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The CARE+E Framework: Reconstructing a New Ontology in Mathematics Education

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Abstrak
Pembelajaran matematika kerap terjebak dalam paradigma instruksional yang memberi penekanan berlebih pada aspek kognitif, sehingga dimensi psikologis dan emosional siswa sering terabaikan. Cara pandang semacam ini berkontribusi pada ketidakmampuan model pembelajaran yang digunakan oleh guru untuk menjawab kebutuhan peserta didik secara holistik. Penelitian ini berupaya merekonstruksi pedagogi matematika agar lebih holistik dengan mengembangkan pendekatan baru yang berorientasi pada keseimbangan rasionalitas dan afeksi. Penelitian menggunakan pendekatan pengembangan instruksional ADDIE, namun difokuskan pada tahap analisis, desain, dan pengembangan. Pada tahap analisis diperoleh informasi bahwa terdapat kekosongan dalam model-model pembelajaran matematika yang umumnya menekankan penyelesaian hambatan kognitif semata. Proses tahap desain menghasilkan landasan konseptual yang berakar pada *Realistic Mathematics Education, Social Emotional Learning*, dan *Meaningful Learning*. Selanjutnya, tahap pengembangan mengoperasionalisasi *framework Compassionate Math* melalui formulasi prinsip-prinsip operasional yang mengintegrasikan dimensi kognitif, afektif, dan relasional dalam pembelajaran matematika. Hasil penelitian menunjukkan bahwa *framework Compassionate Math* dapat diformulasikan melalui prinsip CARE+E (*Contentment, Activity, Relationship, Engagement, Empathy*) yang berpotensi mengatasi hambatan kognitif tanpa mengabaikan aspek psikologis-emosional. Kontribusi penelitian ini terletak pada tawaran paradigma baru pendidikan matematika yang lebih humanis serta memberikan dasar teoretis bagi penelitian lanjutan berupa validasi empiris maupun implementasi di ruang kelas.

Kata Kunci: *Ontologi, pembelajaran matematika, belas kasih.*

Abstract
Mathematics education is often constrained by paradigms that place excessive emphasis on cognitive aspects, while students' psychological and emotional dimensions are frequently overlooked. Such a perspective limits the ability of existing teaching models to address learners' needs holistically. This study seeks to reconstruct mathematical pedagogy by developing a more holistic approach oriented toward balancing rationality and affect. The research employs the ADDIE instructional design model, with a focus on the analysis, design, and development stages. The analysis stage revealed a gap in existing mathematics learning models, which predominantly focus on addressing cognitive barriers alone. The design stage produced a conceptual foundation grounded in Realistic Mathematics Education, Social Emotional Learning, and Meaningful Learning. Subsequently, the development stage operationalized the Compassionate Mathematics framework by formulating operational principles that integrate cognitive, affective, and relational dimensions in mathematics learning. Findings indicate that the Compassionate Mathematics framework can be articulated through the CARE+E principles (Contentment, Activity, Relationship, Engagement, Empathy), which hold potential for overcoming cognitive obstacles without neglecting psychological and emotional factors. The study contributes by offering a new, more

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humanistic paradigm of mathematics education, providing a theoretical foundation for further research through empirical validation and classroom implementation.

Keywords: *ontology, Mathematics learning, compassion*

INTRODUCTION

Contemporary mathematics education remains trapped in the hegemony of the Cartesian paradigm, which rigidly separates the cognitive and affective aspects of learning. This reductionist view, deeply rooted since the era of behaviorism, has constructed mathematics as a rational domain free from emotional contamination and social relations. Ironically, modern neuroscience research shows the opposite (Damasio, 1994) through its study of "Descartes' Error," proving that emotions and cognition work integratively in the learning process, including mathematics. Furthermore, research (Boaler & Greeno, 2000) reveals that when students experience "math anxiety," their cognitive abilities decline drastically, proving that emotional factors are not merely complementary but also a major determinant of academic success (Morris, 1981; Sharma & Pandey, 2017; Walker, 2019). However, the mathematics education system in Indonesia still adheres to the myth of cognitive supremacy, where the affective aspect is still considered the sole cause of students' failure to achieve optimal results in mathematics learning.

The deterministic assumption that math failure is solely due to limited cognitive capacity is not only empirically incorrect but also pedagogically dangerous because it creates “learned helplessness” in students. Students believe that their inability to achieve peak performance in math is a permanent condition. Meanwhile, other research has found that both trait test anxiety and state anxiety significantly affect children's working memory performance (Ng & Lee, 2015). Dweck (Dweck, 2015), through her growth mindset theory, shows that beliefs about the unchangeability of abilities actually hinder academic development. The largest national experimental study ever conducted by Dweck (2017 (Yeager & Dweck, 2012)) demonstrated that growth mindset interventions significantly improved the academic achievement of low-achieving students.

Some ideas in mathematics learning claim to have abandoned the over-behavioral paradigm, but in reality, they fall into a new form of cognitive reductionism. While they demonstrate the importance of affective factors, these aspects are treated only as supporting or moderating factors for the cognitive processes considered core to mathematics learning. Consequently, a strong theoretical foundation for integrating all human dimensions into learning is lacking. Consequently, mathematics education practices remain dualistic and fail to address the root of the problem. Although there is a lot of empirical evidence showing the importance of non-cognitive dimensions in mathematics learning, such as bringing social-emotional values to mathematics learning (Platas, 2017; Seeger, 2011), there are not many conceptual or operational ideas about holistic mathematics learning that accommodate cognitive and psychological barriers at the same time. Geillan Aly is someone who popularized the terminology Compassionate Math, an idea that states that without addressing psychological barriers first, students will not achieve significant cognitive progress in mathematics learning.

This research aims to reformulate the ontology of mathematics learning through the development of the Compassionate Math framework, a learning paradigm that places the dimension of compassion as the epistemological and methodological foundation for understanding the nature of mathematics learning. I first found this terminology used by (Eisenberg, 1992), and then several years later, it was explained very well by Geillan Aly. This contrasts with previous research that merely discussed the urgency and possibility of incorporating compassion into mathematics learning (Rohman et al., 2024), This study aims to develop a more operational guideline for mathematics instruction.

METHOD

This research uses a conceptual development approach with the ADDIE model, focused on three operational stages: analysis, design, and development. In the analysis stage, a critical deconstruction of the mathematics learning literature was conducted to identify reductionist biases that emphasize solely addressing cognitive barriers, and to map theoretical gaps in accommodating students' psychological-emotional dimensions. This analysis was conducted through a systematic literature review of conventional mathematics learning models with a focus on uncovering epistemological assumptions that perpetuate the cognitive and affective dichotomy in pedagogical practice. In addition to the literature review, the analysis stage was also strengthened through observation and interviews. Interviews were conducted with 17 teachers from 12 different schools, allowing for triangulation of findings and enriching the empirical picture of mathematics learning practices in the field.

The design stage constructs an alternative conceptual foundation through a synthesis of the principles of Realistic Mathematics Education, Social Emotional Learning, and Meaningful Learning as the theoretical foundation of the Compassionate Math framework. The development stage operationalizes the framework through the formulation of operational principles that explicitly integrate cognitive, affective, and relational dimensions into a holistic mathematics learning unit. Conceptual validation is conducted through theoretical triangulation to ensure the framework's internal coherence and consistency with contemporary empirical findings in educational neuroscience and learning psychology.

RESULT

Teachers' Views and Literature on Barriers to Mathematics Learning

Interviews and observations conducted by researchers with elementary school teachers indicate that most teachers still view student failure in mathematics as primarily due to limited cognitive capacity, while psychological and emotional factors, such as anxiety, inattention, or impatience, tend to be overlooked. Teachers tend to prioritize cognitive achievement, such as mastery of formulas or solving routine problems, while affective and social aspects are rarely addressed due to curriculum pressures and assessment models.

However, interview results also indicated that teachers were aware of the psychological barriers students experienced in learning mathematics. Several teachers acknowledged that many students experienced anxiety, both during learning and especially when facing exams. Other psychological issues teachers identified included students' tendency to easily lose focus, give up quickly when faced with difficulties, or show reluctance in learning activities that require high-level reasoning. Unfortunately, teachers' awareness of students' psychological barriers was not accompanied by systematic efforts to address these barriers.

Meanwhile, based on the results of the literature review, it was found that most of the research examining obstacles to mathematics learning focuses on cognitive barriers. Among the topics on cognitive barriers in mathematics learning that are widely reviewed are related to students' difficulties in understanding mathematical concepts, procedures, and reasoning (Antonijević, 2016; Tirosh, 2000; Vlassis, 2004). Another cognitive barrier also highlighted in several studies is misconceptions that arise due to weak representation and connection abilities between concepts, so that students often fail to associate mathematical symbols with their contextual meaning (Mutodi & Mosimege, 2021; Niemi, 1996). In general, it can be concluded that research discusses more aspects of logical thinking and mathematical information processing, while the socio-emotional dimension in mathematics learning still receives relatively less attention.

Construction of Compassionate Math Principles

In an effort to develop a new, comprehensive ontology for mathematics learning, researchers based their study on three main foundations: Realistic Mathematics Education (RME), Social and Emotional Learning (SEL), and Meaningful Learning theory. These three

foundations were chosen because each provides specific contributions that cannot be fulfilled by a single approach. RME was chosen because of its ability to deconstruct the artificial dichotomy between "pure" and "applied" mathematics through horizontal and vertical mathematization processes (Heuvel-Panhuizen & Drijvers, 2020). Meanwhile, the SEL construct is used as an integral component that recognizes that mathematical cognition cannot be separated from emotional regulation, intrinsic motivation, and social dynamics in the classroom. Ausubel's (Marsh et al., 2018; Weissberg & Cascarino, 2013). Meaningful Learning theory serves as a theoretical bridge connecting the two, but needs to be expanded beyond the cognitive dimension to include emotional and social relevance (Van Oers, 2013).

These three conceptual foundations are expected to complement each other's weaknesses as a foundation for mathematics learning. RME provides a pedagogical mechanism for building conceptual understanding, SEL addresses non-cognitive barriers that are often the main cause of failure in mathematics learning, and Meaningful Learning provides a psychological framework for understanding how effective learning can be realized. Through the integration of these three conceptual foundations, it is hoped that a holistic foundation for mathematics learning will be created. As a result of the process of synthesizing various studies and findings in the field, a new framework for mathematics learning oriented towards compassion was born. This framework is formulated in the principle of CARE + E, an acronym for Contentment, Activity, Relationship, Engagement, and Empathy.

Contentment emphasizes the importance of bringing positive emotions into mathematics learning so that students avoid mental blocks caused by fear or negative experiences in the past (Rajesh Raj et al., 2015; Udvari-Solner, 2012). Activity refers to the idea of learning by doing, namely, placing students as active participants in rediscovering mathematical concepts through real and meaningful experiences. Relationship emphasizes the social dimension of mathematics learning by building collaborative interactions between teachers and students and between students, thereby creating healthy and reflective relationships. Engagement demands the full involvement of students through contextual learning, relevant to everyday life, challenging but still fun, thus generating motivation and enthusiasm for learning. Meanwhile, Empathy is the characteristic and main differentiator of this principle, because empathy is not only an atmosphere, but also a competency that is developed in mathematics learning, helping students overcome psychological barriers, build social awareness, and create an inclusive learning environment. These five principles form a complete framework for designing mathematics learning designs that are more humane, meaningful, and oriented towards student welfare.

Unlike previous frameworks such as RME, problem-based learning, or constructivism, CARE+E does not exist as a specific learning strategy or model, but rather as a basic principle that can underlie various instructional designs. While RME emphasizes the connection of concepts to reality, PBL prioritizes problem-solving, and constructivism emphasizes the formation of personal meaning, CARE+E moves more fundamentally, framing all of these approaches within an ontological horizon that integrates rational and affective aspects. The philosophical implication is that mathematics learning is no longer reduced to instrumental rationality, but is also experienced as an activity that touches feelings, social relations, and existential awareness.

The practical implication of this principle is the potential for more humane instructional design. Teachers can design mathematics learning experiences that focus not only on cognitive achievement but also on students' emotional well-being and social connectedness. With CARE+E, every mathematics learning activity can be oriented into a space that fosters satisfaction, activates participation, builds relationships, strengthens engagement, and fosters empathy. This is the foundation for a new direction in the development of mathematics learning that aligns with the demands of 21st-century education.

DISCUSSION

Cognitive Paradigm in Mathematics Learning in Elementary Education: Weaknesses and Impacts

The overly cognitive paradigm in mathematics learning, particularly at the elementary level, has fundamental weaknesses that have serious implications for the quality of student learning outcomes. Its excessive focus on individual mental processes assumes that any suboptimal student learning outcomes are solely due to low cognitive capacity (Febriyanti & Pratiwi, 2019; Manjani et al., 2025). This paradigm leads teachers to design reductive learning interventions that fail to address the root causes. As a result, psychological factors such as anxiety, fear of failure, and low self-confidence are ignored, thus reinforcing the cycle of failure and distancing students from meaningful learning experiences. Furthermore, the dominance of the cognitive perspective leads teachers to neglect the affective and social dimensions of learning, including the diversity of learning styles, the need for interaction, and the relevance of the material to students' real lives. (Wood et al., 2012).

Psychological-emotional aspects such as anxiety, fear of mistakes, and low self-confidence have been widely discussed as causes of students' suboptimal potential in mathematics learning activities (Morris, 1981; Mutodi & Ngirande, 2014; Walker, 2019). Ignoring these psychological-emotional barriers results in many students experiencing math anxiety, giving up easily when faced with difficulties, and developing a negative perception of mathematics as a difficult and frightening subject. The impact is that mathematics learning in elementary education often fails to foster a healthy relationship between students and mathematical knowledge.

Compassionate Math Framework Formulation: CARE+E Principles

The CARE+E (Contentment, Activity, Relationship, Engagement, Empathy) framework is offered as a principle for compassion- oriented mathematics learning. The contentment principle emphasizes the importance of bringing about positive emotions such as hope, happiness, and satisfaction, in line with the theory of positive emotions that contribute to engagement and academic achievement (Taylor et al., 2017). The activity principle, which is based on the idea of mathematics as a human activity (Freudenthal, 1991), requires students to actively construct understanding through real experiences so that mathematics is more relevant to everyday life (Mardati, 2016). The relationship principle emphasizes that mathematics learning is a social activity enriched through interaction, collaboration, and teacher-student relationships, in line with Vygotsky's (Kellogg & Li, 2021; Margolis, 2020) Zone of Proximal Development concept. The engagement principle emphasizes student involvement through contextual, collaborative, and meaningful learning, which has been proven to increase motivation and participation (Groccia, 2018; Lei et al., 2018). Meanwhile, the empathy principle places empathy not just as a nuance, but rather as a competency that is trained in mathematics learning, in order to create an inclusive, supportive, and humanizing classroom climate for students (Christov-Moore et al., 2014; Maxwell, 2008).

Philosophically, the CARE+E principle (Contentment, Activity, Relationship, Engagement, and Empathy) is an alternative to countering the dominance of the cognitive paradigm. This principle offers a new ontology in mathematics learning that places psychological-emotional well-being on par with logical thinking skills (Purnama et al., 2025; Susiani et al., 2024). This principle emphasizes that mathematics is not only an individual mental activity but also a humanistic praxis rooted in students' relationships, concerns, and life experiences.

This new paradigm has implications for the transformation of mathematics learning pedagogy, particularly in elementary education, where teachers no longer merely position themselves as facilitators of concept transfer but rather as designers of learning experiences that foster a sense of security, meaningfulness, and collaboration. By integrating the values of contentment and empathy, mathematics learning can function as a recovery space from

learning anxiety, while activity, relationship, and engagement strengthen students' reflective and participatory abilities. The CARE+E principle thus presents a synthesis between rationality and affectivity in mathematics education, while expanding its epistemological horizon towards a more holistic, contextual, and civilized paradigm.

CONCLUSION

The solely cognitive-oriented mathematics learning paradigm is no longer adequate to fully address students' needs. Through the analysis, design, and development stages of the ADDIE framework, this study successfully formulated the Compassionate Math framework based on RME, SEL, and Meaningful Learning. This framework is embodied in the CARE+E (Contentment, Activity, Relationship, Engagement, Empathy) principle that combines cognitive, affective, and relational dimensions, thereby overcoming obstacles to mathematics learning while simultaneously addressing students' psychological-emotional aspects. Thus, this study confirms the important contribution of offering a new paradigm for mathematics learning that is more holistic and humanistic. These results not only provide a conceptual foundation but also open up space for further research to conduct empirical validation and test its implementation in real classroom practice.

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