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Maria Angelica Paez-Barrameda
ORCID 0009-0002-0646-6605
The Abba's Orchard School, Philippines
teacherann@theabbasorchard.com

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The impact of successive Montessori programmes on cognitive achievement

Summary

The Montessori Method of Education, renowned for its child-centred approach, is divided into three key sub-programmes corresponding to distinct developmental planes: the Primary Programme (Casa) for ages 0–6, Cosmic Education for ages 6–12, and Erdkinder for ages 12–18. Despite numerous studies attesting to the superiority of Montessori over other educational systems, research exploring the cumulative impact of successive Montessori programmes on cognitive achievement remains limited. This study addresses this gap by evaluating the cognitive outcomes of students who have experienced varying durations of Montessori education. This empirical research, derived from a 2017 doctoral dissertation at the Xavier University/Ateneo de Cagayan, Philippines, utilized a longitudinal dataset from The Abba's Orchard School in Bukidnon. The study spanned academic years 1999 to 2015, involving 105 students who graduated from the school's adolescent programme beginning from 2007–2008. Students were categorized based on their exposure to Montessori programmes: Group A (37 students) attended all three programmes (Casa, Cosmic Education, Erdkinder), Group B (48 students) attended Cosmic Education and Erdkinder, and Group C (20 students) attended only Erdkinder. Cognitive performance was measured using Grade Point Averages (GPA) and College Admission Test (CAT) results from top Philippine universities. The findings demonstrated that previous Montessori experience significantly enhances cognitive performance. Group A students, who attended the full spectrum of Montessori programmes, achieved the highest GPAs (92–93), followed by Group B (90–91), and Group C (87–88). Statistical analysis revealed highly significant differences in GPA scores among the groups (alpha ≤ 0.01, $P = 0.000$ to 0.001). Additionally, the number of Montessori Programmes Attended (MPA) and Erdkinder Academic Rating (EAR) were positively correlated with CAT success. Group A had an 89% pass rate for at least one CAT, compared to 52% for Group B and 35% for Group C. Further analysis indicated that each additional Montessori programme attended increased the likelihood of passing a CAT by 3.5 times, while a unit increase in EAR enhanced CAT pass odds by 28 times. The results underscore the importance of successive Montessori Programmes Attended (MPA) in fostering cognitive development. Students who progressed through the complete Montessori spectrum exhibited superior cognitive outcomes and higher success rates in college admissions. These findings align with Dr Montessori's philosophy that education should be an integrated continuum, where each developmental stage prepares the child for the next. This study provides robust evidence supporting the efficacy of the Montessori Method in enhancing cognitive achievement. The significant cognitive benefits observed in students with extensive Montessori exposure are advocates for the continuity of Montessori education across all developmental planes. Future research should explore broader samples and additional outcomes to further validate these findings.

Keywords: Montessori education, cognitive achievement, college admissions test, longitudinal study, developmental stages

Słowa kluczowe: edukacja Montessori, osiągnięcia poznawcze, test wstępny na studia, badanie podłużne, etapy rozwoju

Introduction

The primary objective of the study was to investigate whether attending Montessori education has a measurable impact on cognitive performance in subsequent developmental stages, including the adolescent's preparation for university life. Through this rigorous examination, the author aimed to contribute valuable insights into the effectiveness of the Montessori Method and its role in shaping well-developed individuals cognitively. The study aimed to address two primary questions: firstly, "How will a Montessori student cognitively perform at the end of a whole spectrum Montessori education?", and secondly, "How will the children do after Montessori?" As a corollary to this, will the learner be able to hurdle stringent qualifying examinations given by top-tier universities? Will the length of exposure in the Montessori Prepared Environments have a significant impact on the student's cognitive achievement? Will it matter if the student starts in Primary (preschool), in Elementary, or in Erdkinder (high school)?

The findings revealed compelling conclusions: Students commencing their education in Primary exhibit superior cognitive performance in both Elementary and Erdkinder, and there are substantial academic benefits linking comprehensive Montessori education to success in competitive CATs.

Background

The Montessori Method's global impact is substantial, with approximately 15,763 Montessori schools worldwide, including 9% public (Debs 2022). AMS counts the number of Montessori schools in the US at approximately 5,000, with 570 public Montessori schools serving about 125,000 children (AMS 2024). Innovators in various fields have claimed the method influenced their thinking and creativity. Forbes linked the creation of Amazon and Google to Montessori, as their founders received early education from Montessori schools (Denning 2011).

Numerous scientific studies have assessed the efficacy of the Montessori Method in enhancing student performance. Several studies suggest positive outcomes, even when students were exposed to the method years prior to when the studies were conducted. For instance, a 1983 study revealed that males who attended Montessori preschool performed better in reading and mathematics, an advantage persisting until the completion of sixth grade (Miller,

Bizzell 1983). Another study affirmed that participation in a Montessori programme from ages three to eleven was linked to significantly higher standardized test scores in mathematics and science during high school (Dohrmann et al. 2007). Additionally, children exposed to Montessori education for three to four years scored higher in self-esteem and standardized tests during their early elementary years than their non-Montessori counterparts.

A 1999 dissertation showed an increasing advantage of Montessori children in Maths and Reading over their non-Montessori peers, becoming evident during the second year and widening as they progressed in elementary education (Corry 2006). Lillard and Else-Quest's study comparing Montessori and conventional preschool education showed higher academic achievement, particularly in maths and executive function, along with advanced social skills and empathy among Montessori students (Lillard, Else-Quest 2006). A 2011 follow-up demonstrated heightened executive function among Montessori children, indicating superior mental and physical health capabilities (Diamond, Lee 2011).

Montessori education emphasizes independence and self-regulation, leading to higher levels of these traits. Montessori believed the goal of the teacher should be to guide the child towards independence, aiming for the point where "the children are now working as if I did not exist" (Montessori 2007b: 257). Among adolescents, Montessori students exhibited increased energy, heightened focus, and intrinsic motivation in school tasks. These findings highlight the method's positive impact across developmental stages, fostering academic success and well-being.

While these studies support the effectiveness of the Montessori method in fostering optimal development, most are confined to preschool and elementary exposure. Many Montessori schools offer only preschool, and some extend only to elementary levels. Few provide the Erdkinder programme for adolescents, resulting in a scarcity of high-fidelity Montessori campuses covering the complete spectrum. Several factors contribute to this research gap. Firstly, the programme's design and relative "newness" make comprehensive studies challenging. The first Erdkinder setting prototype, the Hershey Montessori Farm Campus in Huntsburg, Ohio, started operating only in 2000. Additionally, Dr Maria Montessori's framework for the adolescent programme is less detailed compared to the Primary and Elementary programmes.

Setting up a Montessori Adolescent environment involves significant logistical and financial challenges, including land costs for a farm environment in urban or suburban settings, availability of specialists to teach more specialized subjects, and limitations on student numbers that will ensure that significant roles are played in the adolescent community. Consequently, few Montessori schools embrace the adolescent programme, and many elementary graduates' transition to conventional schools where they continue to excel academically.

There is also a prevailing societal belief that secondary education primarily serves as preparation for university. Even parents of Montessori children tend to prioritize reputable high schools known for their graduates' success in gaining admission to top-tier universities. This mindset hinders acceptance of the Erdkinder programme, as parents seek assurance

that their adolescents will succeed in university – a proof the Erdkinder programme has yet to conclusively establish.

The lack of comprehensive empirical studies within the Montessori spectrum has led to parental uncertainty about the Erdkinder's long-term value. Committed to providing holistic education and addressing the lack of research on secondary Montessori schooling performance, the author – a mother of four Montessori-educated children and co-founder of The Abba's Orchard School – embarked on an empirical study. This study aimed to reassure herself and the school's parent community about the Montessori Method's effectiveness. As a Montessori specialist trained across all four levels of AMI teacher training programmes for children from birth to 18 years old, the author recognized the importance of scientifically validating the school's pedagogical approach. Instead of relying solely on anecdotal evidence, she sought empirical proof that the Montessori method significantly contributes to students' optimal development. This resulted in a three-hundred-page doctoral dissertation entitled *The Montessori Education Program: Its Impact on Cognitive Achievement* (Barrameda 2017), discussed in this article.

Theoretical Framework

The theoretical framework of this study is rooted in four fundamental Montessori theories: The Planes of Development, the Human Tendencies, the Sensitive Periods, and the Montessori Prepared Environments. These theories interweave to form a cohesive and dynamic approach to education. Recognizing the plane-specific characteristics and intrinsic human tendencies and sensitivities makes it possible to create environments that naturally support and enhance learning. Hence, the concept of the Montessori Prepared Environments, where meticulously designed settings cater to the developmental needs and tendencies of children at each stage. This interplay ensures that education is not only developmentally appropriate, but also intrinsically motivating and supportive of the child's natural growth trajectory.

The *Planes of Development* theory underscores distinct human development stages, emphasizing that each stage has unique psychological needs and potentials requiring unique approaches. Montessori articulated the key role of childhood experiences in adult formation, stating, "The adult is the result of a child. Every adult is the achievement of a grown-up child; the causes of good or of evil in the adult must all be sought in the very short period of the child's growth" (Montessori 2014: 85). Montessori articulated the key role of childhood experiences in adult formation. She wrote, "A man does not just happen; he does not just grow like a flower. A child does not act as an adult. We apply our energies, our maturity, to do something, but a child acts in accordance with nature in order to construct a man" (Montessori 2012: 136). Montessori emphasized the need to recalibrate our views on how to educate the young as she said, "Our aim is to study the child from this new point of view. With this change in our hearts we will want to study him in all his different

phases, to study all his miracles, to realize how man reaches the stage of man through the child that constructs him" (Montessori 2012: 6).

In the first plane (0–6 years), children possess the "Absorbent Mind," an extraordinary capacity to assimilate vast amounts of information and skills from their environment, especially in linguistic acquisition, order, and motor development. This phase involves significant brain development, forming neural pathways through sensory exploration and interaction. The concept of the "powers of the Absorbent Mind" where the very young are able to take in large amounts of environmental information, is supported by contemporary neuroscience. A recent study traces the strength of an individual's Executive Function skills to the neural structures in the infant's brain (Zhao 2022). These findings highlight the importance of providing enriched environments that cater to and stimulate the natural developmental tendencies and sensitivities of young learners.

The second plane (6–12 years) sees children become stable physically, mentally and emotionally. They are capable of hurdling challenging tasks without experiencing fatigue. Their ability to abstract and reason allows them to engage in more complex problem-solving tasks driven by a desire to understand the universe intellectually and socially. Their ability to imagine and reason moves them to explore environments outside the four walls of the classroom. They can synthesize and create in their minds what they eventually concretely produce. These children work in groups towards common goals, propelled by the "herd instinct" and easily follow adult instructions related to group tasks.

During the third plane of development (12–18 years), adolescents undergo significant physical, emotional, and cognitive changes. Brain scans reveal rapid changes in the adolescent's brain, particularly in the amygdala (Santrock 2003), leading to internal conflicts and decision-making challenges. Intense neural pruning results in fatigue and forgetfulness making mastery of presented concepts challenging. Adolescents prefer interacting and working with each other.

The fourth plane (18–24 years) involves young adults solidifying their personal and social identities, applying their education to real-world problems, and becoming independent members of society. After the constructive groundwork of shaping the physical, mental, emotional, moral, economic, and spiritual being of the individual has taken place in the first three developmental planes, this fourth phase serves "a time of life when the individual can develop the spiritual strength and independence for a personal mission in life." This plane, if built upon earlier nurturing environments, can become a place of calm where the individual gains full control of his faculties (Grazzini 2004).

Montessori emphasized the importance of independence in optimal development, stating, "The child's conquests of independence are the basic steps in what is called his 'natural development'. In other words, if we observe natural development with sufficient care, we see that it can be defined as the gaining of successive levels of independence" (Montessori 1949: 123). She described three levels of independence achieved in the successive Montessori prepared environments: physical, mental, and economic independence. Each level builds upon the previous one, forming a foundation for further development. In Casa,

he learns to coordinate and refine his movements which help him acquire the necessary skills needed for him to navigate and explore his surroundings with ease and confidence. This tendency to explore comes at a time when the child's mind is absorbent exhibiting an effortless ability to concentrate. Allowed with the independence to choose, the child uses his hands to explore the Montessori materials and learns on his own how to figure them out and master them. The brain development that happens in the first plane provides the foundation when the child enters elementary.

In elementary, the child exhibits the ability to inquire and use his imagination. He naturally asks, "why, why not, and how come?" While developing mental independence, the child also becomes socially and morally aware – he achieves moral and social independence.

In the Erdkinder prepared environment the child, now an adolescent, explores his evolving sense of dignity and justice. Montessori described this developmental stage as "the 'sensitive period' where there should develop the most noble characteristics that would prepare a man to be social, that is to say, a sense of justice and a sense of personal dignity" (Montessori 1994: 60). The farm environment provides a venue for production and exchange, the economic framework of the adult society the adolescent will next enter into. The student explores what can be called a laboratory of adult life as he progresses to achieve economic independence.

The theory of **Human Needs and Tendencies**, though not explicitly defined by Dr Montessori, refers to innate, universal human traits guiding individual development and behaviour. It was her son Mario who wrote extensively on the human tendencies and how Montessori Education meets these natural propensities (Montessori 1956). These tendencies, when respected, lead to the continual adaptation and development of the individual. They serve as intrinsic powers which guide individual human development and motivate individual human behaviour – in a particular direction and to particular ends. When the human tendencies are respected and allowed to guide the person, their results are: the formation and continual development of the individual personality, and the individual's continual adaptation as a person of his time, place and culture (Sackett 2009: 1). These tendencies are exhibited by human beings in various ways depending on the psychology of their age. They operate in concordance with the developmental characteristics and can thus be supported or hindered. Barrameda (2020) tabulated the human tendencies and how they are manifested in respect to the psychological characteristics specific to each of the four planes of development.

Montessori enumerated three basic human needs: food, clothing, and shelter. Humans possess inherent characteristics that help meet these needs, such as orientation, exploration, order, communication, abstraction, concentration, repetition, perfection, exactness, and precision. The tendency to orientate helps the person become familiar with the environment, a necessary factor for self-preservation. The tendency to explore leads the person towards new discoveries. The tendency towards order leads the person to organize and categorize the myriad of information from the environment leading to logical decisions and self-preserving actions.

Also, humans possess innate abilities that enable each one to move towards the environment by building on those that are meant for survival. These tendencies drive man to collaborate and cooperate with others in order to fashion ways or create things that can be used to meet human needs over and above the basic. Montessori referred to these as "spiritual needs" which include music, art, culture, religion, etc. Sackett named the tendencies that empower humans to build on those used for survival as communication, abstraction or imagination, concentration, repetition and perfection, and exactness and precision.

Montessori's theory of **Sensitive Periods** delineates critical phases in children's development, where they exhibit heightened sensitivity to specific environmental stimuli. During these heightened sensitivities, also referred to as "critical periods," "plastic periods," or "primetimes," the senses are attuned to the specific aspects of the environment needed to satisfy the needs of the brain (Helfrich 2011: 64).

From birth to age 6, children are sensitive to movement, language acquisition, and orderliness. During elementary years (6–12), further exploration, social interactions, moral development, and imagination and reasoning are focal points. Adolescents (12–18) experience sensitive periods for identity formation, fairness, justice, and the dignity of work.

The cornerstone of the framework, the **Montessori Prepared Environments** theory, involves designing educational spaces and activities corresponding to developmental needs and tendencies at different stages. These environments implement the Primary programme in Casa Dei Bambini for ages 2.5–6 years, the Cosmic Education programme in two Elementary environments for ages 6–9 and 9–12 years, and the Erdkinder programme in the Adolescent Farm Campus for ages 12–15 years. Schools without access to a farm set up an Urban Contribution. The Senior High School curriculum for ages 16–18 aligns with national Department of Education requirements.

These Prepared Environments offer a three-year multi-age grouping to stimulate social interactions that reinforce cognitive learning. Uninterrupted three-hour work periods are observed to encourage the exercise of maximum effort independent and collaborative work in doing the activities. The main role of the teacher is to link the child to the materials by showing their use and then leave him to construct himself. Except in The Erdkinder, where work revolves around the Occupations Projects, Montessori designed materials abound in the environments and are placed where children can freely use them as their interests lead them to the apparatus encouraging the children to naturally move and collaborate.

Dr Montessori believed that aligning learning with innate tendencies fosters spontaneous learning characterized by focused attention and deep concentration, leading to profound understanding. Echoing Montessori's Absorbent Mind concept, recent research reveals that rapid neural synaptic formations are linked to hands-on experiences in well-prepared environments. A 1996 Chicago conference highlighted the critical role of early care and nurture in fostering strong neural development and enhancing educational outcomes. The convenors underscored the interplay between nature and nurture, stating that "early care and nurture have a decisive and long-lasting impact on how people develop, their ability to learn, and their capacity to regulate their emotions" (Shore 2003: x). Focusing on the rapid

growth of neural synapse during the first three years of life, which leads to a highly dense brain, the conference emphasized the importance of experience: "those synapses that have been activated many times by virtue of repeated experience tend to become permanent; the synapses that are not used often enough tend to be eliminated" (Shore 2003: x).

The Erdkinder Prepared Environment allows for real-world experiences that help adolescents mitigate the impact of rapid neural pruning, making learning more effective and meaningful. Side-by-side mentoring by adults provides essential guidance and support, fostering emotional regulation and resilience, empowering adolescents to navigate complexities with confidence and self-awareness. Eckert, in her book, Maria Montessori's Erdkinder, discussed extensively various forms of implementation of the plan for adolescents in very diverse environments including those that have just been started to those that are already established through years of practice (Eckert 2024).

Fundamentally, the longitudinal study is built on the premise that the Montessori Method, grounded in these theories, provides an educational framework uniquely attuned to individuals' natural developmental trajectories. The interplay of the four fundamental Montessori theories creates a holistic and dynamic framework that optimally supports children's natural growth and learning processes. Each theory uniquely contributes to understanding and facilitating child development. This integrated approach ensures that Montessori education remains responsive, individualized, and deeply attuned to each child's holistic development, ultimately preparing them for lifelong learning and adaptation in a complex world.

Statement of the Problem

This study determined the impact of the Montessori Educational Programme on learners' cognition as measured by performance in the Primary Programme, the Montessori Cosmic Education Programme, and the Erdkinder Programme, as well as in CATs given by the top three universities in the country. The specific problems addressed were:

1. Problems 1−3 looked at learners' cognition levels in each programme's learning areas.
2. Problem 4 compared the Cosmic Education Programme performance of those who attended both Primary and Cosmic Education Programmes with those who attended only the Cosmic Education Programme.
3. Problem 5 examined adolescents' performance in Erdkinder learning areas based on the length of exposure to the Montessori Programme.
4. Problem 6 investigated the impact of the number of Montessori programmes attended and the Erdkinder Academic Rating on adolescents' CAT performance.

Problems 1–3 are hypotheses-free. The Null hypotheses for Problems 4 and 5 state no significant difference in performance regardless of earlier programmes attended. Problem 6 states that the number of Montessori programmes attended and the Erdkinder Academic Rating have no impact on CAT performance. A 0.05 level of significance was used.

Significance of the Study

The study investigated the effectiveness of the Montessori Method on children's cognitive development, offering significant benefits to educators, parents, curriculum designers, evaluators, and school officials. Empirical data supporting Montessori principles provide detailed insights into experiential aspects. The study offers evidence-based information to parents for informed decisions about their children's education, affirming the method's effectiveness. Curriculum designers and evaluators can use comprehensive research to guide programme development and assessment. School officials, including those at Abba's Orchard School System, can validate and standardize Montessori programmes, ensuring consistent quality across campuses. Overall, the study filled a crucial gap in quantitative research on Montessori education, supporting its broader application and acceptance.

Scope and Limitations of the Study

This study focused on learner cognition in Montessori Educational programmes from Casa to Erdkinder to determine aptitude in standardized university entrance exams of the University of the Philippines (U.P.), the Ateneo de Manila University (ADMU), and the De La Salle University (DLSU). Conducted at the Alwana and La Granja campuses of The Abba's Orchard School, the research is limited to these sites as they are the only campuses offering the complete Montessori Adolescent Programme with a prescribed farm setup. No boarding facilities or permanent hostels are available as components of the Erdkinder Programme. Other Montessori schools could not be included owing to the lack of comprehensive programmes and challenges of establishing a farm environment in urban areas.

The study includes graduates from school years 2007–2008 to 2014–2015, excluding those with cognitive challenges or intermittent attendance. Learning areas studied are Practical Life Exercises, Sensorial Education, Language, and Mathematics for the Primary Programme; Mathematics, Geometry, Geography, Biology, History, and Language for the Cosmic Education Programme; and Self-Expression, Character Development, General Education, and Physical Development for the Erdkinder Programme. Cognitive assessment is defined by performance in Montessori programmes and CATs.

Research Setting

The research was conducted at The Abba's Orchard School, a 25-year-old Montessori school system in the Philippines. Founded in 1998, it has grown to 14 campuses in 11 cities, with a 15th planned for 2025. Four campuses feature Adolescent Farm Environments. The school, serving about 1400 students, offers comprehensive Montessori education based on AMI

set standards for ages 2.5 to 18. The Erdkinder Programme began in 2004, with the first graduates in 2008. The La Granja campus has offered the Erdkinder Programme since 2006.

Research Design

The study employs a longitudinal and descriptive research design to examine past learning experiences and their impact on cognitive development and academic performance in higher education. This approach enables the observation of changes and trends over time, offering valuable insights into the enduring impact of Montessori education on cognitive achievement. Using learners' ratings, the study provides a comprehensive description of cognitive levels across Primary, Cosmic Education, and Erdkinder programmes. Additionally, it assesses learners' performance in the CATs of the U.P., the ADMU, and the DLSU.

Unit of Analysis, Respondents, and Sampling Procedure

The 105 respondents of this study, aged 15–17 years old and predominantly from middle to upper economic tiers, were selected from the graduating students of the Abba's Orchard School in its La Granja campus in Bukidnon, spanning six school years from 2008–2009 to 2014–2015, beginning with the batch that had students who attended the Primary Programme. The respondents were grouped according to the programmes they attended as shown in Table 1.

Table 1. Distribution of Adolescents According to Programmes Attended

Group	Programmes Attended	Number of Students
A	Primary, Cosmic Education, Erdkinder	37
B	Cosmic Education, Erdkinder	48
C	Erdkinder	20

Source: Barrameda (2017: 246).

To reduce bias from varied educational exposures, exclusions included two students who were professionally diagnosed with cognitive challenges and five returnees who did not complete Elementary. Additionally, three students were also excluded as they refrained from participating in any college admissions exams used in the study.

Data Source, Scoring Guidelines, and Statistical Procedure

Data Source

Progress Report Cards (PRCs) of the 105 respondents were collected from the last year of the learners in Primary, the end-of-Grade 6 in Elementary, and the end-of-4th Year in Erdkinder. They were grouped according to the earliest programme they attended. All 105 respondents had records of the number of college admissions tests they took from the UP, ADMU, and DLSU and whether they passed or failed the tests.

Scoring Guidelines

Numerical representations were used in the study in order to perform statistical analyses on the performance ratings gathered through the students' PRCs. The descriptive ratings used in the Primary and Cosmic Education Programmes were transmuted to their numerical equivalents. The numerical ratings used in the Erdkinder Programme already reflected the numerical grades of the adolescents and did not have to be transmuted. The transition from a descriptive type to a quantitative type of rating in Erdkinder is justified by the school in order to prepare the adolescents for the kind of evaluation done at the tertiary or university level.

Statistical Procedure

The statistical tools employed for data analysis and interpretation in this study included descriptive statistics and various tests of comparison or differences. Descriptive statistics were used to quantify learners' ratings obtained from performance in different Montessori Programmes (Primary, Cosmic Education, and Erdkinder) and the CATs. Data frequencies, percentages, means, and standard deviations were calculated for ratings across all learning areas.

For tests of comparison or differences, the Mann-Whitney U Test was utilized to compare the Cosmic Education performance of learners who attended the Primary Programme with those who did not, with the significance level set at alpha = 0.05. The F-Test was used to compare and differentiate the Erdkinder performance among learners who completed the full Montessori Programme, those who attended only the Cosmic Education and Erdkinder Programme, and those who attended only the Erdkinder Programme, also with significance set at alpha = 0.05. Additionally, logistic regression was employed to determine the model for Problem 6, aiming to ascertain the extent to which learners' performance in CATs of UP, ADMU, and DLSU is explained by their Erdkinder Academic Rating (EAR) and the number of Montessori Programmes Attended (MPA), with the level of significance set at alpha = 0.05.

Presentation of Data and Summary of Findings

Considering the inquiries made in this study, this section begins with an analysis of learner profiles based on the Montessori programmes attended (Problems 1–3). To investigate the impact of the Primary programme on the performance of learners in the Elementary programme, the study compared the Cosmic Education performance of learners who attended the Montessori Primary Programme with those who did not (Problem 4). To examine the impact of the Primary and Elementary programmes on the performance of learners in the Erdkinder Programme, a comparison was made among learners grouped according to the length of exposure to the Montessori Programmes (Problem 5). Finally, to explore how learners perform cognitively outside of Montessori, their performance on the college admissions tests of top-tier tertiary institutions in the Philippines was analysed (Problem 6).

Problem 1 evaluated the academic profile of 37 learners who participated in all stages of the Montessori Educational Programmes. The learners achieved an overall mean of 2.71, described as mastered, with a standard deviation of 0.25 indicating performance clustering near the mean. Findings show that 86% of learners demonstrated overall mastery in various learning areas, 8% showed strong progress or interest, and 5% displayed normal developmental patterns, with none needing supplementary work.

The Primary Programme features that could have contributed to an uptake in the level of cognition of the learners at the end of the programme include: 1) the Primary Programme's age-appropriate learning concepts for 3–6-year-olds allowing them to work at levels appropriate to their cognitive faculties; 2) the Casa dei Bambini's "Prepared Environment" addressing cognitive, affective, and psychomotor needs; 3) freedom in work choice and execution; 4) Montessori Materials providing "Higher Order" learning experiences; 5) materialized abstraction feature of the materials where abstract concepts are brought to concrete manipulative forms; 6) the "three period lesson" presentation approach ensuring full concept grasp; 7) the motivating "flow experience" enhancing concentration and focus in tackling even more complex cognitive tasks; and 8) the three-year programme's length of the learner's exposure encouraging repetition and practice that leads to conceptual mastery.

Problem 2 examined the cognitive performance of 85 learners in the Cosmic Education Programme, focusing on various learning areas. The learners achieved an overall mean of 2.01, described as secure, with a standard deviation of 0.12, indicating performance ratings clustered near the mean. Most learners (94%) were secure, 6% were progressing, and none needed support. High performance ratings may be attributed to the "prepared environment" features. Indoor spaces provide about three-square meters of workspace per child, and outdoor environments accommodate larger projects. Appropriately sized furniture encourages group work for 2–4 children, though individual work is also an option. The room is equipped with scientifically crafted Montessori Materials, and school supplies are readily available. These provisions and the flexibility available to the children encourage independent self-expression, resulting in a high degree of focus and concentration and a deeper understanding of learning concepts. The Programme also encourages exploration

outside the classroom through "going-out" activities, allowing interaction with community experts. Overall, the findings highlight the Cosmic Education Programme's effectiveness in fostering high cognition levels across diverse learning domains, with most learners demonstrating mastery in key academic areas.

Problem 3 investigated the profile of 105 adolescents enrolled in the Montessori Erdkinder Programme, including 20 who joined The Abba's Orchard School only in high school. The adolescents obtained an overall mean of 2.41, described as secure, with a standard deviation of 0.24, indicating performance ratings clustered near the mean. About 17% of the adolescents showed mastery, 76% were secure, 8% adequate, and none minimal. High performance ratings are attributed to the programme's focus on life-long skills rather than test preparation. In Montessori, tests indicate comprehension levels, guiding teachers on the need for additional presentations. Montessori, a physician, recognized the internal disequilibrium in adolescents due to rapid physiological changes and recommended attention to diet for proper physical development. The Abba's Orchard School dedicated four hectares in the Bukidnon mountain ranges for its Adolescent Farm Campus, providing clean air and a healthy diet. Adolescents have the freedom to choose and direct their activities, with professionals hired to conduct classes. Older children gain real-life experiences through Practicum work in community organizations. The school collaborates with international Montessori organizations, offering adolescents opportunities to participate in global conferences on socio-environmental issues.

Problem 4 examined the difference in Cosmic Education performance between two groups: Group A (37 learners, attended both Montessori Primary and Cosmic Education Programmes) and Group B (48 learners, attended only the Cosmic Education Programme). The groups differed significantly in Mathematics (U value = 1108*), leading to the rejection of the null hypothesis. Group A performed significantly better in Mathematics, indicating that learners who experienced both Primary and Cosmic Education Programmes demonstrated better proficiency in Mathematics. U-statistics for Geometry, Geography, Biology, History, and Language showed no significant difference, suggesting similar levels of understanding in these subjects. Overall, Group A performed slightly better, but the difference was small.

Problem 5 tested the Erdkinder performance of 105 adolescents divided into three groups: Group 1 (37 attended Primary, Cosmic Education, and Erdkinder Programmes), Group 2 (48 attended Cosmic Education and Erdkinder Programmes), and Group 3 (20 attended only Erdkinder). Results showed significant differences in overall performance among the three groups. Specifically, significant differences were found in Character Development (F = 9.99**) and General Education (F = 7.85**), leading to the rejection of the null hypothesis of non-significant differences in these areas. These outcomes highlight variations in performance across academic subjects, which serve as indicators of cognitive abilities and measures of intelligence in schools.

Problem 6 examined the "Pass or Fail" ratings of adolescents in the CATs of the top three Philippine universities (UP, ADMU, DLSU) and compared these with their EARs and the number of Montessori Programmes Attended (MPA). The same groupings from

Problem 5 were used. The Wald statistics indicated a highly significant contribution ($p < 0.01$) of the Number of Montessori Programmes Attended and the Erdkinder Academic Rating to passing any of the CATs. Results showed that each additional year in Montessori Programmes increased the chances of passing, with an odds ratio of 3, meaning a learner is three times more likely to pass a CAT with each additional programme attended. For EARs, the findings showed an odds ratio of 28, indicating that a unit increase in Erdkinder Academic Rating makes a learner 28 times more likely to pass any CAT, when the number of MPA is constant. Thus, a student with a higher EAR is significantly more likely to pass one or more of the top three CATs.

Further data analysis shows the impact of the number of programmes attended on the likelihood of passing the college admission tests: 30% for those who attended the Erdkinder programme only; 60% for those who attended both the Cosmic Education and the Erdkinder programmes and 90% for those who attended all three Montessori education programmes.

Now, with empirical proof, the earlier questions can confidently be answered: "How will a Montessori student cognitively perform at the end of a whole spectrum of Montessori education?" The answer is: **They will be confident, resourceful, creative, and knowledgeable.** Secondly, "How will the children do after Montessori?" The answer is: **The children will confidently excel and contribute to better their communities.** Corollary to this, will the learner be able to hurdle stringent qualifying examinations given by top-tier universities? **Yes, significantly.** Will the length of exposure in the Montessori Prepared Environments have a significant impact on the student's cognitive achievement? **Yes, significantly.** Will it matter if the student starts in Casa? **Yes, significantly.** In Elementary, or in Erdkinder? **Yes, significantly but not as much as when they start in Casa.**

Conclusion

The study highlights two pivotal insights. Firstly, it underscores the enduring influence of the Montessori Primary Programme on cognitive performance, extending into later developmental stages and success in CATs. Secondly, it emphasizes the integral value of traversing the complete Montessori spectrum, from Primary to Elementary and Erdkinder, nurturing children in self-regulated environments that prioritize holistic development. It can be confidently asserted that attending all three Montessori Programmes – Primary, Cosmic Education, and Erdkinder – significantly impacts cognitive development.

Montessori emphasized the importance of viewing education as an integrated whole, with each developmental level building upon the previous one, nurturing the energies that drive towards the succeeding periods of life. Montessori stated that if "the formation of man" becomes the basis of education, the coordination of all schools from infancy to maturity is a first necessity, recognizing that human development is a unified, interdependent process (Montessori 2007a: 80).

She proposed the importance of sustained purposeful work in fostering development, stating, "The children find joy, satisfaction, and exhilaration in work. More work seems to produce more restfulness… Work thus becomes the sine-qua-non of growth, development, efficiency, and happiness" (Montessori 2013: 87). Montessori's approach is considered an "aid to life," affirming her belief in the transformative power of education: "This is the hope we have – a hope in a new humanity that will come from this new education, an education that is a collaboration of man and the universe that is a help for evolution" (Montessori 2019: 46).

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