific, technological, and sociocultural realms.

- Critical, scientific, and creative thinking articulated through **mathematical knowledge,** cultivated via the systematization of qualitative and quantitative dimensions within social and cultural contexts, significantly enhances decision-making when self-assessment and reflection are fostered; it diversifies personalization and frequent estimations of honor; it emphasizes patterns, characteristics, critiques, ideas, and relationships, while augmenting perspectives and capabilities at various levels of support for practice and implementation.

- The development of self-assessment and reflection facilitates the personalization and presentation of information, accentuates patterns, characteristics, critiques, concepts, and relationships, and enhances capabilities at various levels to support practice and implementation. This process fosters critical, scientific, and creative thinking articulated through **mathematical knowledge**, which is refined through the systematization of qualitative and quantitative dimensions within social and cultural contexts, thereby contributing to critically informed decision-making.

- The facilitation of language fluency involves the use of diverse tools for construction and presentation, clarification of vocabulary and symbols, elucidation of syntax and structure, guidance in information processing and visualization, and expectations and beliefs that enhance motivation. The processes, tools, and technologies developed in the domain of **mathematical**

knowledge — whether through modeling, problem-solving, investigation, or project development — contribute to knowledge production and foster a culture of communication that supports both individual and collective agency in addressing everyday challenges.

- When the significance of goals and objectives is heightened; and their appropriate formulation is carefully guided; students' sense of agency and autonomy are strengthened. Feedback is expanded; and both demands and resources are varied to optimize the level of challenge. Additionally, focusing on information processing and visualization supports the consolidation of **mathematical knowledge** in contexts of social urgency, which is mediated through relational practices via personal and collective action — across local, regional, and global contexts. These practices promote collaboration and empathy, integrating values and attitudes that guide decision-making based on ethical, democratic, inclusive, sustainable, and solidarity-oriented principles.

- Considering the potential of the mathematics teaching proposals and the accessible didactic materials produced during this research project, we emphasize the need for education environments that foster reflective dialogues thereby establishing a strong connection between teacher education and the school curriculum. Moreover, these places should foster and support research, alongside human and professional development through pedagogical initiatives, by means of school planning which is congruent with the tenets of Universal Design for Learning.

Final Considerations

This article seeks to contribute to the debate regarding the assumptions of UDL and its interface with mathematics education. It is centered on the initial education of prospective teachers and the planning of school mathematics lessons from the perspective of the inclusion paradigm. This is achieved by constructing a formative episode that serves as an educational instance and demonstrates the connection among the components of an educational activity.

In order to investigate innovative and inclusive formative contexts, we conducted collaborative action qualitative research, utilizing the principles and guidelines of UDL within a curricular component of the mathematics program, of a Federal Institution of basic, technical, and technological education, involving 28 participants. Thus, we chose to create a formative

episode, built around an immersion phase focused on organizing mathematics teaching in inclusive educational settings. The pedagogical mediation design involved defining the components — objectives, methods, materials, and assessment —informed by the diversity and learning styles of the participants to be used in the educational activity based on the UDL approach.

Starting with the premise that multiple strategies can be employed for each principle, and that there is no established sequence required for the successful implementation of certain techniques. Figure 1 presents a conceptual framework that contextualizes the learning experiences of those involved in this study.

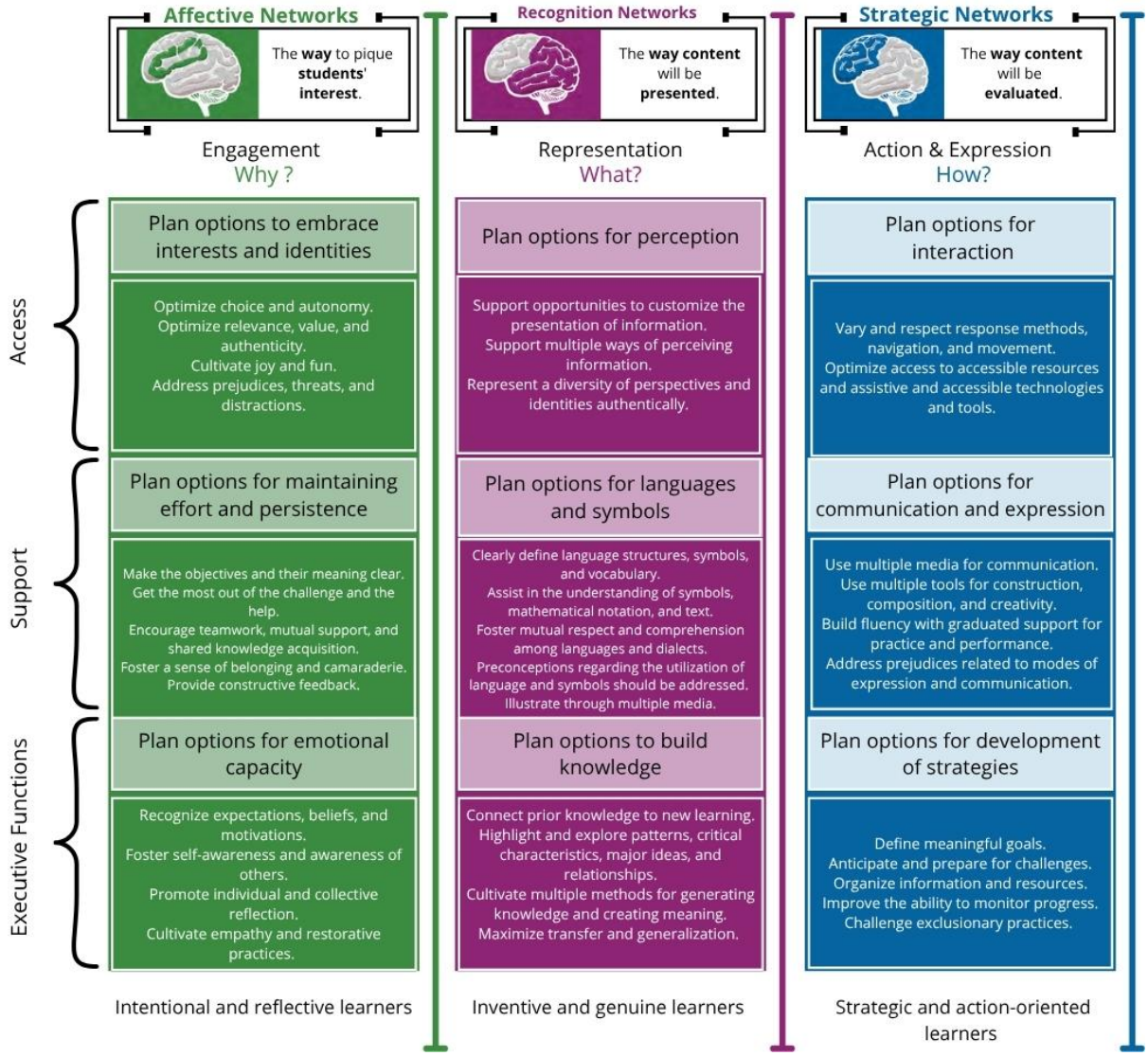

Figure 1.

Education for inclusion: Methodology Applied to Mathematics Education in Inclusive Education (Santos, 2024, p. 149)

During the school planning phase (immersion stage), the processes and products (accessible teaching materials) generated in the previously mentioned formative episode sought to present strategies for curricular accessibility in basic mathematics education through UDL. Consequently, we addressed our question — how might Universal Design for Learning and the requisites for mathematics prescribed by the National Common Curriculum be interconnected? — by highlighting some parallels between the concepts of UDL and the specific abilities within the field of mathematics.

From the experience gained during the formative episode, we found that the application of the theoretical-practical foundation of UDL in the planning of mathematics teaching activities by these students provides a rich resource for developing flexible, personalized, and differentiated curricular proposals, as well as fosters debates regarding pedagogical practice from an inclusive standpoint. Such dialogue should focus on developing learning environments dedicated to nurturing intentional and reflective learners who are innovative, genuine, strategic, and action oriented.

Therefore, we can state that the Universal Design for Learning approach offers a perspective that enhances school mathematics by strengthening the decision-making processes that underpin mathematical knowledge beyond socially regulated norms. Furthermore, it broadens students' experiential capacity to comprehend and construct a sense of belonging.

In conclusion, we affirm the value of the Universal Design for Learning approach in the design of initial teacher education programs, as it promotes innovative engagement methods, equitable access opportunities, knowledge construction, fosters a culture of school inclusion, and provides avenues for inclusive curricular transformations. Therefore, we confirm the hypothesis that applying the theoretical and methodological principles of UDL in teacher education will result in the enhancement of pedagogical attitudes, promote greater autonomy, critical thinking, and reflective practices, while also improving opportunities for student inclusion within learning environments.

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