International Dialogues on Education

2024, Volume 11, Issue 1

https://idejournal.org

ISSN: 2198-5944

Editorial

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Welcome to this issue of International Dialogues on Education. The articles brought together in this issue span mathematics education, artificial intelligence and literacy, comparative education, higher education pedagogy, and teacher professional learning. Although these topics are varied, they are connected by a shared concern with educational agency, meaningful participation, and the design of learning experiences that respond thoughtfully to human needs and institutional realities. Across distinct national and disciplinary contexts, the contributions in this issue examine how education can be made more humane, more reflective, and more effective for learners, teachers, and educational systems.

Connor Desai's Humanizing Rational Numbers in Middle School opens the issue by reconsidering how rational numbers are taught and understood. Grounded in constructivist learning theory and informed by the historical development of mathematical language, the article argues for instruction that reconnects mathematical ideas to meaning, belonging, and human experience. Rather than reducing rational numbers to procedures alone, the author advocates for teaching that strengthens conceptual understanding while affirming students' place within the mathematics classroom.

Julie Antilla-Garza's Using ChatGPT for Story Creation: One Autistic Teen's Autonomous Reading Motivation turns to the relationship between emerging technology, literacy, and learner motivation. Framed by Self-Determination Theory and Cognitive Evaluation Theory, this case study explores one autistic teen's use of ChatGPT for story generation and finds that AI-generated stories increased intrinsic reading motivation, aligned with personal interests, and supported literacy practices. The article is especially timely in its focus on autonomy and accessibility, showing how digital tools may support engagement when used in ways that honor the learner's interests and agency.

In A Comparative Overview of Educational Indicators in Norway, Sweden, Germany, and Iran, Flora Keysan and Radka Wildová provide a structured comparative analysis of educational systems through the indicators of structure, governance, evaluation, and funding. Their descriptive synthesis reveals important differences across national contexts, including decentralized and equity-oriented Nordic models, Germany's federal and regionally

differentiated approach, and Iran's centralized system of decision-making. The article offers readers a useful comparative framework for considering how educational policy and institutional design shape educational opportunity and quality.

Septian Bayu Kristanto and Yunias Monika, in Implementation of the Experiential Learning Cycle in the Public Sector Accounting Course, show how higher education can connect academic study with authentic practice. Using Kolb's experiential learning cycle, the authors describe a course design in which students engage directly with non-governmental organizations, conduct interviews, document practices, and produce reflective video reports. The study points to the value of experiential learning in deepening conceptual understanding, strengthening practical skills, and increasing student engagement through purposeful connection between coursework and real-world settings.

The issue concludes with Stephanie Thomas's Positioning Teachers as Informed Agents: A Pilot Study on Professional Learning and Collective Teacher Efficacy. This pilot study examines whether professional learning designed to help teachers understand and enact the sources of efficacy can strengthen collective teacher efficacy. The findings indicate a positive impact within the volunteer sample and suggest the promise of professional learning that positions teachers as informed participants in the development of their own collective capacity. In doing so, the article contributes to current conversations about professional agency, school improvement, and the conditions that support sustained educational effectiveness.

Taken together, the articles in this issue reflect the mission of International Dialogues on Education to provide a venue for educational scholarship informed by international, comparative, and humanistic concerns. They also reflect the journal's commitment to offering opportunities for both established and emerging scholars to share work that meets the journal's standards and contributes meaningfully to educational thought and practice. As a whole, this issue offers research and reflection of clear scholarly value, and it speaks to questions of enduring international relevance across classrooms, institutions, and educational systems. We warmly invite future contributions from scholars around the world whose work advances thoughtful, rigorous, and dialogic engagement with the pressing educational questions of our time.

Humanizing Rational Numbers in Middle School

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Abstract

This paper aims to re-examine the curricular pedagogy and framework of math education, particularly concerning rational numbers in middle school. The introduction presents an overview of sequential pathways and statistical data in U.S. mathematics education, followed by a summary of rational number concepts through the lens of constructivist learning theory and the author's positionality surrounding these topics. The literature review explores attributes of successful organizations and systems, followed by an analysis of mathematics education in the U.S. as an organizational system, and the evolution of the language of mathematics to its current state. Implications for learning are then considered from the following perspectives: students, teachers, and curricula. Considering national and anecdotal data, math learning theory, the rational number domain as a sequential step to algebra, and the physio-cultural evolution of our number system, arguments and strategies for humanizing rational numbers for students are presented. The author hypothesizes that a dual-pronged approach of (a) increasing students' sense of agency and belonging in the math classroom by offering students a way to recognize themselves as successive participants in the global journey of math; and (b) providing base-ten contextualized algorithmic lessons that demystify common operational stumbling blocks within the rational number domain, holds the potential to appease both sides of the systemic math education debate (accessibility vs. rigor) and lay the groundwork for students' future academic opportunities by increasing their math achievement.

Keywords: math education, rational numbers, middle school, place value, teacher education

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No known conflict of interest to disclose. Anecdotal data in this article originates from the author's employment as a middle school math teacher at Our Lady of Fatima Parish School in Seattle, WA, from 2017 to the present.

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Introduction

Several studies identify success in algebra as the gateway to higher Education, progression in STEM (science, technology, engineering, and math) fields, and even economic opportunity (Darling, 2010; Miller & Kimmel, 2012). It is not an exaggeration to say that algebra marks a watershed moment in the life of a student. It is impossible to advance in mathematics without it. However, according to the Mathematical Association of America, each year, roughly 50 percent of students fail to pass college algebra with a grade of "C" or better (Liston & Getz, 2019). Similar to most systemic dysfunctions, by the time problems arise, the issues have been present for some time. Troubling statistics plague the nation's K-8 schools. For example, standardized math assessment data from 2019 indicate a null change from 2017 and "proficient" scores for only 41% of fourth graders and 34% of eighth graders (National Center for Education Statistics, 2019). This downward trending effect was compounded in subsequent data by pandemic-era learning (National Assessment of Educational Progress (NAEP), 2022). Costly ed-tech interventions and ambitious reform proposals have yielded little fruit (Doroudi et al., 2019; Knee, 2016).

Algebra represents a shift from quantifying the known world to quantifying a realm of possible worlds. It repurposes every operational component in the vast web of the base ten universe for a whole new machine, one that is adaptable and predictive rather than discrete. Algebraic math is base ten math version 2.0. The domain that precedes algebraic numbers is rational numbers. Rational numbers build on students' prior learning of whole numbers to allow them to think in terms of ratio or one whole number compared to another whole number. The term "ratio" refers to the quantitative relationship between two values, showing how many times one value contains or is contained within the other. (Simpson, 2002). Rational numbers are defined by their ability to be written in *ratio*, i.e., fraction form. The rational number domain encompasses most number concepts and operations that do not involve variables. These concepts can include but are not limited to fractions, decimals, percents, rates, ratios, unit conversions, exponents (squares and cubes), square roots and cube roots, scientific notation, and all four number operations within these concepts.

The idea that changing one or the other number within a ratio changes its overall quantitative value is a logical and necessary stepping stone to algebraic functions, where the input value or independent variable determines the output value or dependent variable. Put another way, rational numbers represent a student's first function, where the number of times one value contains the other determines its overall output value.

Rational numbers are usually introduced in third grade with fractions and studied almost exclusively by the time students reach sixth grade. While many reforms have focused their attention on algebra, owing to its academic gateway status, the reality is that students without a solid understanding of rational numbers will not be able to successfully transition to algebraic number sense, regardless of the robustness of the algebra-based intervention. Therefore, middle school math education represents the cornerstone of a K-12 student's math journey because rational number sense is solidified in middle school.

While several learning theories are referenced throughout this paper, middle school students' knowledge of and fluency with rational numbers is primarily explored through a constructivist framework. Constructivism is the belief that groups construct knowledge with and for one another, including a shared culture with shared artifacts imbued with meaning (Ertmer & Newby, 2013). Our number system represents the single most shared cultural artifact the globe has ever produced, yet most math curricula ignore this potentially humanizing feature. Constructivism further contends that new information is "constructed" in the mind, requiring learners to retrieve prior information in the process.

Civil rights leader and activist Angela Davis said, "Radical simply means 'grasping things at the root" (Davis, 1984, p. 14). Whether Davis intended it or not, this quotation has mathematical and social connotations. For example, the radical symbol in the problem $\sqrt{64}$ asks the student, *what is the one number* (the root) *needed to grow a square of 64?* A wealth of information must precede this problem to truly grasp its meaning, symbolically and conceptually, and to know that a dimension of eight (by another dimension of eight) grows a square of 64.

The implication of Davis' statement can and should also be applied to math. The tyranny of the present often dictates that teachers focus on upcoming tests and standardized assessments through algorithmic practice siloed in grade bands. However, math is sequential. New skills are constructed on the foundation of prior concepts and skills. If students are to truly take ownership of mathematics, they must be encouraged to grasp it at the root, not just once but as a continual practice.

Many of the theories in this paper originate from questions that date back to 2013. That was the year my daughter started middle school, and her math scores plummeted. Usually a great student, neither of us could identify precisely how it started. Slowly, she stopped raising her hand and turned her focus toward subjects that seemed more hospitable. I recognized the forces that were quietly but firmly ushering my daughter away from math because they had done the same to me when I was her age. Despite a love for numbers, patterns, and art as an elementary student,

by the time I reached my college counselor's office, I was choosing the least rigorous courses that would satisfy my B.A. degree math credit requirements. It was disheartening to realize that the intervening years had produced few if any, additional means of accessibility.

Given this historical context, I was not interested in reviewing algorithms that would help my daughter get through the next set of homework problems. I recognized that she had lost her footing in math in a more holistic sense, and my goal was to help her regain it in the long run. Not knowing where to start, I sought the beginning. The beginning of math. That was the day it dawned on me: I was subconsciously laboring under a lifelong assumption that math predated humans. Math seemed intrinsically divine, abstractly mystical. Throughout my academic life, I experienced math as a code that was there for the taking if only I were smart enough to "get it."

Of course, numbers, the values and movements inherent to the cosmos, predate humans, but the language of math does not. It was forged by ancient cultures all over the world, born out of a basic human drive to explore and communicate (Howe, 2018; O'Connor & Robertson, 2000; Smith & Ginsburg, 1937; Yong & Se, 2004). Over a decade and hundreds of middle school math students later, Davis' epithet still hangs on my classroom wall.

From my perspective as a middle and graduate school classroom teacher, I intend to show how the multiple systems that govern rational number study in the U.S., from the conflicting stances of Higher Education to pedagogical shortcuts, are counterproductive to teacher preparation and learning acquisition, respectively. I propose that the best way forward is to go back to the source, to how the language of math was constructed in the first place, and to the foundation of that language, the base ten place value chart.

Literature Review

This literature review aims to give an overview of the research regarding successful organizations and systems, math education in the U.S. as an organizational system, and the language of math as it was organized by humankind.

Successful Systems and Organizations

There is a wealth of evidence to support the idea that the most successful systems and organizations (regardless of their size or area of focus) are the ones that can straddle and equally value paradoxical elements such as individuality and corporation, innovation and specialization, and myth and fact (Argyris, 1957; Barnes et al., 2013; Bolman & Deal, 2013; Pugh, 1971).

One observable hallmark of ineffectual organizations is that no effort is made to merge the individual and organizational processes involved in self-actualization (Barnes et al., 2013).

Individual self-actualization and corporate self-actualization, and the erroneous sacrifice of the former for the sake of the latter, are characterized as being consistently devoted to maximizing human potential for the sake of the organization (Argyris, 1957). When self-actualization is sacrificed, personal motivation wanes, and productivity follows.

A similar effect is produced when specialization is favored over innovation. While people may initially appreciate the gratification involved in specialized roles, eventually, as the work becomes more rote or routine, motivation is lost. Well-intentioned but ultimately anti-innovative advice like "fit the man to the job and the job to the man" created situations where workers lost a sense of connection to their jobs in terms of interest and satisfaction (Pugh, 1971).

While few would doubt the importance of dealing with facts within organizations, a landmark study conducted over 50 years ago discovered the importance of shared ritual, mythology, and symbolic meaning within organizations through the role of religion. Religion, in this case, Catholicism, created more systemic commonalities in companies across differently industrialized countries than between companies in similarly industrialized countries without a shared religion (Pugh, 1971). Shared myths are foundational elements of human culture, fostering a sense of belonging and identity within communities. They provide a framework for understanding the world and shaping collective values, beliefs, and behaviors. Myths and symbols are essential for societies to transmit knowledge, preserve traditions, and reinforce social cohesion across generations (Bolman & Deal, 2013). This research suggests that within any human-driven system, symbolic and mythic elements are as crucial as literal and factual ones.

Compounding the issue of instilling paradoxical elements into systems and organizations is the human tendency to view problems as frame-bound rather than reality-bound. Bolman and Deal (2013) assert that many of us passively acquiesce to solutions to problems as they are presented, thus seldom encountering opportunities to discern the degree to which our preferences are constrained by framing rather than grounded in reality. True organizational success requires the continual infusion and balance of opposing forces, yet we are often presented with evidence that compels us to delegitimize one or the other force. Frame-bound solutions that seek to eliminate a crucial, opposing force will only perpetuate the cycle of dysfunction.

Math Education in the U.S.

The U.S. math instruction as an organizational system has been mired in a frame-bound, opposing force-eliminating cycle. For the sake of simplicity, I will call one force rigor-centered

(factual, specialized, technical) and the other accessibility-centered (mythologized, innovative, artistic).

From a systemic perspective, historically, math curricula and instruction in the U.S. have suffered from a lack of accessibility-centered force. District initiatives focused on standardized assessments subsume individuality, algorithmic specialization overrides innovation, and facts displace myth. When considering the quantitative nature, indeed the minutiae and the breadth, of K-12 math instruction, it is easy to understand how educators, and society in general, found themselves in this curricular predicament.

Interventions that aim to increase accessibility tend to focus less on content and more on culturally responsive teaching practices and methods for sharing authority in the math classroom (Holland, 2022; Kang et al., 2018; Langer-Osuna et al., 2020; Selbach-Allen et al., 2020). Proponents of these strategies insist they can move the needle regarding academic achievement. However, those results remain to be seen. Many schools, districts, and even states have instituted alternative math pathways such that students can "opt out" of traditional math and enroll in courses that are more akin to math appreciation to satisfy their math credit graduation requirements (California Department of Education, n.d.; Liston & Getz, 2019). While a case could be made for allowing alternative pathways in specific, individualized contexts, the problem with this strategy as a wholesale solution is that it does nothing to address the concerns of the rigor-minded set and generally contradicts what countless teachers profess daily as truth in terms of growth mindset and the universal ability to learn math to high levels (Boaler et al., 2021; Selbach-Allen et al., 2020). Policies that adjust content rather than delivery give the subtextual impression that our math achievement scores are so low as to be insurmountable.

Dissenters of these policies, many of them higher education STEM professors, claim that they detract from and diffuse the academic rigor needed to practice and learn math at high levels. Math education as a system is continually oscillating between these opposing forces of maintaining rigor and increasing accessibility. The opposing sides' mistrust of and focus on the other's methods have created unprecedented learning gaps and have cost American students greatly.

These two warring schools of thought will continue to cost the U.S. in terms of student gains as long as they are frame-bound instead of reality-bound. To effectively restructure math education, we must be willing to break out of traditional educational frameworks and the detrimental belief that there is only one correct pedagogical focus (rigor or accessibility). If any academic field should know about opposing and balancing forces, the ingredients for every

formula and equation, it is math. It is time we take the data to heart and reframe math instruction from a reality-bound perspective.

When considering the cut-and-dried nature of math, indeed the fact that there is only one correct answer to every problem, one can understand how, in our effort to enhance the math potential of our students, we lost the forest for the trees. Unlike English Language Arts and other academic subjects within the humanities, which offer obvious ways for students to personally connect to texts and historical events in the process of self-actualization, math self-actualization must be more intentional. We have become so focused on the specialized subject of math (the job) and the students who learn it (the man) that we have inadvertently forgone any chance at real curricular innovation.

In his seminal work juxtaposing two struggling Chicago schools, "Organizing Schools for Improvement," Bryk et al. (2010) noted that while reading gains could still be made in schools despite weak supports, no school lacking in support showed improvement in mathematics. The language of numbers has yet to be contextualized for students in the same way the language of words has. It is hidden behind a shroud of inaccessible cryptology, a chasm that appears to increase with each subsequent school year.

Reframing math education from a reality-bound perspective requires that we put down our chalk for a minute and go back to the beginning, the beginning of math. It is easy to see the apparent ways math is quantitative; it is the language of numbers. However, most ignore the qualitative elements intrinsic to math, the way that human beings across time and cultures shaped it into a useful, shared artifact (O'Connor & Robertson, 2000; Smith & Ginsburg, 1937; Yong & Se, 2004).

Few things in life are more bluntly factual than balancing an equation to solve for x. While we may not be able to incorporate mythology into every equation, we can help students grasp the shared symbolism that gave rise to our number system. The language of math quite literally depends on symbols.

The Language of Mathematics

Much like tree leaves and ocean shells contain math in the form of fractals and numerical sequences, the language of math contains human fingerprints, of those who brought it into existence and those who continue to use it. From this perspective, every subsequent equation or operation is also tied inextricably to human connectedness and ingenuity.

Imagine you are an alien from outer space and stumble upon the symbol "3." Would you have any idea what it meant? There is nothing inherent to "3" that makes us know that it represents a quantity of three. This exercise allows us to imagine how students construct mathematical understanding through a process called concrete-pictorial-abstract or CPA.

In the concrete stage, a student can hold up three fingers or collect three blocks to communicate a value in a one-to-one ratio. In the pictorial stage, the student can draw a quantity, for example, three flowers, to show understanding and begin to adjust to the idea of representing value through symbolism. The final stage is abstract, here, the student uses the symbol "3" to mean three of something. This seemingly mundane transition is not just an arrival at a procedural destination but a rite of passage inducting the learner into a vast, intricate, globally shared web of collective, symbolic meaning.

We have been teaching students dozens of math symbols, from numbers and operations to exponents, variables, and formulas without any of the ritualistic shared meanings that brought them into being in the first place.

Much of that ritual can be found in a weathered and decaying booklet, "Numbers and Numerals: A Story Book for Young and Old," published in 1937 by the Columbia Teachers' College (Smith & Ginsburg, 1937). Full of imagery and diagrams, from the eloquent stick system of China to the pragmatic finger numerals of Europe, it is clear that humans and numbers have a long and storied relationship. It is also clear that our current base ten positional system is arguably the single greatest global achievement of all time (Howe, 2018; O'Connor & Robertson, 2000; Smith & Ginsburg, 1937; Yong & Se, 2004). Most cultures began with hash marks, or a unary system, which represented value in a 1:1 ratio. As civilizations became more sophisticated, symbols denoting larger values in varying ratios, such as the Romans' L for 50 or 1:50, emerged. Eventually, humans kept the idea of symbols like the Romans, but unlike the Romans, they devised individual symbols for 1-9 based on ancient Sanskrit (Smith & Ginsburg, 1937). Thus, Hindu-Arabic numerals were employed. These were given further meaning by formalizing our biological affinity for 10 through the symbols' placement on an invisible 1:10 ratio board of ones, tens, and hundreds, aka place value. One hundred years later, around 600 CE, the concept of 0 as a numeral caught on, which exponentially increased the new system's functionality and paved the way for decimals (O'Connor & Robertson, 2000; Smith & Ginsburg, 1937).

Implications: Constructing Mathematical Literacy in the Rational Number Domain

This section aims to provide an overview within a constructivist framework for how mathematical literacy is thwarted or achieved. Student, teacher, and curricular perspectives are considered.

Student Learning

When considering rational number comprehension from the student's perspective, it is essential to recognize that rational numbers represent the second domain of number sense they acquire. The first number sense students develop is natural numbers, sometimes called counting numbers, e.g., 1, 2, 3, 4, and so on. In this domain, students learn to order and compare numbers, as well as compute values using the four primary operations of addition, subtraction, multiplication, and division. Over time, they develop an intuitive sense of how these numbers behave, e.g., adding and multiplying numbers gives a greater answer, and subtracting and dividing numbers gives a lesser answer (De Keersmaeker et al., 2022; Van Hoof et al., 2020). When students begin to study rational numbers, they often erroneously apply numerical reasoning intrinsic to their natural number sense, called natural number bias (Van Hoof et al., 2020).

Due to natural number bias, numbers may appear larger to students that are not, e.g., 15.2 > 5.1346 (more digits do not mean a greater number) and $\frac{1}{8} < \frac{1}{2}$ (larger digits do not mean a greater number). Operations follow suit in this inverse world, e.g., $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ (the product is smaller than its factors) and $0.6 \div 0.2 = 3$ (the quotient is larger than the dividend and divisor). It is not enough for students to take the teacher's word for the correct answer and how to get there. They need to know why this inverse world exists and how to navigate it themselves.

Furthermore, many sixth-grade students begin using the set of integers, including negative numbers. From anecdotal data, the most common error of writing a negative number line is writing it from greatest to least, e.g., -1, -2, -3, -4, and so on. This response contains natural number bias in the form of a directional error. Unaddressed, these errors persist and are exacerbated with negative rational numbers, e.g., on a number line with -6 on the left and -5 on the right, many students mark the midpoint as -6.5 when the correct answer is -5.5.

Consider a student entering the rational number domain who is taught to "move the decimal" rather than the digits to solve various problems. This means that they must (a) know that as we read numbers left to right, their place values go from greatest to least (the opposite of how they learned to count) (Howe & Epp, 2008); (b) understand place value's multiplicative structure, that a digit *moves left when multiplied* by ten and *right when divided* by ten; and (c)

fluidly and simultaneously translate this knowledge to instead move the decimal *right to multiply* by ten and *left to divide* by ten. This is not something we should ask our math learners to do. It is time to consider the true cost of teaching this deceptively convenient and shortcut practice. It is akin to teaching a child to play chess and then telling them to move the board instead of the pieces.

As a middle school math teacher, I have let students ponder the same questions I had: Why does math exist? How did it become a language? What other number systems were used, and what is it about base ten that made it stick? Alongside the organizational ritualism that involves in tying meaning to symbols lies the learning theory known as Constructivism. As previously mentioned, Constructivism is the belief that groups construct knowledge with and for one another, including a shared culture with shared artifacts imbued with meaning (Ertmer & Newby, 2013).

Additionally, Constructivism contends that new information is "constructed" in the mind, requiring learners to retrieve prior information in the process. The Vygotskian theory of Social Constructivism embraces the idea that we first learn new information in a social context from a more knowledgeable other before internalizing that information for repeated use over time. Phrases such as "move the decimal" essentially skip the entire social construction process and move immediately to internalization. Once students have fully developed rational number sense and have moved on to algebraic number sense, these phrases may become part of their internalized dialogue. However, relying on them during the learning process can delay learning or create a faulty foundation for subsequent knowledge construction.

Exploring the role of our biological affinity for ten in the global formation of our number system leverages the learning theory known as embodied cognition, which contends that the physical elements of the human body significantly shape the workings of the human mind (American Psychological Association, n.d.). This theory is further extrapolated to mathematics in what Nathan and Walkington (2017) called the theory of grounded and embodied mathematical cognition or GEMC. GEMC suggests employing physical actions and gestures to comprehend concepts associated with science, technology, engineering, and mathematics. At the same time, embodied cognition as it pertains to STEM fields has been researched, as well as the historical origins of our number system; both fields stop short of making the explicit curricular link between students' deep understanding of place value and the physio-cultural origins of our number system. This gap in academic research needs to be acknowledged and addressed.

The goal of humanizing rational numbers seeks to build on the existing literature, which deals with common pitfalls students encounter while constructing rational number understanding, such as natural number bias and rote algorithm errors. The cognitive process known as transference is critical for students transitioning from whole to rational number sense (Ertmer & Newby, 2013). When the Common Core State Standards uses one of its eight Standards for Mathematical Practice to encourage students to "look for and make use of Structure," they are leveraging the idea of transference (Common Core State Standards Initiative, n.d.). Transference occurs when situations characterized by identical or similar features facilitate the transfer of knowledgeable behaviors across shared elements (Ertmer & Newby, 2013). Like transference, the cognitive process known as adaptive expertise is a highly valued feature of mathematical thinking.

In contrast to routine expertise, adaptive expertise is characterized by interconnected procedural and conceptual knowledge that can be flexibly employed in unfamiliar situations (McMullen et al., 2021). Adaptive expertise is noted for increasing procedural flexibility with whole numbers, rational numbers, and linear algebra. Students who were taught rote, siloed algorithms (such as *keep it, change it, flip it* for fraction division), and procedural shortcuts (such as *moving the decimal* for multiplication and division) are denied the opportunity to socially construct the expertise necessary for future mathematical domains. Intuitive place value knowledge is a prerequisite for adaptive expertise and transference to occur.

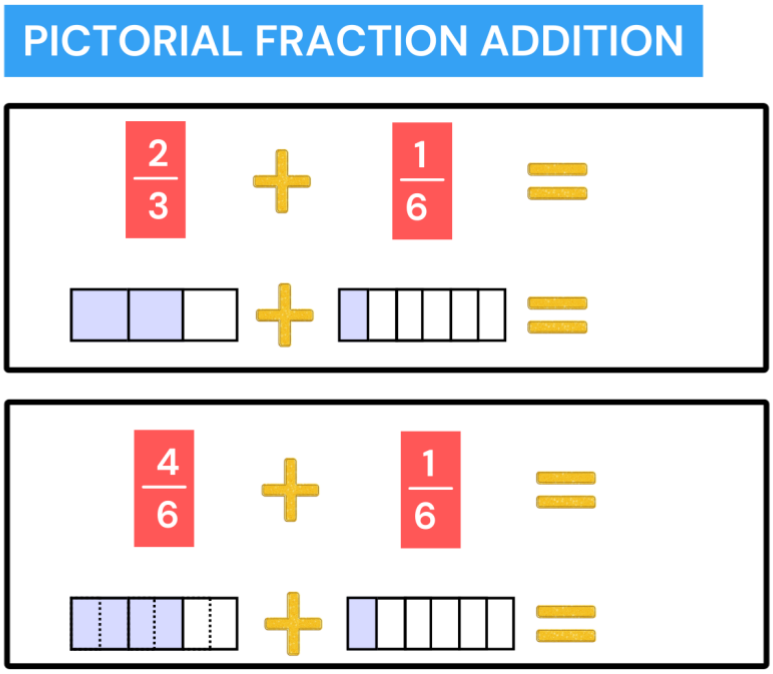
Similarly, Agarwal and Bain (2019) advocated for multiple learning strategies in "Powerful Teaching: Unleash the Science of Learning." Among these strategies are two practices called retrieval and interleaving. Retrieval involves the skilled extraction of information from students' knowledge reservoirs, in contrast to the act of cramming information into them. Interleaving involves mixing closely related topics and encouraging students to draw comparisons and distinctions between the two (Agarwal & Bain, 2019).

Recall the CPA (concrete-pictorial-abstract) method of constructing mathematical understanding to understand the importance of retrieval. Rather than stand up at the chalkboard and drill algorithms into students' heads, a CPA-trained teacher encourages students to use prior stages of learning to personally and actively construct conceptualization and consequently imbue meaning to the third and final abstract algorithmic stage. A typical example (shown in Figure 1) highlights the conceptual underpinnings of equivalent fractions when adding or subtracting fractions with unlike denominators. When a student draws a bar model to represent $\frac{2}{3}+\frac{1}{6}$ she is revisiting the pictorial stage to imbue meaning to the abstract stage. In this example, the

importance of only adding quantities of the same relative (ratio) size is illustrated in the pictorial representation of the equivalent fractions $\frac{2}{3}$ and $\frac{4}{6}$. As a student internalizes this concept, she will be able to reason abstractly to find an equivalent fraction, e.g., $\frac{2}{3} \times \frac{2}{2} = \frac{4}{6}$. Retrieval in action looks like encouraging elementary students to explore concrete (with math manipulatives like base ten blocks) and pictorial stages for every new abstract skill, from adding fractions to subtracting across zeros to the multiplication algorithm to long division and so on.

Figure 1

CPA Example of Abstract Fraction Addition Tethered to Pictorial Representation



The learning theory of interleaving, or mixing up closely related topics, is leveraged as students compare and contrast whole number sense and operations with rational number sense and operations (Agarwal & Bain, 2019). Interleaving in the context of whole and rational numbers might look like asking students why the product of rational numbers is often smaller than its factors when the reverse is true for whole numbers or what might have caused the directionality error in a fictitious student's negative number line. Encouraging students to revisit natural numbers and comprehend their own natural number bias enables them to assess and contrast prior foundational knowledge regularly. This allows them to incorporate a whole new number sense, rational, into their cognitive repertoire. To quote a famous childhood organization's motto, *make new friends, but keep the old; one is silver, and the other's gold*.

Furthermore, the strategy of "friendly numbers" allows students to leverage their intuitive natural number sense to understand rational number word problems. For example, when given a word problem with rational numbers, many students (and adults) experience confusion and anxiety upon seeing non-natural numbers, such that it prevents them from making a plan to solve the problem. Consider the following word problem: *Anna has 8 liters of juice which she would like to pour evenly into ⅕-liter cups. How many cups can Anna fill?* The inclusion of the rational number $\frac{1}{5}$ prevents students from using their natural number intuition to solve this problem. However, if we temporarily substitute a "friendly" or whole number for $\frac{1}{5}$, such as 2, we can easily decide which operation to use. *Anna has 8 liters of juice, which she would like to pour evenly into 2-liter cups. How many cups can Anna fill?* This problem now becomes one that an average third-grader could solve mentally. Based on anecdotal data, when using this strategy with sixth-graders, they are quite excited to shout "Four!" When asked what operation they used, they think back to pouring 8 liters into 2-liter cups and say, "Division!" The interleaving of whole and rational number sense has provided a procedural roadmap. This inter-domain scaffold enables them to replace the original number in the problem and solve it correctly: $8 \div \frac{1}{5} = 40$ cups.

Teacher Preparation

Humanizing rational numbers for first-year middle schoolers must also address the issue of teacher preparedness in terms of rational number teaching. Vanhoof et al. (2018) assert that by the end of elementary school, only a limited subset of learners fully understands the intricate structure of rational numbers. Much of this difficulty arises from the fact that teachers' understanding of rational numbers is often very limited (Howe, 2020; Ma & Ma, 1999; Thanheiser, 2009; Van Hoof et al., 2018). While insightful and robust, this body of research frequently diagnoses the issue and offers potential solutions. However, further research is required to see if the prescribed solutions are effective. Many K-8 math teachers were taught math in a similar, rote way—devoid of symbolic and concrete meaning. We must attend to them as their students' primary source of math information.

Many teachers lack what researcher Liping Ma called PUFM, or a profound understanding of fundamental mathematics (Howe, 2020; Ma & Ma, 1999). In her seminal report, researcher Eva Thanheiser (2009) found that only 20% of the preservice teachers in her study could reliably conceive of the reference units for each digit in a three-digit number. Thanheiser concluded that in order to facilitate student understanding of numbers and algorithms, teachers need more than the ability to perform the algorithms. Given that Social Constructivism requires the presence of a

"more knowledgeable other," it is essential that Thanheiser's conclusion be taken into account when it comes to professional development regarding place value and rational numbers.

Curricular Implications

Akin to the cornerstone that is middle school math education, the decimal point is the keystone of our base ten positional number system. It lives in a fixed location between the one's and the tenth's place. Nevertheless, popular curricula and online platforms such as khanacademy.com teach decimal movement, some as young as fifth grade (Houghton Mifflin Harcourt, 2020). Given the stages of constructing mathematical understanding on the part of the students and the need for PUFM on the part of the teachers, it is hard to justify this method of math instruction. Considering the cultural and linguistic diversity in today's classrooms, it becomes even more challenging to justify this methodology and its obvious toll on students' ability to build a solid rational number sense to support future study. Countless students enter algebra classrooms thinking they can "move the decimal" or "add a zero" when multiplying by ten (Howe & Epp, 2008). Similarly, students learning rational numbers are often told to "keep it, change it, flip it" to divide fractions. While momentarily expedient, ultimately, uncontextualized algorithmic practices sever the mathematical meanings from the symbols and structures created to represent them.

Children who are taught math in this rote way can be successful for a time. Many students can memorize dozens of siloed tricks (untethered to base ten understanding) which temporarily provide correct answers (Irwin, 2001; Lortie-Forgues & Siegler, 2017; McMullen et al., 2021). However, this methodology is failing them when they try to learn algebra. Consider that we read (text and numbers) from left to right, and we begin teaching math by counting from least to greatest. Forty percent of the Kindergarten Common Core State Standards and substandards are in the domain of "counting and cardinality" (Common Core State Standards Initiative, n.d.). However, from left to right, digits in our place value system go from greatest to least (hundreds, tens, ones). This makes sense from a utility standpoint; as adults, we want to know about the 100 dollars before the tens and ones, but it is prudent for educators to think about this multi-directionality in terms of student learning, especially those with directional learning difficulties. Furthermore, most students today have very little interaction with physical money. Grounding concepts such as regrouping across place values through the ritualistic acts of making change and finding sums or differences with whole and fractional monetary units, once the strongholds in a teacher's contextualizing toolbox, are verging on obsolete (Irwin, 2001; McMullen et al., 2021).

There are myriad ways to leverage our natural inclination to base ten in pursuit of plasticity and fluency with rational numbers, from sums of ten in early elementary to scientific notation in high school, which leads to deeper conceptualization. This is especially true for percent, decimal, and fraction (i.e., rational number) domains where many of our most academically vulnerable middle schoolers, e.g., first-years, live. Notably, sixth grade is also where the strand "Numbers and Operations in Base Ten" stops appearing in the Common Core (Common Core State Standards Initiative, n.d.). The shift from using whole number sense to building rational number sense is a critical stepping stone to building algebraic number sense. Rational number knowledge is a strong predictor of more advanced mathematical learning, yet many students' math struggles begin with the introduction of rational numbers (Thompson & Smith, 2017). Causes of this are commonly attributed to students' natural number bias and teachers' lack of PUFM.

Conclusion

Given our country's continually declining math achievement scores and the importance of building a solid rational number sense for future study, there is evidence to support an examination and restructuring of the organization of math education as it pertains to curricular instruction, particularly where the rational number domain is concerned.

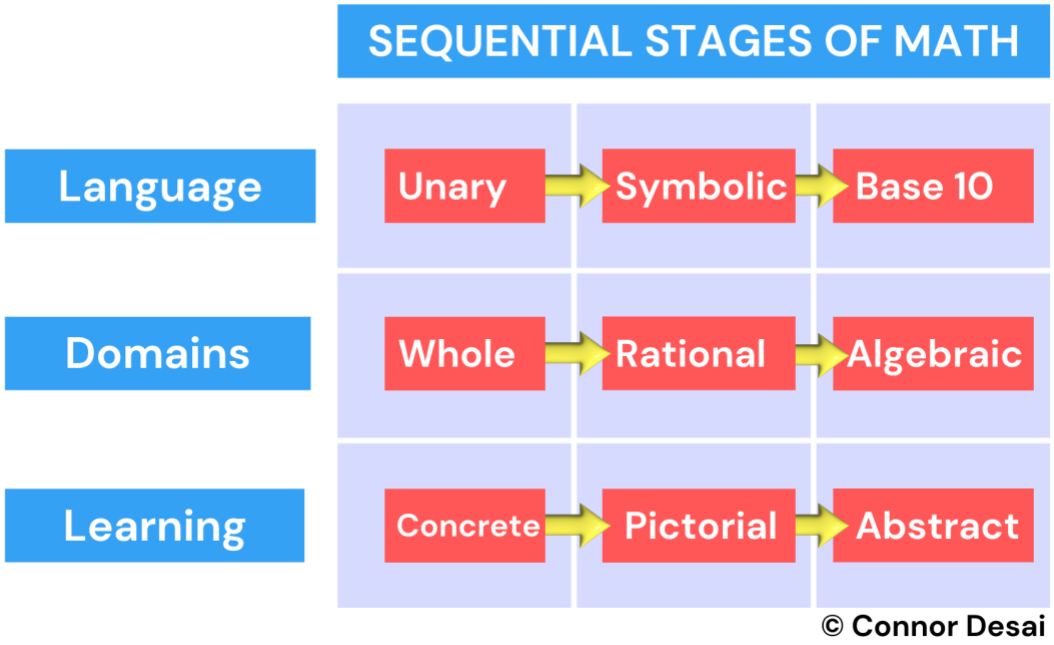
As Hosun Kang et al.'s (2018) work illuminates, middle school plays a critical role in shaping young individuals' perceptions of themselves in relation to STEM subjects, influencing their long-term engagement with these fields. Ultimately, students need to feel successful in math (i.e., arrive at the correct answer and know *why* their computations worked) to feel confident in mathematics learning spaces (Thompson & Smith, 2017). The goal of decolonizing and humanizing rational numbers is more than a curricular enhancement. A lack of intuitive base ten place value knowledge is a form of illiteracy. Every new mathematical skill must be explicitly tethered to its shared meaning, its concrete, humanistic base ten roots. This is what it means to "get" math.

Each round of CPA stages, like each student's journey toward constructing mathematical understanding, is a microcosm of humanity's shared construction of our number system. There is an observable symmetry as students practice and master each number domain, from whole (natural) to rational to algebraic (see Figure 2). These symmetrical, sequential math learning processes, like our base ten positional system, are grounded in our biological evolution. Human ontogeny, the development of an individual organism within its lifetime, parallels phylogeny, the evolutionary history of the human species. Each progressive stage, starting from the yolk sac to gills and embryonic tail, mirrors the evolutionary progression of our ancestors, from single-cell

amoebas to fish and reptilian forms. All steps are necessary to arrive in human form, just as all steps are necessary to arrive at mathematical literacy.

Figure 2

Chart of Sequential Stages of Mathematical Language and Literacy Construction



Drawing back the curtain on the origins of math and contextualizing lessons to their base ten roots has the potential to address the needs of both sides of the math education debate. Rigor can be reinstated with the mathematical literacy that stems from base ten teaching. A working knowledge of humanity's shared labor in creating the number system will improve accessibility in terms of students' sense of agency and identity in mathematics learning spaces and perhaps dispel the pervasive but thinly disguised belief in the United States that white male students from affluent backgrounds inherently possess the "math gene" once and for all (Wibneh, 2016).

Eradicating the damage of harmful stereotypes, rote teaching methods, and poor mathematics achievement requires a restructured, systemic solution, one that invites children to identify themselves as successive participants in the journey of math.

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Using ChatGPT for Story Creation: One Autistic Teen's Autonomous Reading Motivation

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Abstract

ChatGPT has experienced exponential growth in its number of users since its launch in November 2022. Researchers studying early adopters of the generative artificial intelligence (AI) chatbot have found positive reactions from those who have used ChatGPT for reading and writing. However, this research is still in its infancy and few studies exist on the impact of AI Large Language Models (LLMs) on reading motivation. No studies have been published on autistic teens' reading motivation and behavior when using AI LLMs for story generation. Framed by Self-Determination Theory and Cognitive Evaluation Theory, this case study explores one autistic teen's use of ChatGPT and his resulting autonomous motivation for leisure reading. Findings reveal that AI-generated stories increased the teen's intrinsic reading motivation, addressed his personal interest in fictional characters, and strengthened his literacy practices. Caregivers and educators may consider permitting the use of AI LLMs for story creation by autistic teens to develop their reading motivation and behavior.

Keywords: ChatGPT, AI, Large Language Models, autism, self-determination theory, reading motivation

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No known conflict of interest to disclose.

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Introduction

In early 2023, Michael, an autistic teen, sat in his living room staring at his smart phone. He began to laugh. His mother asked him what he was laughing at, and he said he was reading a story ChatGPT had written for him. Michael's mother watched as her son read silently. And read and read. Not only had she not seen her son read for such an extended amount of time, she had not had any hands-on experience with ChatGPT. She asked him to show her how it generated a story. Michael showed his mother the 23-word prompt he had typed into ChatGPT and the output of the story. They scrolled through the pages of the narrative. Michael seemed pleased to have a story designed for his personal interest and his mother was thrilled to see him reading for an extended period of time.

Researchers have studied reading motivation in young people for decades (Baker et al., 1996; De Naeghel et al., 2012; Guthrie, 1996; Troyer et al., 2019; Wigfield, 1997). The emphasis on intrinsic and extrinsic motivation in the research builds on general motivation theories of Deci and Ryan (1985) and Ryan and Deci (2000) and points to the impact intrinsic motivation has on reading engagement and proficiency. Dimensions of intrinsic reading motivation include situational interest (Wigfield, 1997) and activity-specific motivation (Schiefele et al., 2012), which are worth considering when investigating the impact ChatGPT has on leisure reading.

ChatGPT is an artificial intelligence (AI) Large Language Model (LLM) that is available on smartphones in the United States and can generate text for various purposes. ChatGPT generates text when a prompt is typed or spoken into its user interface. The multimodal interface makes ChatGPT usage accessible to many individuals with disabilities. OpenAI introduced ChatGPT on November 30, 2022 (OpenAI, 2022) and defines its text models as "advanced language processing tools that can generate…text with high levels of coherence and accuracy" (OpenAI, n.d.). ChatGPT gained instant popularity, acquiring 1 million users within five days of its launch, 100 million users within two months, and as of July 2024 has over 180 million users (Duarte, 2024; Jayaputri, 2024; Skjuvi et al., 2024). Over 14% of ChatGPT's users are in the U.S., while India, Brazil, and Indonesia each make up between 4% and 10% of the users worldwide (Duarte, 2024).

Early adopters of ChatGPT reported that entertainment and creative story generation were among their top uses for the AI tool (Skjuve et al., 2024). Autistic adults in South Korea use ChatGPT to discuss issues they do not want to discuss with family members or others around them and to write poetry and generate ideas for novels (Choi et al., 2024). Autistic adults in the United States report using ChatGPT as a chat partner, with one reporter writing that the AI

platform can be therapeutic and can be used to empower people and help them be fully autonomous and experience success on their own terms (Hoover & Spengler, 2023).

One form of autonomous learning is autodidacticism. Autodidacticism is "the process or practice of learning a subject without a teacher or formal education" (dictionary.com). Berger (2022) states that autodidacticism is "motivated by self-determination and enthusiasm for learning independently" (p. 2) and Firat (2023) writes that "autodidactic learning allows learners to take control of their own learning and development, and to learn at their own pace in a way that is tailored to their individual needs and goals" (p. 1).

Firat (2023) wrote about the potential of using ChatGPT to enhance autodidactic experiences in open education settings. He asserted that "ChatGPT may not only encourage learners' autonomy but also improve learning experiences" (p. 2). He then articulated six ways that ChatGPT could enhance autodidacticism:

1. Personalized support and/or suggestions for learning materials based on a learner's individual needs and objectives
2. Real-time feedback and guidance
3. Increased accessibility
4. Convenient and flexible learning
5. Enhancing the use of open educational resources
6. Self-assessment and reflection

While a wide range of individuals may have autodidactic tendencies, this ability may be enhanced through the use of AI Large Language Models. For those prone to social anxiety, such as autistic individuals, those with attention deficit/hyperactivity disorder, and those who are demand-avoidant, taking control of one's own learning may be especially beneficial. There is a lack of research on autistic individuals and those with ADHD using ChatGPT in autodidactic ways.

Autism, classified as a developmental disability, is a diagnostic label for naturally occurring variations in brain development evidenced in divergent sensory processing. Evolving understanding of autism moves beyond the deficit-perspective of the Diagnostic Statistical Manual's (American Psychiatric Association, 2013) criteria of repetitive habits and impaired social communication to include physical and mental co-morbidities and the inclination to appear neurotypical by "masking" typical autistic tendencies. Autism is currently identified in

approximately 1% of the world's population and occurs across ethnicities and nationalities (World Health Organization, 2023). Many individuals with the diagnosis see it as an indelible part of their identity and prefer the term "autistic" as opposed to being referred to as a "person with autism."

Autism and Attention Deficit/Hyperactivity Disorder (ADHD) co-occur in 50-70% of the autistic population (Hours et al., 2022). ADHD is an umbrella term for symptoms of inattention (not being able to keep focus) and/or hyperactivity (excessive movement that is not fitting to the setting) and impulsivity (hasty acts that occur in the moment without thought) that interfere with functioning or development (American Psychiatric Association, 2024; National Institute of Mental Health, n.d.). Individuals with ADHD may "struggle with relationships and antisocial behaviors" and ADHD may negatively impact "academic and professional achievements" (American Psychiatric Association, 2024; National institute of Mental Health, n.d.). Between 2.5% and 8.4% of the population have been diagnosed with ADHD with the top of the range being children (American Psychiatric Association, 2024). While the presentation and support needs of autistic individuals and those with ADHD vary from person to person, a percentage also fit a demand avoidant profile.

Demand Avoidance refers to a profile in which an individual, often autistic, needs "to be in control and avoid other people's demands and expectations" (Fidler & Christie, 2019, p. 11). This need for autonomy and control is anxiety-driven. An individual with a demand-avoidant profile may feel anxiety from demands of time, questions, praise, transitions, and from being expected to make decisions (PDA Society, 2021). AI LLMs may provide a low-anxiety option for developing intrinsic motivation in literacy practices for those with demand-avoidant profiles.

Theoretical Framework

Self-Determination Theory (SDT), intrinsic motivation, and Cognitive Evaluation Theory (CET) are interrelated. SDT focuses on "what kind of motivation is being exhibited at any given time" (Ryan & Deci, 2000, p. 69) with intrinsic and extrinsic motivation being the primary categories of motivation. Intrinsic motivation has to do with "the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn" (p. 70). CET focuses on environmental conditions that support intrinsic motivation and posits that "freedom from demeaning evaluations…facilitate[s] intrinsic motivation" (p. 70) and "according to CET, people must not only experience competence or efficacy, they must also experience their behavior as self-determined for intrinsic motivation to be in evidence" (p. 70). While CET research emphasizes the positive impact of support and security from adults in the environment,

"many intrinsically motivated behaviors are happily performed in isolation, suggesting that proximal relational supports may not be necessary for intrinsic motivation" (p. 71) and this is especially true for autistic individuals with demand-avoidant profiles whose anxiety is triggered by the presence of perceived authority figures.

Literature Review

AI LLMs and Literacy Practices

Published studies on young people's use of AI LLMs are still in development, with few articles available in 2024 at the time of this writing. I searched for related articles using a university library's access to multiple databases including GoogleScholar and EBSCOHost in June 2024. I found 16 articles that included the topic of AI LLM use for literacy practices. Five studies are reviewed below. All the published research on students' use of AI LLMs is of studies that took place in Asian countries. I was not able to find any published studies on the use of ChatGPT for student literacy practices from the U.S. at the time of this writing.

Jayaputri (2024) used a pretest-posttest experimental design to study the impact of ChatGPT on student motivation in English language development. Jayaputri surveyed 40 academy students in Papua, Indonesia in November and December 2023. The survey assessed intrinsic motivation, perceived ease of use of ChatGPT, perceived usefulness of ChatGPT, and the participants' behavioral intentions for using ChatGPT in the future. Before and after receiving lessons on using ChatGPT, the students completed surveys to evaluate changes in motivation in learning English. The researcher found that students were more motivated to use ChatGPT as a specific learning methodology after the intervention and that several factors fostered the learner motivation. Factors mentioned in the study include personalized and instantaneous interactions with AI chatbots, heightened sense of engagement and interactivity, augmenting the educational journey for students, and the prompt and pertinent responses provided by ChatGPT.

Lee et al. (2023) also used a pretest-posttest survey with students in English-as-a-foreign-language classes in elementary schools in South Korea. Sixty students were provided with three 40-minute intervention lessons using an AI-based content generator (AICG) that created English texts for them to read, while 61 students served as the control group and did not engage with AICG. The researchers surveyed the students with a focus on foreign language enjoyment and learners' interests in reading English books. The intervention group showed significantly greater foreign language enjoyment and interest in reading English books in the posttest than the control

group. The researchers articulated that AICG allows students to generate original passages on themes they find to be interesting.

Li et al. (2023) surveyed and interviewed middle school and high school students at a summer camp in Beijing, China on their behavior and motives for using AI LLMs. They had 76 participants complete surveys – 34 middle school students, 42 high school students, and 19 parents. The survey covered five domains of AI LLM usage: information, practicality, sociality, technical characteristics, and adoption attitude. Fourteen of those surveyed were also interviewed to investigate the behavior, motivation, and attitude of students and parents toward using AI LLMs for learning. Researchers found that AI LLMs stimulate student interest in learning and that parents had a more positive outlook on using AI LLMs for school education than the students did. However, the parents expressed concern over a potential decline in students' independent learning abilities when using AI LLMs in middle school.

Salas-Pilco et al. (2022) conducted a systematic review of literature published between 2017 and 2021 that focused on ethnic, cultural, and linguistic minority students' use of AI in inclusive educational settings. They analyzed 27 studies from nine countries and concluded that AI could help personalize learning based on students' needs. Nine studies demonstrated that AI improved student academic performance, and five studies showed that AI promoted student engagement. The researchers concluded that AI can help support the inclusion of minority students in educational settings.

Toyokawa et al. (2023) conducted a case study in which they studied two students who attended a special education classroom to explore how AI can be used to support learners in inclusive education. This study took place in Japan, where placement in a separate special education classroom is considered inclusive education, a designation different than inclusive education in the U.S. Toyokawa et al. (2023) concluded that AI can be personalized to individual learners' needs and pace and that attention should be given to AI that offers "precise, individualized guidance and feedback for more effective interventions" (p. 11). Moreover, they stated that "it would be possible to use natural language generation to support reading-learning by navigating the contents and the flow of reading activities in an easy-to-understand manner using both text and audio" (p. 12).

Although few, the published studies on students' use of AI LLMs for literacy practices provide descriptions of populations and purposes worth studying in research on autistic students' use of AI LLMs for leisure reading. Lee et al.'s (2023) study establishes that students use AICG for personal reading pleasure, while Salas-Pico et al.'s (2022) and Jayaputri's (2024) studies

provide similar findings about AI positively influencing student engagement. More specifically, Toyokawa et al.'s (2023) research demonstrates the potential of studying AI use by students with disabilities, and Li et al. (2023) includes the vital element of parents' perspectives on the use of AI LLMs among young people. Each of these publications presents findings that demonstrate the need for more research, such as this current case study of an autistic teen who uses ChatGPT to generate stories for leisure reading.

Reading Motivation

Articles on motivation in general and specifically reading motivation abound as the subject has been theorized and studied for more than 50 years. In my review of literature, I focused on intrinsic motivation and found 11 articles specifically related to intrinsic motivation and reading. The following studies are representative of related literature from the past three decades.

De Naeghel et al. (2012) developed and used the SRQ-Reading Motivation questionnaire to assess recreational and academic reading. They surveyed 1,260 Flemish fifth graders and 67 of their teachers. They found that autonomous (intrinsic) motivation plays a significant role in recreational reading motivation, behavior, and performance. They concluded that "students spend more of their leisure time on reading, are more deeply and attentively engaged in reading, and perform better on a standardized reading comprehension test, when they read for their own enjoyment or believe it is personally relevant" (p. 1017).

Schiefele et al. (2012) published a review of 20 years of research on reading motivation. They concluded that intrinsic reading motivation makes a positive contribution to reading behavior and reading competence. They further affirm forms of intrinsic reading motivation such as object-specific reading motivation, in which "the person is motivated to read because of an interest in the topic of the text" and activity-specific reading motivation, in which "the person is motivated to read because the activity of reading provides positive experiences" (p. 429). They also considered categories of reading motivation, and their review of literature found interest, enjoyment, and relief from boredom to be among those identified.

Troyer et al. (2019) enrolled 4,529 rising fourth- and fifth-grade students from 59 elementary schools in North Carolina for a 2014 study on intrinsic motivation. The researchers had students answer questions about reading involvement, curiosity, self-efficacy, and autonomous recreational reading motivation. They found that intrinsic motivation has a greater effect than reading amount on achievement. They also concluded that the quality of reading material, meaning the text matches the reader's interest and skill level, matters for less-skilled readers.

Wigfield (1997), in a seminal article on reading motivation, described the development of the Motivation for Reading Questionnaire (MRQ) and subsequent studies' findings that students' reading motivation is multidimensional. One key dimension is that of situational interest, when the reader's "interest is sparked by a particular text or other features of a particular reading act" (p. 63). Wigfield connects reading motivation to other aspects of reading and concludes that when compared to extrinsic motivation, intrinsic motivation is the stronger predictor of the amount and breadth of reading students do.

Methodology

Given the rapid growth in the use of AI, the multiplying population of autistic teens, and the growing awareness of autodidacticism, I conducted qualitative research using a single case study method. "Qualitative research gathers participants' experiences, perceptions, and behavior. It answers the hows and whys instead of how many or how much" (Tenny et al., 2022, p. 1). A "case" may be an individual, as it is in this study, and the purpose of a case study is to "explore a phenomenon about which not much is known" (Ashley, 2012, p. 102). Creswell and Poth (2018) note that a case, regardless of size, must be bounded in time and setting and that the study is composed "to illustrate a unique case, a case that has unusual interest in and of itself" (p. 98). This case study came from two audio-recorded interviews and follow-up questions sent by text.

The participant in this study is a 16-year-old autistic male with ADHD who fits the demand-avoidant profile. He attends school in an intensive therapeutic setting, and his core academics are taught in a one-on-one format. At home, he is resistant to any work or activities that remind him of school. He does not choose to read books or other print material. His use of ChatGPT occurs in the home, outside of school hours. He uses ChatGPT independently, with his mother's permission, and decided to create stories using the LLM tool without adult prompting. This study covers the participant's use of ChatGPT from March 2023 to June 2024. During this time, no curricular, pedagogical, or home environmental factors changed. Assent from the participant and parent consent were provided for this case study.

Two interviews, with semi-structured questions and follow-up text correspondence with clarification questions took place in June and July 2024. The participant also provided a copy of his original ChatGPT prompt and the story the AI chatbot generated. To analyze the data, I listened to the audio-recorded interviews several times and transcribed the questions and responses. I also transferred the text responses to the secured document with the transcribed interviews. I then sorted the transcript excerpts, placing similar responses together and identifying themes.

Findings

I identified four themes in Michael's responses related to the use of ChatGPT for leisure reading. The following section contains excerpts from the interviews organized by the themes of interest, enjoyment and engagement, behavior, and participant concerns.

Interest

Michael created his first story using ChatGPT in March 2023. He would be considered an early adopter of ChatGPT as the AI LLM had been publicly available for less than six months when he began creating stories to read. His first prompt was 23 words long and included character names from the long-running and popular cartoon *SpongeBob*. Michael's favorite cartoon is *SpongeBob,* so he built his reading around his personal interests.

Michael's reading interests are currently dominated by one genre. During the interview, Michael identified himself as a lover of fiction, and his primary access to fiction is through ChatGPT rather than through hardcopy books: "I'm a big fiction guy. I haven't read any copies of any books as of recently, particularly in the fiction variety."

Enjoyment and Engagement

I asked Michael about his motivation for using ChatGPT for story generation. He said the following:

> "I think it's mostly fun for experimentation."
>
> "It's good for experimentation and it helps when you are bored."
>
> Researcher: "How does it make you feel to use ChatGPT when you are bored?"
>
> Participant: "Mildly entertained."

Michael discovered the ability of ChatGPT to address one of his personal needs – the need to resolve his boredom. He was able to find a free, personalized, non-disruptive way to entertain himself at home. He said that he enjoys that the plots ChatGPT creates are *ambitious* and *over the top*.

When asked how many stories he has had ChatGPT generate for him since March 2023, Michael opened his notes app on his phone and began counting. He counted under his breath for more than a minute and stated: "Approximately 75 or 76 story prompts I made with ChatGPT."

In the 15 months since he started using ChatGPT, Michael has autonomously created more than six dozen stories for his leisure reading. He has transitioned from reading no narratives at home to creating and reading more than a story a week.

Reading Behavior

Although Michael sees his mother reading frequently at home, he associates his reading behavior with the practice of oral reading expected in his therapeutic school setting. At one point in the interview, he clarified his style of reading when using ChatGPT: "I do read in my head, just not out loud."

By engaging with ChatGPT without parents or teachers around, he was able to expand his repertoire of reading practices. Michael's use of ChatGPT changed not only his modality of reading but also changed the amount of reading he does and where he does it.

Researcher: "Do you read more on ChatGPT or more at school?"

Participant: "If I were to be brutally honest, these days I read on ChatGPT. I don't have to worry about getting a physical book."

Michael's changed reading behavior also reinforces the literacy skills he has learned at school. Each time Michael asked ChatGPT to generate a story, he used a prompt similar to a Mad-Libs template. In the paper-and-pencil word game Mad-Libs, players write story templates with key words missing, as other players are asked to provide parts of speech without knowing the sentences in which the parts of speech are going to be placed. During one interview, Michael explained how he provides information to ChatGPT: "Here's the prompt I would normally give: Write me a blank (adjective) story where this character, this character, this character, that character, that character, etc., (verb, verb that), and other details adjacent to the plot."

Michael named the parts of speech in his explanation, indicating that while his topical interest may change from story to story, he provides parameters for ChatGPT's stories. He continued to demonstrate his understanding of language features when he described ChatGPT's work: "These stories do tend to fill in some generic tropes and cliches into the stories it creates for me."

Participant Concerns

Michael's understanding of ChatGPT showed evidence of ethical considerations. He mentioned risks associated with the proliferation of AI chatbots that extended beyond his own use and captured some universal cautions: "People are becoming more and more concerned

about AI being used to generate stories and pictures because it is going to replace writers and artists. That and AI is kind of a lazy way to do something."

Michael included in his responses to questions about good uses of ChatGPT warnings about the potential misuse of AI. He also expressed concerns about AI LLM hallucinations and how ChatGPT may deliver content that is not true.

Discussion

This case study gathered data on Michael's experiences, perceptions, and behavior with ChatGPT. The phenomenon of autistic teens using AI to generate stories for leisure reading has not been widely studied and is not well understood. Michael's responses to interview questions were sorted into four themes, which provided insights into both the use of ChatGPT and intrinsic reading motivation.

First, Michael revealed that his situational interests (Wigfield, 1997) guide his use of AI LLMs for story reading. He provides prompts that include some of his favorite fictional characters. This is an example of object-specific reading motivation, as described by Schiefele et al. (2012) in their synthesis of research. Object-specific reading motivation is a form of intrinsic motivation that has been shown to have a strong effect on reading achievement and performance (De Naeghel et al., 2012). Li et al.'s (2023) study on students using AI LLMs at a summer camp in China revealed that ChatGPT is a good tool for stimulating student interest in learning. It is likely that there is a reciprocal relationship between Michael's intrinsic motivation to read stories about fictional characters and his use of ChatGPT to create new stories. Each reinforces the other – as Michael uses ChatGPT to create fictional stories, his motivation to read increases, and as his object-specific motivation increases, he creates more stories on ChatGPT. This supports Lee et al.'s (2023) finding that AICG, like ChatGPT, allows students to create stories they find interesting. For Michael, this is a form of autodidacticism.

Second, Michael identified one of the key categories of reading motivation – relief from boredom – as one of the main reasons he uses ChatGPT to make stories. He has found ChatGPT to be entertaining and fun, a good form of help when he's bored. Schiefele et al's (2012) summary of Greaney and Neuman's (1990) analysis of students' reading motivation identifies "escape" as a factor of reading motivation. They stated, "Students scoring high on this factor read to avoid boredom and when they have nothing better or more exciting to do. For these students, reading functions as a source of distraction and relaxation" (p. 435). Michael has found ChatGPT's story generation to be so enjoyable and engaging that he has created 76 stories in a little over a year. Salas-Pilco et al.'s (2022) literature review found five studies that concluded

that AI promotes student engagement. De Naeghel et al. (2012) also found that engagement and time spent reading stem from enjoyment. To relieve his boredom, Michael used his activity-specific motivation to increase reading activity because it provided positive experiences (Schiefele et al., 2012).

Third, Michael's reading behavior with ChatGPT stories reinforces his school-based literacy learning and provides him with the opportunity to practice literacy in new and autonomous ways. This allows him to practice his autodidacticism. With his ChatGPT stories, he is free to read silently. He has become proficient at autonomous recreational reading and is motivated to continue. Troyer et al. (2019) found this to play a significant role in reading achievement. Schiefele et al. (2012) concluded that intrinsic reading motivation positively impacts reading behavior.

Finally, I found Michael's inclusion of concerns about ChatGPT to show adeptness. Although he uses ChatGPT independently, with his mother's permission, he is aware that there are reasons to be cautious about an overreliance on the AI chatbot. Most of the published literature on the use of ChatGPT also warns of the misuse and misrepresentation of AI-created material. Michael's autodidacticism extends beyond reading; it includes wanting to learn about and act in an ethical manner when using ChatGPT.

The use of an AI LLM for story creation afforded an autistic teen the opportunity to control enough content in AI-created stories to motivate him to read for pleasure and to read in environments outside of school settings. According to CET, this environmental freedom facilitates intrinsic motivation. Of interest when considering reading motivation among autistic students is Deci et al.'s (2001) findings that tangible rewards have an undermining effect on intrinsic motivation. It comes as no surprise that an autistic teen who has worked within an extrinsic reward system for more than a decade in school has developed the habit of not reading at home, but this case study shows that with ChatGPT, he can create his own stories using AI-generated literature to read for enjoyment. By using ChatGPT, Michael simultaneously fulfills his needs for agency and reading for enjoyment.

Conclusion

ChatGPT is a beneficial tool for teens to extend their reading behaviors to leisure settings. In this case study, findings show that one autistic teen's intrinsic reading motivation increased with the use of the AI language processing tool. There have been more than 30 years of research on reading motivation but very little on reading with AI text models. The body of research on student use of ChatGPT is still in its infancy, and the exploration of ChatGPT's use in the autistic

community is new. ChatGPT gives autistic individuals control over the characters and settings in the stories they prompt the chatbot to create so that their interest level is sufficient for extended engagement in reading.

Teachers and parents may consider using AI with their teens who are developing readers. Depending on individual support needs, adults may have to guide young people in using the prompt interface. Alternatively, adults may gather information on characters and actions of interest, input the prompt into ChatGPT for the students, and then give the AI-generated stories to them to read.

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A Comparative Overview of Educational Indicators in Norway, Sweden, Germany, and Iran

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Abstract

Education is characterized as a structured and systematic process of acquiring knowledge, skills, and attitudes, forming a fundamental base for the progress of individuals and societies. Educational systems vary across countries, reflecting complex interactions among cultural, social, economic, and technological factors that shape how students learn and experience schooling. The present study aims to provide a descriptive comparative overview of key educational indicators in four countries, Norway, Sweden, Germany, and Iran, in order to explore similarities and differences that may inform policy and educational development. This study adopts a descriptive and synthesis-based approach with a focus on key indicators: the structure and levels of education, governance aspects, and distribution of responsibilities, evaluation and assessment strategies, and funding budgets. Findings of the study reveal considerable variations in governance structures, funding, and evaluation approaches across these countries. Norway and Sweden highlight decentralized structures and equity-based models, while Germany reflects a federal and region-specific model. Iran's educational system follows a centralized decision-making structure. Additionally, as this study employs a descriptive approach and relies on secondary data, findings are interpretive rather than evaluative or causal. Moreover, the synthesis of these key indicators provides policymakers and educators with valuable insights into different governance structures and strategies for promoting educational quality and equity. It also contributes to comparative education by providing a structured comparative overview of four educational systems.

Keywords: education, educational systems, structure of educational systems, four indicators

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We have no known conflict of interest to disclose.

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Introduction

Education is one of the most essential elements of any social system. According to Boavista (2017), education aims to enhance individuals' self-confidence and provide better job opportunities. Education also enables individuals to participate in public debates and advocate for healthcare and social security policies.

Europe is shaped by diverse cultures and languages, and these distinctions are noticeable in various facets, including the structural variations across different educational systems (Ministers of Education and Cultural Affairs of Germany [MECAG], 2014). Educational structures vary according to each country's policies, programs, and objectives. Moreover, making effective use of other countries' educational policies and experiences is highly beneficial in shaping the education systems of individual countries.

The current study aims to compare the educational systems of three developed countries, Norway, Sweden, and Germany, and a developing country, Iran, in terms of four general indicators. These indicators include the structure and levels of education, governance and distribution of responsibilities, evaluation and assessment, and funding. The structure and levels of education cover the age of children, the study duration, the categorization of education levels, and the curriculum. The governance and distribution of responsibilities deal with the divisions of educational responsibilities between sectors and organizations. The third indicator examines evaluation and assessment procedures in the selected countries, while the fourth addresses funding sources and the sectors responsible for allocating and distributing budgets among schools.

Literature Review

Educational System and Structure: Norway

Norway has a strong welfare-state model, and the state supports the economy and education (Eurydice, 2009). A fundamental principle in Norwegian educational policy is that education is available for all children, and they possess an equal entitlement to education irrespective of their location, gender, cultural, or social background (Norwegian Ministry of Education and Research [NMER], 2010). Norway's educational system is highly comprehensive, and Norwegian educational policy attempts to provide equal educational chances for students regardless of their gender, cultural identity, geographic location, and economic status (Eurydice, 2010).

Additionally, all public education in Norway is provided without charge, but kindergartens have parental fees (NMER, 2010). In Norway's educational system, both public and higher education are provided free, but early childhood education and care are not free of charge. It is worth mentioning that student selection is not based solely on academic ability and the option for year repetition is not available (OECD, 2011). Moreover, although Norway spends high levels on education and the outcomes of the International Student Assessment (PISA) in the OECD's Program are at or above the OECD average, these results have raised concerns. The educational quality varies between municipalities sharing similar characteristics. This variation has emphasized the need for improved national monitoring of educational quality. During the last decade, Norway has focused more on making national tools and processes to supervise the educational system's quality at different levels to improve practices and increase students' performance (Nusche et al., 2011).

Levels of Education

According to Nusche et al. (2011), the educational system in Norway is composed of three phases: Pre-primary education phase (typical ages 1-6): This level is held in both public and private daycare centers. The national government considers objectives for the pre-primary education level and allocates funding for these centers. It is the responsibility of municipalities to run and monitor institutions. Participation at this level is not mandatory (Eurydice, 2010).

Compulsory education phase (typical ages 6-16): Norwegian students start their formal education at the age of 6. The compulsory education phase comprises ten years and is organized into the primary level (school years 1-7) as well as the lower secondary level (school years 8-10). Upper secondary education phase (typical ages 16-19): This educational level lasts three or four years and includes twelve educational programs comprising three core programs and nine vocational programs. Attendance at the upper secondary education level is optional.

According to Nusche et al. (2011), the Norwegian national curriculum for knowledge promotion aims to concentrate more on fundamental skills and result-based learning. This program encompasses the whole education system, spanning from primary level to upper secondary education level, and consists of four essential parts:

- The core curriculum: It incorporates inclusive goals for both the primary and secondary education levels, as well as explains the fundamental cultural values and educational knowledge (Nusche et al., 2011).
- The quality framework: This framework elaborates school owners' liabilities to improve education quality (Nusche et al., 2011).

- The subject curricula: This curriculum outlines student competency objectives for compulsory schooling (Years 2, 4, 7, and 10), as well as for each school year in upper secondary education (Vg1, Vg2, and Vg3). The competence objectives of an individual subject include the combination of five essential skills: verbal expression, reading literacy, numeracy, written expression, and computer literacy (Nusche et al., 2011).
- The structure of distributing teaching hours and subjects: For each subject, this structure describes the required minimum teaching hours. While school owners have the freedom to autonomously assign extra teaching hours in specific subjects, separate funding is necessary for this purpose (Norwegian Ministry of Education and Research [NMER], 2010).

Notably, school owners are eager to set particular local objectives corresponding to national objectives. They are also liable to accept and perform the curriculum at the local level. Defining objectives for each year falls under the responsibility of school principals, whereas schools bear the responsibility of specifying the content, organization, and teaching methods (NMER, 2010). Moreover, the subjects covered in both primary and lower secondary levels in the Norwegian education system are "Norwegian, mathematics, social science, Christianity, Religion and Ethics Education (CREE), arts and crafts, natural science, English, foreign languages/ language in-depth studies, food and health, music, physical education, student council work, and optional program subject" (NMER, 2010, p. 4).

Governance and Distribution of Responsibilities

Norway follows an ancient and fixed tradition of school autonomy. Local communities in Norway have ownership and responsibility for individual schools instead of being under the supervision of national authorities. This decentralized running process is particularly noticeable at both primary and lower secondary education levels. Four hundred thirty municipalities manage schools, excluding a small private sector (Nusche et al., 2011). County authorities are responsible for upper-secondary education and training (NMER, 2010).

In addition, the Norwegian Parliament (*Storting*) sets general educational goals, accepts the legal structure, and establishes standards. The Ministry of Education and Research in Norway is tasked with regulating national education policies, encompassing acts, regulations, and curricula. School owners, including counties, municipalities, and private providers, are responsible for organizing and managing school services, providing resources, and improving the quality and progress of education within their relevant schools (Nusche et al., 2011).

Evaluation and Assessment

In Norway, a National Quality Assessment System (NQAS) has been developed to support education authorities, school owners, and schools in measuring students' performance and introducing appropriate strategies for their improvement. This system provides both national guidance and flexibility, granting schools and local authorities substantial autonomy to design and administer local evaluation strategies (Nusche et al., 2011).

According to Nusche et al. (2011), in the Norwegian educational system, student assessment relies on the integration of both teacher-conducted classroom evaluations and centralized assessments. Additionally, teachers bear the main responsibility for evaluating students at all levels of the school system, encompassing both formative and summative formats:

- In the 1-7 school year levels, the main objective of assessment typically revolves around both diagnostic and formative formats. At these levels, no marks are given to students.
- In the 8-10 school years and upper secondary education level, the main emphasis is on a summative format based on the overall achievement marks of students.

Funding

Norwegian counties and municipalities earmark financial support to schools in accordance with various factors, for example, students' enrollment, geographical location, and internal organization of schools (Norwegian Directorate for Education and Training [NDET], 2007). They also provide budgets to finance school education, including local tax incomes and central state transfers (Eurydice, 2010).

Educational System and Structure: Sweden

The national agency for education in Sweden, or *Skolverket,* is responsible for managing the Education Act of 2010 (*Skollagen*), which oversees all levels of the Swedish educational system and emphasizes principles such as gender equality (Kandel, 1933; Jarvis, 2000; Berglund, 2017). Sweden has a comprehensive, inclusive, and fairly equitable educational system. The education system in Sweden is also free of charge for all Swedish nationals and individuals from the EU/EEA and Switzerland (Peterka et al., 2017).

According to BrandãoI (2019), in the Swedish educational system, the structure is as follows:

- Basic Education phase: Includes the Early Childhood Education stage (*förskola*), the Elementary School stage (*grundskola*), and the Upper Secondary School stage (*gymnasium*).

- Higher Education phase: Comprises Post-secondary level (*folkhögskola*, *kompletterand utbildning* or *yrkeshögskolan*), College level (*högskola*), and University level (*universitet*).

Levels of Education

Early Childhood Education (ECE): Participation in ECE is voluntary and may take place in public, private, or independent schools. A one-year-old Swedish child can enroll in preschool at the municipal ECE School (*förskola*) (Kazamias, 2001). In Sweden, preschool class is entirely free of charge, even for children with special needs. This class aims to simplify the transition process from the preschool level to the initial year of elementary school. In addition, the main aim of ECE level and preschool classes is to provide children with a range of pedagogic activities that inspire both the child's creativity through playing activities in groups and the development of learning, as well as help him/her understand and discover the environment (BrandãoI, 2019). It is worth noting that in Sweden, there are high enrolment rates in early childhood education (Peterka et al., 2017).

Compulsory Education: After preschool, children begin nine years of compulsory education, subdivided into three three-year periods. This stage, known as *Grundskola*, is compulsory and free of charge. The three periods are *Lågstadiet* (the first period includes the first three years), *Mellanstadiet* (the second period), and *Högstadiet* (the third period) (Makuwira & Ninnes, 2004). The education level is compulsory for all students from ages 7 to 16 (Peterka et al., 2017). Compulsory school attendance in Sweden is different from some other European countries. Swedish law emphasizes that education, not schooling, is compulsory. Thus, home-schooling is almost non-existent in Sweden (Berglund, 2017).

Secondary School or Upper Secondary Education: Secondary school education, known as *gymnasiet*, is non-compulsory and lasts three years. Although attendance is voluntary, most young people in Sweden participate. Secondary education (*gymnasieskola*) is free and offers both national and introductory programs, as well as specialized programs beyond the standard structure outlined in the national program (Noah & Eckstein, 1969).

Governance and Distribution of Responsibilities

Sweden has a decentralized education system guided by national priorities. Based on the Education Act, 290 municipalities are responsible for public schools (Peterka et al., 2017). At the national level, the central government oversees education policy, curriculum development, and national goals, supported by three independent agencies as follows:

- The Swedish National Agency for Education assesses the procedures of both municipalities and local schools. This agency, in collaboration with the Ministry, defines national objectives and curriculum, as well as produces various statistics related to education.
- The Swedish Schools Inspectorate possesses the authority to establish new autonomous schools, and ensures compliance with central laws and regulations by both municipalities and the organizers of autonomous schools and the schools themselves.
- The National Agency for Special Needs Education oversees attempts made by the government related to special educational needs.

Evaluation and Assessment

The primary emphasis on student assessment in the Swedish educational system lies in formative format during the initial stages of education. Additionally, students are encouraged to determine specific learning objectives using personalized development plans, self-assessment, and peer evaluations. Teachers use classroom-based assessments to collect various data on student development and give regular feedback to students (Peterka et al., 2017).

Additionally, the Swedish schools are mainly accountable for evaluation and assessment. The schools have two kinds of evaluation procedures: internal and external. Schools, school regulations, and compulsory education curricula determine particular internal school evaluation procedures. In this regard, the Swedish Schools Inspectorate aims to control education quality and fulfill regulations, and is also responsible for external evaluations. Moreover, in Sweden, there is a requirement to increase the evaluation procedures of schools to ensure uniformity and a clear direction toward educational development (Peterka et al., 2017). It is worth noting that there is no formal teacher appraisal system in Sweden. While the Ministry of Education and Research in Sweden is mainly accountable for creating a framework for assessing the educational system's quality, the Swedish National Agency for Education has practically the authority for system evaluation (Peterka et al., 2017).

Funding

The procedure of funding in the Swedish education system is principally public. Municipalities and autonomous education providers are responsible for financing and funding the education system. Each municipality is also accountable for deciding how resources will be distributed between schools. In both primary and secondary schools in Sweden, the budgeting process is decentralized to municipalities, with finances derived from local taxes and distributed in different forms depending on the municipality (Peterka et al., 2017). The responsibility of the

home municipality of students is to allocate school funding, regardless of whether students attend a public school or an autonomous school. It is also worth noting that the accessibility of school choice affects school funding because funding is related to students rather than schools (Peterka et al., 2017). In addition, the primary responsibility of the Swedish government is to allocate public funding for higher education institutions. Sweden's government can also allocate financial support to students through study grants and loans to meet students' living expenses (Peterka et al., 2017).

Educational System and Structure: Germany

The education system in Germany is segmented into three stages: early childhood education, primary education, and secondary education (Ministers of Education and Cultural Affairs of Germany, [MECAG], 2014). Germany's school system comprises public and private schools, such as religious or Waldorf (Lergetporer et al., 2017).

Levels of Education

Early Childhood Education (ECE): Educational institutions catering to children provide ECE programs until age six. These establishments are designated to either the ECE or the primary education sector based on the specific Land. While this level of education is typically not compulsory, most of the Lander authorities are given the right to make it compulsory (MECAG, 2014). Enrolment rates of German children at the ECE level are high, and participation in Early Childhood Education and Care (ECEC) contributes to promoting equity within the educational system (Organisation for Economic Co-operation and Development [OECD], 2014).

Compulsory Education: All German children enter school at six and start general compulsory schooling, which includes nine years of full-time education. They enroll in the *Grundschule,* which includes grades 1 to 4. Although the role of preschool is to guide children toward more play-oriented learning approaches, the role of primary school is to direct students toward more systematic and structured approaches to learning in an educational setting. In addition, primary school plays a role in adjusting both the format and substance of instructional programs to cater to the diverse learning needs and abilities of individual students. The primary school aims to establish the foundation for subsequent educational levels as well as lifelong learning. Moreover**,** at the primary school level, the curriculum emphasizes reading and writing skills, as well as basic arithmetic skills. The teaching subjects encompass German language, foundational mathematics, comprehensive *Sachunterricht* (general studies), art, music education, physical education and sports, and instruction in religious studies (MECAG, 2014).

After completing full-time mandatory education, students enter a subsequent period of part-time mandatory education, known as mandatory vocational education, which lasts for three years (MECAG, 2014).

Secondary Education: The secondary level covers grades 5/7 to 12/13 in the Lander. Its structure is segmented into diverse educational paths, and various school types bear the responsibility for them, including Hauptschule, Realschule, Gymnasium, and Schularten mit mehreren Bildungsgangen (MECAG, 2014). Students move into the upper secondary education stage after completing compulsory schooling. The kind of school is contingent on the qualifications attained and entitlements acquired upon completing lower secondary education (MECAG, 2014).

Governance and Distribution of Responsibilities

The educational system is decentralized in Germany, and the responsibilities are distributed among the Federation, the *Länder,* and local authorities (OECD, 2014). Germany's Federal Ministry of Education and Research is liable for the areas under the authority of the Federation, including overseeing education and the care of children in daycare centers and child-minding services. Moreover, the management of the education system in various domains, including the educational domain at the school level, the tertiary education sector, the adult education sector, and the continuing education domain, falls under the responsibility of the Lander (MECAG, 2014).

Evaluation and Assessment

An essential part of the comprehensive strategy for the education system is the regular assessment of student achievement (OECD, 2014). In Germany, preschool assessment depends on curriculum needs and evaluates students' knowledge, abilities, and skills, with teachers responsible for conducting the assessments. The assessment of the first two grades of primary school is a yearly report that fully describes a student's development, strengths, and weaknesses in different learning majors (MECAG, 2014). In addition, Germany has a highly structured legal framework for external school evaluation (OECD, 2014).

Funding

In Germany's education system, public primary and secondary schools are free of charge (OECD, 2014). In Germany, decisions concerning the financing of education are jointly made by the Federation, Länder, and local authorities (Kommunen). It is worth noting that both the Länder, in addition to local authorities, contribute significantly to most governmental

expenditures (MECAG, 2014). In addition, the division of duties between the Länder and local authorities plays a vital role in financing the public sector. While local authorities cover the expenses for non-teaching staff and material costs, the Lander is liable for covering the payroll for teaching staff (MECAG, 2014).

Educational System and Structure: Islamic Republic of Iran

Iranian schools come in two categories: publicly funded schools that are free of charge, and privately owned schools (Menashri, 1992). Iran's centralized education system stems from France's old education system. The central government controls the conditions of policymaking and educational decision-making. Provinces and local groups need the opportunity to create or take new actions or measures to apply their plans or notions (Behbahania, 2010). In 1951, the first transfers occurred, and the provincial and city departments assumed control of specific aspects of crucial authorities and took on responsibilities, including managing employment, facilitating the mobility of teachers and staff in provinces, distributing funds, and handling budgets for certain expenditures. Acting on the Ministry of Education's behalf, the related departments in the provincial centers and cities take on more power and responsibilities; nonetheless, the central government possesses decision-making authority and operates in a centralized manner (Behbahania, 2010). While the Ministry of Education in Iran is dedicated to promoting the process of decentralization, predicting the forthcoming developments in education within this country remains challenging due to ongoing cultural shifts (Madandar et al., 2012). Additionally, some crucial factors are mainly to be noticed in the performance of the Iranian education system, including principals, teachers, student councils, parent-teacher associations, and school councils (Moradia et al., 2012). It is important to note that the educational structure of Iran has four stages: pre-primary education stage, primary education stage, lower secondary education stage or guidance level, and upper secondary education stage or high school.

Levels of Education

Iran's formal education system encompasses primary education (six years) and secondary education (six years). The new school year commences on September 21 and extends until June 21 of the following year. To enter university, each student must get a high school diploma (Bakhshalizadeh, 2021).

Pre-primary education level: In Iran, the pre-primary education phase lasts one year, and children typically begin this stage at the age of five. The program's primary focus at this level is on behavioral and pedagogical techniques, fundamental “life skills, natural sciences, hygiene,

literacy, history, and religious history and practice" (Madandar et al., 2012, p. 3). In addition, the pre-primary education level is non-compulsory and helps children enter the compulsory primary education level. Regular activities related to the pre-primary level and a one-month Farsi course constitute the curriculum of this level. The Farsi course is a requirement in those areas where the primary language is not Persian (Bakhshalizadeh, 2021).

According to Bakhshalizadeh (2021), the primary aims of the pre-primary education level include:

- to support children's physical, mental, emotional, and social development
- to improve socio-emotional growth and self-confidence
- to encourage participation in group activities
- to reinforce religious perspectives and ethical values
- to improve oral language progress and develop communication skills

Primary education: The first level of formal compulsory education, or primary education, consists of two periods, each lasting three years. It covers grades 1 to 6 (6–11 years old). In primary education, one teacher typically teaches all subjects, apart from religion, art, and physical education, in the first period (grades 1-3) (Bakhshalizadeh, 2021). Additionally, the primary school (Dabestan) in Iran includes "Qur'an, Persian composition, dictation, Persian reading comprehension, social studies, arts, hygiene, natural sciences, mathematics, and physical education, but the primary emphasis is on reading comprehension (Madandar et al., 2012, p. 4).

According to Bakhshalizadeh (2021), the crucial goals of the primary level are as follows:

- Contribute to moral development
- Promote literacy, numeracy, and social skills
- Train personal hygiene

Lower secondary education or guidance level: Following primary school, students begin middle school or the guidance level (Rahnamayi) (Menashri, 1992). The subsequent stage of compulsory education consists of a three-year lower secondary phase. It includes grades 7-9 for 12–14-year-old students (Bakhshalizadeh, 2021). In addition, the lower secondary curriculum encompasses subjects, for instance, "history, geography, Arabic, vocational training, foreign languages, and defense preparation," but the primary emphasis is placed on mathematics and natural sciences (Madandar et al., 2012, p. 4). In addition to the primary education subjects, this

stage has second language instruction, vocational education, and defense education for boys (Bakhshalizadeh, 2021).

This educational level emphasizes guiding students to explore a specific area of expertise rather than instructing general knowledge (Madandar et al., 2012). According to Bakhshalizadeh (2021), the essential purposes of the lower secondary education stage include:

- Promote moral and intellectual skills
- Enhance general knowledge
- Reinforce academic discipline and improve scientific imagination

Upper secondary or high school level: This stage comprises three years, including grades 10–12 for 15–17-year-old students. They can select one of the three study programs (academic, technical, vocational, or KarDanesh). Each program includes various goals and is planned for students with different skills and interests. For instance, academic programs help students enter university; these programs emphasize mathematics, natural science, or the humanities. The other two programs help students enter the labor market after graduating high school. They can receive a post-diploma degree and later have the chance to enter a vocational college (Bakhshalizadeh, 2021).

Governance and Distribution of Responsibilities

K-12 education falls under the responsibility of the Ministry of Education, while higher education is overseen by the Iranian Ministry of Science and Technology (Menashri, 1992). In addition, the Ministry of Education bears the responsibility for "educational planning, financing, administration, curriculum, textbook development, teacher training, grading, and examinations" (Madandar et al., 2012, p.2). As per the constitution of Iran, the government is dedicated to offering free education for students until the end of high school (Ansari, 2016). Moreover, the Organization for Educational Research and Planning, along with the Welfare Organization, supervises and prepares educational programs for preschool centers (Bakhshalizadeh, 2021).

Evaluation and Assessment

It is the teacher's responsibility to assess educational activities. There are two types of assessments in Iran's educational system: continuous and formative. Continuous assessment depends on the participation of students in educational tasks, for example, completing homework, participating in class questions, and undertaking out-of-class activities. Examinations may be written, oral, or practical, depending on the subject content, with written exams being the most common. The minimum passing score for progression to the next grade is ten, and the

maximum is 20 (Madandar et al., 2012). Testing and assessment are strictly based on the content of instructional textbooks, and national exams are also used to evaluate students' overall performance (Madandar et al., 2012).

Funding

In Iran, the general budget finances all education expenses, as the government is responsible for meeting the needs of education due to its significant social benefits (Behbahania, 2010; Ansari, 2016). In addition to government funding, non-profit educational institutions, parent-educator associations, municipal bodies, donors supporting school buildings, student councils, boarding schools, and the boards of trustees of certain schools also play a substantial role in fostering public participation in the education system (Ahmadi et al., 2016).

Methodology

Nature of the Study

This study aims to provide a descriptive comparative overview of key educational indicators. The present study used a desk-based comparative policy analysis approach, focusing on the synthesis of secondary data to investigate and compare key indicators of four countries: Norway, Sweden, Germany, and Iran. Relying exclusively on secondary data, the study analyzed policy reports, statistical data, and existing literature to determine similarities and differences in the educational indicators of the chosen countries.

Criteria for Selection of Countries

Three main criteria were considered to purposively choose the four countries:

Diversity of governance structures: Norway and Sweden demonstrate decentralized systems. Germany has a federal structure, but Iran runs a highly centralized educational system.

Variety in socio-economic and cultural settings: The study samples include two Nordic countries (Norway and Sweden), a federal European economy (Germany), and a developing Middle Eastern country (Iran).

Accessibility of reliable data: International organizations (the OECD and Eurydice) and national reports offer accessible and reliable secondary data for comparative purposes.

Sources of Data

The present study employed exclusively secondary data, including international educational reports and databases (OECD and Eurydice), national policy documents, annual reports, and statistics from the ministries of education, as well as prior academic studies that

offer interpretive information. The collection of these sources ensured the richness and reliability of the data while providing multiple perspectives for analysis.

Analytical Approach

This study utilized a descriptive comparative approach with a structured basis, focusing on four key indicators widely recognized in the field of comparative education: structure and levels of education, governance and distribution of responsibilities, evaluation and assessment strategies, and funding budgets. Information collected from secondary sources was systematically organized under these educational indicators. The synthesis of information highlighted similarities and differences across the selected countries. Findings and interpretations were descriptive rather than causal or evaluative.

Results and Discussion

The present study employed a desk-based comparative policy analysis approach. This section aims to synthesize the descriptive results obtained from secondary sources across four key indicators: structure and levels of education, governance and distribution of responsibilities, evaluation and assessment strategies, and funding and budgeting.

Structure and Levels of Education

All four countries share the fundamental stages of education, but they differ in how these stages are organized and when students are directed into different educational pathways. In Norway and Sweden, universal early childhood education is highlighted, and upper secondary education is broadly available, emphasizing equitable access. The educational system in Germany offers differentiated secondary school types, which can create regional inequalities. Iran has a highly centralized system, and early childhood education is comparatively less accessible.

Governance and Distribution of Responsibilities

Governance models vary across the four countries. Norway and Sweden follow decentralized systems with local municipal management; Germany operates under a federal model with a multi-level structure across the Länder; and Iran maintains a highly centralized model with ministerial control, ensuring uniformity in policy and curricula.

Evaluation and Assessment

Assessment approaches combine teacher-based assessments with national assessments. Nordic countries (Norway and Sweden) emphasize formative and classroom-based assessments

alongside national tests, while maintaining a strong focus on teacher autonomy. Germany combines teacher assessments with structured external evaluations, while Iran's evaluation system depends on high-stakes national exams and classroom assessments, closely aligned with textbook content.

Funding and Budgeting

Funding systems vary in terms of sources, methods of distribution, and the extent to which funds are allocated to individual students or managed centrally. In Norway and Sweden, high public investment is the main funding source, and municipalities hold primary responsibility for distributing these funds. In Germany, the federal government, Länder, and municipalities share responsibility for financing, teacher salaries, and major recurring costs. Iran relies primarily on the central government budget and public contributions, such as non-profit organizations and parents.

As this study is descriptive and relies exclusively on secondary data, the findings are interpretive rather than causal. Nevertheless, the results suggest important implications for policy and practice. Governance models may benefit from balancing local autonomy with national guidance to promote equity. Evaluation mechanisms should emphasize formative approaches and teacher-based assessments while limiting overreliance on high-stakes national examinations. Equitable funding remains critical, particularly in ensuring additional resources for disadvantaged regions. Promoting long-term equity also requires expanding access to high-quality early childhood education.

Conclusion

The present study compared the educational systems of four countries: Norway, Sweden, Germany, and Iran, focusing on four key indicators: structure and levels of education, governance and distribution of responsibilities, evaluation and assessment, and funding. Various reasons exist for selecting the countries of this study. Prior scholarship has noted the significant distance separating developing countries from economically advanced education systems (Franco, 1992). In addition, they are education systems shaped by distinct historical trajectories, despite certain surface similarities (Franco, 1992, pp. 34–35). Moreover, it is customary for nations such as Iran to acquire international expertise and adopt models from more advanced countries (Mahzoun, 2019).

The comparative synthesis revealed clear differences between the Nordic countries (Norway and Sweden), Germany's federal model, and Iran's highly centralized structure. The priority in the educational systems of Norway and Sweden is equity, achieved through

implementing comprehensive frameworks, play-driven early childhood education, and strong formative assessment approaches. Germany's federal structure implements early tracking that can increase inequalities in certain areas. In contrast, Iran's centralized system reinforces consistency and uniformity but limits local adaptability, improvement, and responsiveness.

Several lessons emerge for developing countries such as Iran. Broadening the availability of high-quality ECE, delaying early tracking while integrating national supervision with local autonomy can contribute to more equitable outcomes and improved learning achievements. Decreasing the overreliance on high-stakes national exams and employing formative, teacher-based assessments can promote in-depth learning. Moreover, introducing equitable funding models that provide disadvantaged areas with additional resources can mitigate ongoing inequalities in the quality of education.

Future research should transcend descriptive comparisons by conducting field studies and incorporating structured comparative education models to investigate how variations in governance structures, assessment methods, and funding mechanisms affect educational outcomes. Such examinations can offer practical insights for policymakers aiming to develop education systems that promote equity and are responsive to local contexts.

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Implementation of the Experiential Learning Cycle in the Public Sector Accounting Course

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Abstract

This study explores the implementation of the experiential learning cycle in the Public Sector Accounting course at Universitas Kristen Krida Wacana, Indonesia. The cycle consists of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Experiential learning provides students with practical, real-world experiences necessary for contextualizing their newly acquired skills. One of the learning objectives of the course is to understand the governance of non-profit organizations (NGOs). Students were assigned to observe an NGO for a semester, interview management staff, document workflows, and analyze how these organizations report their funding accountability to donors. As part of project-based learning, students created video reports as reflective observations on organizations such as Indonesia Care, Habitat for Humanity, the Historical Museum of Jakarta, Dwituna Rawinala, Satria Jaya Daraka Cooperative, and Sinode Gereja Kristen Indonesia. Following this project, students presented their observations, received feedback, and refined their understanding through video documentation. The implementation of experiential learning effectively bridges the gap between theory and practice in public sector accounting education.

Keywords: experiential learning cycle, public sector accounting, non-profit governance, project-based learning, real-world application

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We have no known conflict of interest to disclose.

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Introduction

Traditional accounting education often prioritizes theoretical knowledge over practical application, providing students with a strong conceptual foundation but leaving them unprepared for real-world challenges. Accounting curricula typically emphasize lectures, textbooks, and standardized tests, which, while effective in conveying theoretical concepts, do not adequately equip students with the practical skills necessary for professional practice (Albrecht, 2000; Bonner, 1999). This disconnect between theory and practice has been a longstanding concern in accounting education, with graduates often struggling to navigate the complexities of the profession (Joshi & Dsouza, 2024).

Experiential learning, as conceptualized by Kolb and Kolb (2005), offers a structured approach to bridging this gap. Kolb's experiential learning cycle consists of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. This cyclical process enables students to engage with real-world scenarios, reflect on their experiences, derive theoretical insights, and apply their knowledge in practical contexts (Kolb & Kolb, 2005). The integration of experiential learning into accounting education has been shown to enhance student engagement, critical thinking, and problem-solving skills (Boyce et al., 2001; Weil et al., 2001).

This study examines the application of experiential learning in the Public Sector Accounting course at Universitas Kristen Krida Wacana. By involving students in hands-on projects with NGOs, the course aims to facilitate a deeper understanding of public sector accounting principles. Students actively apply classroom knowledge by conducting interviews, analyzing organizational operations, and documenting financial reporting processes, ultimately improving their preparedness for professional challenges.

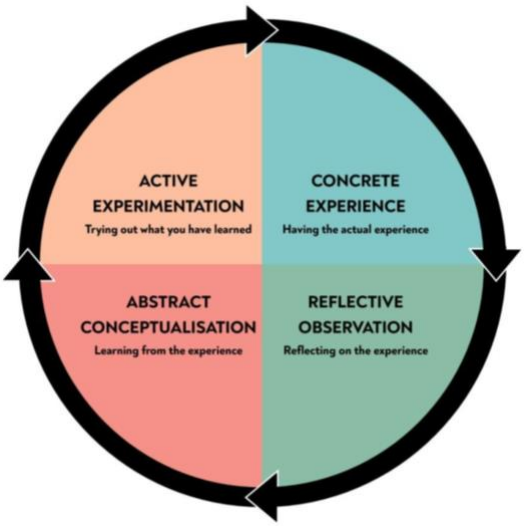
Literature Review

Experiential Learning Theory

Kolb's Experiential Learning Theory (ELT) posits that learning occurs through the transformation of experience (Figure 1). The cycle includes four stages: (1) concrete experience, where learners engage in hands-on activities; (2) reflective observation, where they analyze their experiences; (3) abstract conceptualization, where they integrate insights with theoretical frameworks; and (4) active experimentation, where they apply acquired knowledge in new contexts (Kolb & Kolb, 2005; Kolb, 1984). This approach enhances critical thinking, problem-solving abilities, and student engagement (Beard & Wilson, 2013; Merriam & Bierema, 2013).

Figure 1

Experiential Learning Cycle (Kolb, 1984)



Application in Accounting Education

Experiential learning in accounting education involves internships, case studies, simulations, and real-world projects. Research has shown that such approaches improve students' understanding of complex accounting concepts and better prepare them for professional challenges (McCarthy & McCarthy, 2006). Case studies and real-world projects allow students to develop practical skills, such as financial accountability, ethical decision-making, and organizational governance (Beard & Wilson, 2013).

Methodology

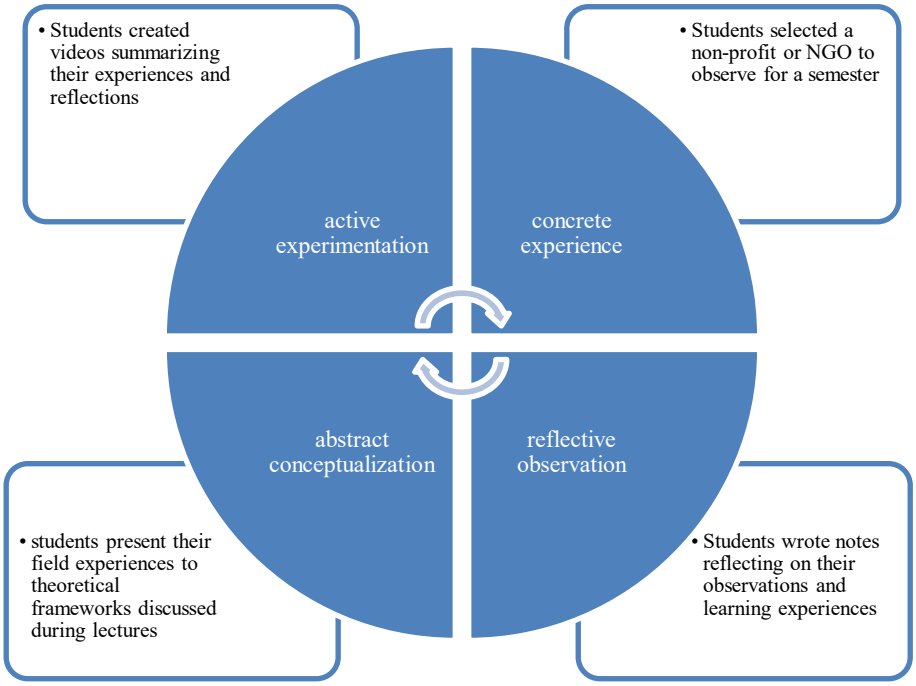
The Public Sector Accounting course at Universitas Kristen Krida Wacana was redesigned to integrate experiential learning. The implementation (Figure 2) followed Kolb's four-stage model:

1. **Concrete Experience:** Students selected an NGO to observe throughout the semester. Organizations included Indonesia Care, Habitat for Humanity, the Historical Museum of Jakarta, Dwituna Rawinala, Satria Jaya Daraka Cooperative, and Sinode Gereja Kristen Indonesia.
2. **Reflective Observation:** Students documented their observations, interviewed management staff, and noted key financial and operational insights.
3. **Abstract Conceptualization:** Classroom discussions facilitated connections between field experiences and theoretical accounting frameworks.

4. **Active Experimentation:** Students presented their findings, received feedback, and created video reports summarizing their learning.

Figure 2

The Implementation Process



Results and Discussion

The experiential learning approach yielded positive outcomes in three key areas. First, enhanced understanding, students demonstrated a deeper grasp of public sector accounting principles and the financial challenges faced by NGOs. Second, practical skill development and engagement with real-world organizations improved students' abilities in interviewing, critical thinking, and problem-solving. And third, increased engagement, hands-on projects, heightened student motivation, and interest in the subject (Beard & Wilson, 2013).

The study underscores the effectiveness of integrating the experiential learning cycle into accounting education, particularly in the context of the Public Sector Accounting course at Universitas Kristen Krida Wacana Indonesia. By moving beyond traditional lectures and immersing students in real-world projects, the course facilitated a deeper understanding of public sector accounting and governance issues. This finding aligns with existing literature highlighting

the benefits of experiential learning in enhancing student learning outcomes (Bonner, 1999; Kayes et al., 2005).

The involvement of students in real-world projects allowed them to apply theoretical concepts to practical situations. It makes a deeper understanding and connection with practice. This involvement fosters a deeper understanding of public sector accounting principles and governance issues. This approach provided students with valuable insights that cannot be gained through textbooks alone. The findings are also highlighted by Beard & Wilson (2013), who argue that experiential learning activities enhance student learning by promoting active engagement and application of knowledge.

Reflective practice, a core component of experiential learning, played a crucial role in reinforcing learning. Writing reflections and creating video reports encouraged students to critically analyze their experiences and articulate key insights. These findings align with prior research demonstrating the value of experiential learning in enhancing student outcomes (Kolb & Kolb, 2005; Merriam & Bierema, 2013).

Students' feedback highlighted the positive impact of experiential learning activities on their engagement and perception of course relevance. It is called student engagement and relevance. The opportunity to work with real organizations was particularly valued by students, as it provided them with practical, real-world insights that enhanced their learning experience. This increased engagement is consistent with studies showing that experiential learning promotes student motivation and interest in the subject matter (Beard & Wilson, 2013). The findings underscore the importance of incorporating experiential learning opportunities to enhance student engagement and relevance in accounting education.

Conclusion

The integration of experiential learning into the Public Sector Accounting course at Universitas Kristen Krida Wacana effectively bridged the gap between classroom instruction and real-world application. This approach not only deepened students' understanding of accounting principles but also equipped them with essential professional skills. Future research could explore the long-term impact of experiential learning on career readiness and professional success in accounting.

Future studies could investigate the long-term impacts of experiential learning on career readiness and professional success in accounting. By tracking the career and performance of students who have undergone experiential learning interventions, researchers can gain valuable insights into the lasting effects of such pedagogical approaches. Exploring the specific skills and

competencies, linking experiential learning with industry demands, could inform the design of more targeted and effective accounting education programs. Finally, a deeper understanding of the sustained benefits of experiential learning can guide lecturers and departments in optimizing the accounting curriculum to better meet the needs of the profession and ensure the success of future accounting professionals.

Acknowledgments

We extend our gratitude to all students who participated in the experiential learning project. Your dedication and contributions have greatly enriched this initiative.

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Positioning Teachers as Informed Agents: A Pilot Study on Professional Learning and Collective Teacher Efficacy

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Abstract

Despite broad interest in fostering high levels of collective teacher efficacy (CTE), inquiries into the intentional development of CTE through professional learning are scarce in the literature. This pilot study examined whether professional learning that positioned teachers as informed agents in efficacy development increased CTE. The professional learning was intentionally designed to 1) engage participants in learning and enacting the sources of efficacy, 2) examine outcomes associated with high CTE, and 3) apply strategies to grow and sustain efficacy over time. Results indicated a positive impact on CTE within the small volunteer sample. Findings invite further examination of designing professional learning to intentionally enact the four sources of efficacy, to emphasize positive correlates of high levels of CTE, and to develop teacher expertise in efficacy development. Such professional learning approaches that engage teachers as informed agents warrant continued investigation, contributing to the growing body of research on CTE.

Keywords: teacher efficacy, collective teacher efficacy, professional learning, professional development, agency

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I have no known conflict of interest to disclose.

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Introduction

Collective teacher efficacy (CTE) refers to the shared belief among a group of educators that they have the ability, through their collective efforts, to positively impact student outcomes even in the presence of perceived barriers to learning (Bandura, 1997; Goddard et al., 2004; Tschannen-Moran & Barr, 2004). Bandura (1993) demonstrated that when educators believe their actions can enable all students to learn at high levels, schools serving predominantly minority students from low socioeconomic backgrounds performed at the highest national percentiles in language and mathematics. Evidence that CTE had a greater impact on student achievement than demographic factors sparked robust interest in the construct. In 2016, CTE gained further exposure, particularly among practitioners, when drawing on Eells's (2011) meta-analysis, Hattie identified CTE as the most powerful influence on student achievement in the context of his Visible Learning work (Donohoo et al., 2018). In the most recent Visible Learning work, Hattie (2023) found that CTE is positively correlated with increased student achievement, with an effect size of 1.34. Further, CTE is associated with positive outcomes and productive behaviors for educators, including professional engagement, leadership, openness to innovation, and greater job satisfaction with reduced stress and burnout (Donohoo, 2018). Despite strong evidence that CTE drives student achievement and positive educator outcomes, current research rarely informs teachers about the benefits of high-level CTE or how efficacy develops, leaving them unable to act as informed agents in strengthening CTE.

Professional learning designed to enhance teacher efficacy and make evident both the mechanisms and importance of its development offers a pathway to informed agency, directly addressing this research gap. By gaining expertise in the sources of efficacy, examining outcomes associated with robust efficacy, and applying those strategies to grow and sustain efficacy over time, educators become informed agents able to make deliberate choices to enhance both their individual and collective efficacy. Informed agency, the capacity to take action grounded in knowledge and context, positions teachers as active participants in their efficacy development. Given ongoing challenges in student achievement and teacher retention, exploring strategies that enable educators to deliberately enhance their collective efficacy is both urgent and necessary.

This exploratory study investigates whether professional learning that engages teachers as informed agents in understanding and applying the sources of efficacy can foster measurable increases in CTE. Prior research largely measures CTE without providing teachers with insight into efficacy development. In contrast, this study positions teachers as informed agents, engaging

them in professional learning designed to make the process of efficacy development explicit and actionable. This professional learning was intentionally designed to 1) engage participants in learning and enacting the sources of efficacy, 2) examine outcomes associated with high CTE, and 3) apply strategies to grow and sustain efficacy over time. Few studies have focused on the direct development of CTE through professional learning, and none have intentionally educated teachers about CTE. To situate this study within the broader field, the following review examines established correlates of high CTE and recent literature examining CTE and professional learning, providing context for this exploratory work.

Literature Review

An inquiry into efficacy development begins with understanding self-efficacy as the "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). Perceived efficacy levels are context-specific and can be held by an individual or by a group; groups with high efficacy levels are typically comprised of individuals with strong perceived efficacy (Bandura, 1997). The collective efficacy of a staff is informed by the efficacy beliefs of the individual teachers who make up that staff. Efficacy develops through four sources: mastery experiences, vicarious experiences, social persuasion, and affective states (Bandura, 1977, 1986, 1997). *Mastery experiences* occur when an individual or group sets a goal and, through action, achieves that goal. *Vicarious experiences* emerge from observing or learning about the mastery experiences of others. These individuals or groups must be perceived as peers with similar capabilities existing in like circumstances. *Social persuasion* occurs when a trusted and credible source expresses confidence in the ability of an individual or group to be successful in a course of action and achieve a desired outcome. Finally, *affective states* refer to the emotional and physiological responses that accompany the anticipation of a course of action, such as physical tension, emotional distress, feelings of ease, or perceptions of safety versus fear. These four sources inform the development of perceived efficacy held by an individual or a group. It is through the routine enactment of the sources that self- and collective efficacy develop.

Existing research has advanced understanding of CTE by developing measurement tools and analyzing associated factors; this work has also made evident the value of high levels of CTE. Most studies examine CTE either through its positive outcomes for students and educators or through environmental factors and leadership practices that support its development. Correlational studies show positive relationships between CTE and student (Donohoo et al., 2018; Hattie, 2023) and educator (Donohoo, 2018) outcomes, and research identifies environmental characteristics and enabling conditions, such as goal consensus and supportive

leadership, that educational leaders can cultivate to foster CTE (Hite & Donohoo, 2021). While these studies illuminate key factors and outcomes, they rarely address teachers as informed agents in efficacy development. The existing research provides the basis to explore how professional learning can be designed to engage teachers as informed agents in actively fostering CTE.

Adams and Forsyth (2006) examined the formation of CTE through the contextual variables of school level, school structure, and socioeconomic status using hierarchical multiple regression. They found that these environmental conditions significantly shaped teacher perceptions of control over student outcomes beyond the effect of prior school performance. While their study highlighted the importance of understanding how CTE forms within school contexts, teachers were not provided with information about the sources or development of efficacy, nor were they engaged as active participants in shaping efficacy beliefs. Instead, the researchers framed CTE as a construct largely determined by prior experiences and contextual conditions outside teachers' immediate control.

Similarly, Ross et al. (2004) studied over 2,000 teachers across 141 elementary schools to identify antecedents of CTE, finding that shared goals, collaboration, alignment of plans with school needs, and empowering leadership practices had the strongest influence. They cautioned against policies that undermine teacher ownership and emphasized the value of leadership that supports shared decision-making. Donohoo et al. (2018), along with Donohoo and Katz (2017), further reinforce that high-levels of CTE are linked to stronger school culture, student achievement, and productive teacher behaviors, describing leadership strategies such as collaborative inquiry to support CTE. Taken together, this research demonstrates consistent connections among CTE, environmental conditions, and leadership practices, yet it overlooks the potential of inviting teachers to become informed agents who understand and intentionally cultivate efficacy within their professional contexts.

Recent Australian studies provide insights into how professional learning intersects with the cultivation of CTE. Professional learning often aims to prompt teachers to change their practice. Its effectiveness depends in part on teachers' willingness to act, which relies on strong levels of efficacy. The studies recognize that CTE is critical to achieving the intended outcomes of most professional learning. Several seek to foster CTE through professional learning. These studies provide a foundation for exploring how professional learning can be designed to equip teachers to intentionally foster collective efficacy within their schools.

Stokes and Brunzell (2019) focused on professional learning specific to teachers developing trauma awareness and becoming skilled in trauma-informed positive education (TIPE). The researchers demonstrated awareness of CTE's importance and observed evidence of efficacy development throughout their qualitative data, stating "teachers mentioned that the professional learning enhanced their own self-regulatory capacities, their resilience, and their stamina" (2019, p. 9). In short, the teachers gained mastery experiences in skills they would later teach students. The researchers concluded:

This professional learning in TIPE and subsequent implementation has developed the CTE at this school. The leaders and teachers believed that working together, they could make a difference to the academic and well-being outcomes for their students, even those students from the most disadvantaged backgrounds. (Stokes & Brunzell, 2019, p. 9)

These Australian researchers recognized the role of CTE in the success of TIPE implementation. The gap remains in engaging teachers with the sources of efficacy, examining outcomes of high CTE, and applying strategies to grow and sustain efficacy.

Woodcock et al. (2022) examined the relationship between teacher efficacy and the implementation of inclusionary practices. From a larger sample of 140 primary teachers in New South Wales, they interviewed 41 teachers selected for scoring above the 85th percentile or below the 15th percentile on Tschannen-Moran and Woolfolk Hoy's Teacher Self-Efficacy Scale (TSES). The interview included eight questions on inclusive education. One central question guided analysis: "How are all students included and accommodated in your classroom, and what are some of the strategies that are employed to facilitate inclusion?" (Woodcock et al., 2022, p. 4). The study used thematic analysis, which revealed that while teachers with high-efficacy beliefs and teachers with low-efficacy beliefs equally understood the value of inclusive education, differences emerged in practice. Teachers with low efficacy sometimes employed strategies that challenged inclusion and risked creating opportunities for micro-exclusion (Woodcock et al., 2022). The authors state that, "the study acknowledges that teachers who perceive themselves as highly efficacious are likely to embrace their roles as inclusive educators with greater resilience and examine ways for overcoming challenges in this context" (Woodcock et al., 2022, p. 11). They conclude that strengthening CTE is vital for ensuring all students have access to high-quality, inclusive practices. While the authors did not advocate direct professional learning on CTE, their findings indicate that fostering teachers' efficacy beliefs is key to achieving the intended outcome: implementing inclusive practices effectively.

De Carvalho et al. (2023) note that while CTE enhances student outcomes even when accounting for socioeconomic factors and prior achievement, professional learning rarely focuses on intentionally developing CTE. Their professional learning program in primary mathematics was structured around Bandura's (1977, 1997) four sources of efficacy (mastery experiences, vicarious experiences, social persuasion, and affective states). Although the study details the four sources of efficacy and how the professional learning program activated each source for participating teachers, it does not provide evidence that CTE was explicitly addressed. The authors describe CTE as a promising framework for understanding how and why professional learning works and assessing the impact of professional learning. De Carvalho et al. (2023) go on to recommend that professional learning facilitators use processes and structures, as they did in the professional learning detailed in their study, to activate the four sources. While the study demonstrates the potential of structuring professional learning around Bandura's four sources, the involvement of teachers as informed agents in developing collective efficacy remains an area for further exploration.

Loughland and Nguyen (2020) describe CTE as a validated framework with the potential to guide teacher professional learning. Using a qualitative case study, they examined the impact of a collaborative professional learning model on CTE. The study found strong evidence of mastery and vicarious experiences but limited evidence of social persuasion and affective states. Both social persuasion and affective states merit focus in future professional learning design and research (Loughland & Nguyen, 2020). Loughland and Ryan (2022) observed the work of emerging teacher leaders and sought to identify antecedents of CTE in a professional learning setting. They conducted focus groups and analyzed the data thematically and deductively using Bandura's sources of efficacy. They found that professional learning aligned with best practices, such as collaborative, trusting, and discipline-specific professional learning, is more likely to enhance CTE. Both studies aimed to inform the design and facilitation of professional learning using CTE as their framework, but did not directly engage teachers as informed agents in efficacy development.

In discussing the intentional design of professional learning, it is essential to consider adult learning theory and research on professional learning, which highlight that adult learners are goal-oriented and self-directed (Darling-Hammond et al., 2017; Desimone, 2009; Knowles et al., 2015). By clearly communicating intended outcomes in professional learning, teachers are positioned as informed agents, able to engage with content, implement strategies, and make deliberate choices in working toward the articulated goal. In short, engaging teachers as informed agents in efficacy development aligns with principles of effective teacher learning,

including emphasizing relevance, purposeful engagement, and reflective practice as key mechanisms for promoting agency and sustaining collective impact (Opfer & Pedder, 2011; Guskey, 2000). This further underscores the potential for professional learning that is intentionally designed to enable teachers to be informed and active in shaping their own and their colleagues' efficacy development.

Methodology

This study aimed to gather initial evidence on whether professional learning intentionally designed to engage participants with the sources of efficacy, to explore outcomes associated with high CTE, and to apply strategies to grow and sustain efficacy over time can produce measurable positive effects. Guided by social cognitive theory and focusing on the four sources of efficacy, the study was designed to position teachers to build understanding and agency through an intervention consisting of three in-person sessions, each followed by asynchronous activities. An integrated mixed-methods design was employed, allowing the study to move beyond asking whether the intervention had an impact and gain insight into why it had an impact and how it might be refined for greater effectiveness in future studies. Qualitative data offered context for interpreting quantitative changes, and triangulating these data provided further interpretive support aligned with the study's exploratory purpose of informing future hypotheses and guiding design improvements rather than producing generalizable findings.

Participants

The study invited participation from 20 secondary-level school sites and programs within a large urban school district in the Pacific Northwest. The study was conducted at the initial responding school site, a traditional comprehensive middle school serving students in grades 6-8 with a volunteer group of 13 teachers. The participants represented varied career stages and content areas, providing a range of professional perspectives. The sample size reflected the preliminary nature of the study, balancing qualitative needs for a small, manageable group with quantitative goals to support an integrated mixed-methods approach with concurrent data collection and analysis. The setting offered an authentic context to explore the feasibility of professional learning designed to engage teachers as informed agents in fostering collective efficacy development.

Most study participants were female, with only one male participant. They represented a range of content areas, including language arts (4), social studies (4), science (2), art (1), special education (1), and instructional specialist (1). Most were established teachers. Experience levels included 1 participant with 1-10 years of experience, 1 participant with 11-20 years of

experience, and all remaining participants with 20+ years in the classroom. Eleven participants identified as white, and two identified as other when asked about racial identity.

Professional Learning Design

The professional learning series included three in-person sessions, each with an asynchronous follow-up, designed to explore whether engaging teachers as informed agents in efficacy development could strengthen CTE. The sessions addressed the relationship between student achievement and CTE, understanding and fostering CTE through the four sources, and applying effective practices to grow and sustain CTE over time. In addition to collaboratively developed norms that established how participants would work together, a warm welcome and inclusive close framed each session to cultivate a safe learning space (Collaborative for Academic, Social, and Emotional Learning, 2019), an essential condition for the vulnerability and risk-taking inherent to enacting the four sources of efficacy. Without this intentional work, the affective state of teachers could be a barrier to the successful enactment of the four sources. The series moved participants from foundational knowledge of CTE to practical application, culminating in planning for their ongoing implementation of efficacy practices.

In-person session one opened the series by establishing norms for collaboration among participants. Teachers reflected on their beliefs about the key factors influencing student learning and compared these to evidence from research, fostering awareness of the influence of CTE on achievement. Hattie's Visible Learning research was presented to provide a foundation for understanding evidence-based factors affecting student achievement. In the asynchronous component, participants read a section of the grounding text, *10 Mindframes for Visible Learning: Teaching for Success*, and explored a self-selected topic from a small menu of resources aligned to evidence-based teaching. The primary outcome of session one was for participants to recognize their central role in student learning and understand why CTE's strong effect size is relevant to classroom teachers.

In-person session two focused on understanding CTE, its importance, and the four sources of efficacy. Teachers discussed how fostering CTE could be woven into existing initiatives rather than treated as an additional task. They were then introduced to the Mini Success Analysis Protocol (School Reform Initiative, 2022), which provided structured opportunities to practice conversations that enact the four sources of efficacy. The Mini Success Analysis Protocol allowed participants to highlight mastery experiences and generate vicarious experiences for peers while providing opportunities for peer feedback and interaction to foster social persuasion and generate a positive affective state. During the asynchronous component,

participants applied the protocol with colleagues in their professional contexts to reinforce learning and practice enacting the sources of efficacy.

Session three reinforced the four sources of efficacy as participants engaged in collaborative discussion and practiced using the protocol to support both immediate application and future transfer to similar practices and protocols. In the final asynchronous session, participants reflected collectively to consolidate their learning and committed to specific next steps for enacting efficacy practices in their professional contexts. They were also provided with an opportunity to share feedback to refine the professional learning. Overall, the series integrated knowledge-building with practical application, equipping teachers to act as informed agents who foster both individual and collective efficacy.

Data Collection

The study used concurrent data collection embedded within the professional learning series. Quantitative data were gathered through pre- and post-measures of the *Collective Teacher Beliefs Scale* (Tschannen-Moran & Barr, 2004), which was developed from Tschannen-Moran and Woolfolk Hoy's (2001) *Ohio State Teacher Efficacy Scale*. Qualitative data were drawn directly from participant activities during the professional learning sessions, primarily from participant reflections. This mixed-methods approach provided quantitative evidence of change in CTE and contextual qualitative insights that enriched the interpretation of the results. As an exploratory study, the primary aim was to generate preliminary insight into the potential for further inquiry rather than to yield generalizable findings. All data were anonymized before analysis.

Results

This section presents findings from both quantitative and qualitative analyses to examine whether the professional learning series positively influenced CTE. Results are organized to reflect both measurable outcomes and experiential insights related to Bandura's four sources of efficacy. Quantitative results summarize statistical changes in CTE, while qualitative findings illustrate how mastery experiences, vicarious experiences, social persuasion, and affective states emerged during the professional learning series.

Quantitative data were analyzed using a paired-samples t-test to determine whether participation in the professional learning series produced significant changes in CTE. Qualitative data were coded deductively by the researcher using Bandura's four sources of efficacy as a framework. Coding decisions were refined through repeated review and comparison across data sources to enhance credibility and maintain internal consistency in interpretation. Participant

reflections highlighted instructional shifts and the ways peer interactions, facilitator modeling, affirming feedback, and emotional responses contributed to efficacy development. Framing the analysis around the four sources provided theoretical coherence with social cognitive theory and supported the interpretation of how professional learning may be used to influence CTE. The qualitative findings provided contextual depth to the quantitative results, offering insight into how participants' experiences and perceptions reflected or explained shifts observed in measured CTE.

Quantitative

The data collected from the pre-intervention administration and post-intervention administration of the *Collective Teacher Beliefs Scale* were analyzed to determine the effect of the professional learning series on CTE. On average, participants showed greater CTE following the professional learning series ($M = 94.54$, $SE = 1.76$) than prior to receiving professional learning ($M = 87$, $SE = 1.56$). This difference of 7.54, BCa 95% CI [3.82, 11.25], was significant, $t(12) = 4.42$, $p < .001$, and represented a large effect, $d = 1.227$. The result indicates that the professional learning series did have a positive impact on the CTE of participants.

Qualitative

The qualitative results highlight participants' voices during the professional learning series, emphasizing the participant experiences that contributed to efficacy development. These reflections illuminate the mechanisms through which the professional learning appeared to influence CTE. Findings are presented through the lens of Bandura's four sources of efficacy (mastery experiences, vicarious experiences, social persuasion, and affective states).

Mastery Experiences

Mastery experiences are the most powerful source of efficacy, built when teachers connect their actions to successful outcomes. Teachers described moments of success, growth, and effective practice that reinforced their belief in their capacity to impact student learning. Many participants pointed to moments where their teaching practices directly supported student success. Several teachers described how stepping into unfamiliar practices and seeing them work contributed to their sense of growth and competence:

I have stepped out of my comfort zone and conducted Socratic Seminars, facilitated more small group work, and designed hands-on projects (Joan).

Others connected the use of assessment tools to evidence of instructional effectiveness:

I have started using exit tickets/quizzes to check to see how successful I was in reaching the desired lesson objectives (Ted).

Some noted that visible signs of student learning reinforced their sense of instructional impact:

Watching students grasp concepts and, in turn, help others is the best positive reinforcement of what and how you are teaching (Julie).

For some, professional identity was tied to efficacy beliefs, as past successes shaped how they viewed their role:

Even when we see ourselves as experienced educators, this belief changes everything. We are the change agents (Molly)!

Teachers also described how adapting instruction to student needs confirmed their effectiveness:

I never underestimate the learning capabilities of my students. Some students need different ways to demonstrate understanding, and the important thing is that I provide multiple ways to show me their learning (Joan).

At times, participants emphasized the importance of recognizing influence as central to efficacy:

Teachers need to realize the impact they make on their students (Mary).

Others connected student choice and engagement with stronger outcomes, reinforcing a link between their instructional decisions and student performance:

I think that when a teacher provides an avenue for students to share their learning by giving choice to how that will look, students will perform at a higher level because they are engaged in the activity to share the learning, regardless of interest in the subject (Jill).

Teachers described how daily instructional practice and responsiveness to student needs contributed to their sense of efficacy. One reflection highlights how ongoing assessment not only informed instructional decisions but also reinforced the teacher's responsibility in adapting practice to support learning:

In my class, we…assess daily on what students are learning and how to teach it in a more understanding manner. What I have learned...is that I should be looking for how I can engage in a different manner of teaching when students are struggling. It may be all about them, but it's also about how I am teaching and how I am meeting my students' needs (Barbara).

Teachers also described how their confidence developed through designing and refining instructional practices that actively engaged students in deeper learning. This reflection shows how applying scaffolding and project-based tasks built the teacher's sense of impact, while simultaneously prompting consideration of how to expand strategies to reach an even broader range of learners:

I scaffold students to build information and then ask them to engage in project-based learning or performance tasks… I am now wondering if there is an even more rounded approach that would meet the needs of even more learners (Jaclyn).

This example illustrates mastery experience as the teacher reflects on both successes and areas for continued growth. By recognizing that their instructional methods have produced meaningful learning opportunities, while also questioning how to improve further, the teacher demonstrates efficacy built from practice and reinforced through ongoing reflection.

By viewing student feedback as a vital tool for adjusting and refining practice, this reflection highlights how confidence is built through direct engagement with evidence of student learning and the resulting instructional adjustments:

The power of formative evaluation is the feedback provided from the learner to the teacher (Marie).

This example illustrates mastery experience because it underscores how teachers grow in efficacy by analyzing feedback from their own classrooms and using it to make effective changes. The teacher's recognition of formative evaluation as a reciprocal process demonstrates the power of practice-based evidence in strengthening instructional decision-making and reinforcing efficacy.

As a whole, these reflections demonstrate how teachers recognized their own successful instructional actions, linking outcomes to their efforts. Such mastery experiences shared in a collaborative setting are central to strengthening CTE.

Vicarious Experiences

Participants drew inspiration and confidence from observing or hearing about the successes of colleagues. The intentional creation of vicarious experiences allowed teachers to strengthen their own efficacy beliefs by gaining awareness and understanding of their peers' successes. Educators engaged in vicarious experiences through peer interactions and facilitator modeling during professional learning sessions, as well as through stories of real classroom teachers presented in the grounding text, all of which provided accessible models of effective

practice. Exposure to others' experiences provided confidence that similar outcomes were possible for them. Some participants highlighted how structured reflection protocols deepened their understanding of both their own and others' successes:

I noticed with the Success Analysis Protocol that it forced me to really think through why it worked and what made it work. I also noticed that it really helped me understand my partner's successes at a different level (Jo).

Others noted that the same protocol encouraged presenters to articulate their practice clearly, offering a replicable model for colleagues:

As we did the Success Analysis Protocol, I noticed how the presenter really has to break things down into small pieces to help the group truly understand how the success came about…so that they can perhaps try something similar (Rebecca).

Some teachers gained confidence by seeing specific strategies used effectively across classrooms:

I noticed that many teachers are using our new PBIS rewards system successfully in their classrooms to motivate student growth (Ted).

At times, participants pointed directly to colleagues as models of effective instruction, recognizing their influence on shaping personal practice:

I really appreciated your thoroughness and quality teaching. You were a great model of what I should be doing in my classroom (Jo).

Teachers also described how observing examples of practice through vignettes reinforced shared understandings of effective instruction. Exposure to these narratives highlighted how educators balanced high expectations with appropriate supports, offering a transferable model of success:

I noticed that they (vignettes) all seemed to build upon the idea that when teachers have high standards for students and provide support, students can be successful (Jill).

Here, teachers drew lessons from others' practice. This reflection shows how vicarious experiences provided teachers with concrete illustrations of effective practice, strengthening confidence that similar approaches could yield positive outcomes in their own classrooms. These vicarious experiences strengthened efficacy by providing concrete models of success to adapt in their own classrooms. Through vicarious experiences, teachers internalized a sense that effective

practices were both possible and replicable. Seeing peers succeed under similar conditions expanded their confidence in their own capacity.

Social Persuasion

Social persuasion occurs when encouragement or expressed belief from a knowledgeable and trusted other influences an individual's confidence in their ability to succeed. This can occur between colleagues, between mentor and mentee, or between teachers and students. Social persuasion strengthens teachers' confidence by providing encouragement or recognition that validates their expertise as educators. The data reveal how educators experienced social persuasion and their understanding of its power.

Teachers reflected on the broader influence of professional learning and collaborative discussion:

It is always good to have time together with other teachers to share ideas. Having the book as a guide made it even better. I look forward to taking time to dig into the ideas and having more conversations with my co-workers to help me grow as a teacher.

Here, the encouragement and support from peers reinforce the teacher's belief in their ability to improve. The structured opportunity to discuss ideas, guided by a shared resource, functions as social persuasion by providing affirmation and practical insights. Through collaborative dialogue and shared reflection, teachers draw motivation and confidence from collective input, reinforcing their sense of efficacy. Participants spoke often of social persuasion in the teacher-student relationship:

I think that as a teacher, if you say that a student isn't capable of doing something, then they won't do it, but if you show them you believe in their abilities, they will meet those expectations and often go beyond (Jill).

This reflection illustrates how expressing belief in students' abilities can influence performance. By communicating confidence and providing autonomy in learning, teachers use social persuasion to motivate students. The insight also parallels how receiving similar affirmation from mentors or peers can encourage teachers themselves, showing an understanding of how social persuasion operates. Teachers noted the influence of observing colleagues who maintained high expectations for all students:

It is a very powerful [story] that speaks to the idea that we will get from our students what we expect. High expectations will result in high outcomes, and low expectations will result in low outcomes (Molly).

This demonstrates social persuasion, as the reflection emphasizes the motivating effect of seeing colleagues believe in student potential, reinforcing the teacher's own sense of responsibility and efficacy while also noting the effect of social persuasion on students. Overall, teachers demonstrated their understanding of social persuasion largely in the context of providing it to students as knowledgeable and trusted individuals, while minimally addressing its influence on their own professional growth.

Affective States

Teachers' reflections reveal that their affective responses to the professional learning sessions positively contributed to their ability to gain efficacy that resulted in agency, or action. Many described feelings of energy, inspiration, and appreciation for the opportunity to reflect and collaborate. For example, one participant noted:

I loved our sessions, but I feel like one-hour sessions are too quick. I feel like we just get going, and it is over. For me, 90–120-minute sessions would be better (Ted).

This sense of wanting more time points to a high level of engagement, as teachers were deeply invested in the learning process. Positive affect also came from the pacing and quality of facilitation:

I enjoyed the pacing of this class, and the instruction techniques were super engaging. All the information we received via handouts/links was very relevant to my day-to-day teaching (Joan).

Several teachers emphasized how the sessions encouraged deep reflection, sparking both affirmation and new questions:

Thank you! I enjoyed the collaboration and reflection time. Wow! Very thought-provoking (Molly).

Finally, participants highlighted the emotional lift of being reminded of their agency and successes as educators:

I really needed to read this quote because it reminded me that I have had a lot of successes and I have had students succeed on a higher level, which means I have more control over my teaching situation than I previously realized (Jo).

Taken together, these affective responses suggest that the professional learning sessions were not neutral experiences but emotionally rich. Teachers felt engaged, affirmed, and motivated to reflect more deeply on their practice. These feelings are critical in shaping efficacy

because positive affect can fuel persistence, openness to change, and willingness to take risks, contributing to a renewed sense of professional purpose.

Combined Results

The combined quantitative and qualitative findings illustrate the impact of professional learning intentionally designed to help participants engage with the four sources of efficacy, examine outcomes associated with high CTE, and apply strategies to sustain efficacy. The quantitative results indicate a significant increase in CTE following the professional learning series, with a large effect size ($d = 1.227$). These findings are reinforced by the qualitative data, which provide insight into the mechanisms underlying the observed gains. Teachers described mastery experiences gained through experimenting with new instructional strategies and refining existing practices, vicarious learning from peers and facilitator modeling, social persuasion through feedback and encouragement, and positive affective shifts, including increased optimism and confidence. The alignment between quantitative improvements and teacher reflections reinforces the evidence, showing not only measurable gains in CTE but also the processes through which these changes occurred.

Discussion

The professional learning series positioned teachers as informed agents in their own efficacy development through professional learning intentionally designed to engage participants in enacting the sources of efficacy, examining outcomes associated with high CTE, and applying strategies to grow and sustain efficacy over time. As a result, participants showed measurable increases in CTE, and qualitative data revealed teacher experiences of the four sources of efficacy. These findings raise the question of whether this approach could be an important element in broader efforts to increase CTE and suggest the potential value of further inquiry into engaging classroom teachers in developing understanding and agency to foster CTE.

While these findings offer meaningful insights into the impact of professional learning on CTE, several limitations should be considered when interpreting the results. The small sample size ($n = 13$) and the underrepresentation of male teachers and teachers of color, though reflective of the school's demographics, limit the generalizability of both the quantitative and qualitative findings. Voluntary participation introduces potential self-selection bias, as participants may have been more motivated or reflective than non-participants. The qualitative data relied on self-reported reflections, which may have been influenced by social desirability or participants' perceptions of expected responses. Additionally, the study measured changes in CTE immediately following the professional learning series, so longer-term effects remain

unknown. Finally, the context of a single school or district may limit the applicability of findings to other educational settings. Despite these limitations, the study provides valuable preliminary insights into how professional learning can foster CTE and engage teachers as informed agents in their own efficacy development.

Given the demonstrated positive correlation between high levels of CTE and student achievement, as well as the broad range of positive outcomes and productive behaviors for educators, the question that researchers and practitioners currently face is how robust levels of CTE can be grown and sustained. Existing research addresses the responsibility educational leaders hold in providing enabling conditions for the development of CTE. This study's findings suggest that while educational leaders play a critical role in fostering CTE, significant influence can also be achieved by positioning teachers as informed agents in their own efficacy development.

Successful implementation of policies, frameworks, or curricula requires individuals to enact complex behavioral changes with fidelity. Such changes are most effective when participants possess a sense of efficacy in both the context and in the tools or processes being used. This is an especially important consideration for initiatives that require change in teacher practice to be successful. Therefore, it is reasonable for policymakers and district-level leaders to prioritize proactive or concurrent development of CTE when designing and funding initiatives that involve changes in teacher practice. Professional learning addressing CTE could be implemented either in advance of or embedded within such initiatives to support successful implementation.

This emerging area of inquiry aligns with a call from Tschannen-Moran and Woolfolk Hoy (2001) for expanding research into teacher agency in developing CTE. They highlight several important considerations for future research, including teacher preparation, induction, initial placement, and professional development. While they emphasize the implications of teacher efficacy, their discussion primarily addresses those who study and train teachers and does not examine the inclusion of classroom teachers as active participants in the process. Several studies from Australia demonstrate a high degree of intentionality in fostering and monitoring CTE during implementation processes (de Carvalho, A. et al., 2023; Stokes & Brunzell, 2019; Woodcock, S. et al., 2022). These studies underscore the importance of CTE, which should not be overlooked in any implementation. The research to date implies that direct action to grow and sustain robust CTE should be considered a vital component of organizational efforts, whether focused on continued implementation of established practices or on new initiatives and improvement processes.

Taken together, the quantitative and qualitative findings of this study suggest that professional learning intentionally designed to engage teachers in understanding and enacting the sources of efficacy can meaningfully increase CTE. They also underscore the importance of considering teacher agency alongside supportive leadership actions when designing interventions aimed at strengthening CTE. These findings imply that efforts to strengthen CTE should consider not only the provision of knowledge and strategies but also the creation of opportunities for teachers to engage actively with the sources of efficacy in their own contexts. By foregrounding teacher agency and collaborative reflection, schools may enhance the sustainability of efficacy development and, ultimately, support improved student outcomes. Future research could examine how these approaches function across diverse school contexts, the long-term maintenance of CTE gains, and the specific mechanisms through which professional learning influences both individual and collective teacher efficacy.

Conclusion

Given these findings, educational leaders, especially building-level administrators, might strategically empower teachers to understand and apply the four sources of efficacy in addition to attending to environmental characteristics and enabling conditions. They might also support teachers in leveraging these sources within existing structures and facilitate examination of evidence demonstrating the benefits of high CTE for students, teachers, and the school community. Leaders responsible for implementing change initiatives, including policymakers, district leaders, school administrators, and professional development facilitators, might consider how positioning teachers as informed agents in efficacy development could influence the initiatives they lead. Future research could examine the long-term impact of CTE-focused professional learning on teacher practice and student outcomes across diverse contexts, including rural, suburban, and high-poverty settings. Studies might explore how teacher characteristics, the duration of CTE-focused professional learning, or integration with broader school initiatives influence outcomes. Longitudinal research could track the sustainability of efficacy development and its effects on student achievement over multiple years.

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