

A RESEARCH BASED PRO-D WORKSHOP FOR MONTESSORI TEACHERS PIVOTING
TO REMOTE LEARNING

by

SHERYL C. EDWARDS

Bachelor of Elementary Education, St. Louis College of Bulanao, Philippines, 2002

Master of Science in Teaching, St. Paul University, Tuguegarao, Philippines, 2006

CAPSTONE PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN EDUCATIONAL
STUDIES – SPECIAL EDUCATION

in the

SCHOOL OF GRADUATE STUDIES

We accept this capstone project as conforming to the required standard

Dr. Lara Ragpot, Supervisor

Dr. Matthew Etherington, Second Reader

TRINITY WESTERN UNIVERSITY

May 2022

Abstract

Montessori education philosophy is one of the most astounding in the world-with, with the schools being overtly unique. The system of education, in this case, stresses the use of artifacts in learning. Unlike a typical elementary school, Montessori schools have specialized items for manipulation to teach learners how to use their innate and acquired skills and abilities to solve their problems. For a long time, Montessori school administration has been opposed to the influence of disruptive technology on learning. As such, much of the learning has followed the approach of the conventional model. However, the insurgence of COVID-19 brought disruptions that adversely interfered with face to face learning. As such, most if not all Montessori schools had to resort to remote learning. With this transition being the best shot, most schools were affected because teachers-most of whom teach the lower grades- were not properly prepared to teach remotely. This transition has brought severe challenges that have negatively impacted the quality of learning of Montessori education. The biggest concern was how hands-on learning approach would easily be incorporated into remote learning. Coupled with that, most teachers struggled to adapt to this reality of remote learning because they lacked the necessary skills, experience, and exposure meant to help them smoothly transition. As such, this paper intends to develop a professional development workshop for Montessori teachers, educational assistants, resource teachers, and school administrators to address these issues pertaining to the skills gap and the challenges faced in transition. The approach used to develop the professional development workshop was by use of a design-based approach (DBR).

Keywords: Montessori education, remote learning, design-based research

ACKNOWLEDGEMENTS

I have invested time and effort in this endeavour. However, this would have been impossible without numerous individuals' generous support and assistance. I would want to express my heartfelt appreciation to each of them.

I am grateful to my supervising instructor Dr. Lara Ragpot for her direction and regular supervision and for supplying vital information about the project and assisting me in completing it. I feel incredibly fortunate to have the opportunity to work with such an empathetic and motivating supervising instructor like her.

To Dr. Matthew Etherington, who was my second reader, for providing me with essential feedback for the success of this study. Without his willingness to be my second reader, I would be unable to complete my studies at Trinity Western University.

I owe a debt of gratitude to my family and friends, especially for their constant support and undivided attention in assisting me during the process of this study. In addition, I'm grateful for the enormous encouragement and motivation they had given me to stay on the challenge provided by my research.

Finally, I am incredibly thankful to my husband and to my son for their understanding and love in giving me the space I needed during the completion of my research. I'm grateful for the enormous delights and happiness you have given me every day, which provide me with the strength to complete this research.

Table of Contents

ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
CHAPTER 1: INTRODUCTION	1
Introduction	1
Background and Problem Statement	3
Research Question	6
Aims and Objectives	7
Background and Literature	7
Theoretical Framework	8
Overview of Research Methodology	11
Research Design	11
Sampling/Participants	12
Data Processing and Analysis	13
Intended Workshop	14
Trustworthiness	14
Ethical Consideration	15
Study Organization	16

CHAPTER 2: LITERATURE REVIEW	17
Introduction	17
Montessori - A glimpse into her history	17
The Montessori Education	19
Teaching in a Montessori-focussed context	22
Remote Learning	26
Challenges during remote learning	32
Challenges with teaching Montessori online: a rethinking of learning in a relationship.	39
CHAPTER 3: METHODOLOGY	42
Introduction	42
Definitions and Background	42
Design-based Research	43
Figure 1 A diagram depicting the Design-based Research Process	45
The planning phase of a Professional - Development Program	49
Practicality in DBR in Education	49
Features of DBR	50
Using a DBR to guide the design of a workshop for Montessori teachers	53
The focus of the workshop	54
Understanding the problem and contexttualizing solutions	55

CHAPTER 4: THE PRO-D WORKSHOP	59
Introduction	59
Figure 4.1 Progression of Workshop Planning	60
Brief context of the workshop	60
Potential Participants	61
Montessori Teachers	61
Educational Assistants	62
Resource Teachers	62
School Administrators	63
Logistic Involved in the workshop development and presentation	64
Workshop Objectives	65
Actual Workshop	67
Focus 1: Opening and Introduction	67
Focus 2: Montessori Methods	67
Focus 3: Remote Learning	68
Focus 4: Remote learning and Montessori education	70
Focus 5: Practical teacher activities with the students during remote learning ..	72
Conclusion	73
CHAPTER 5: SUMMARY & CONCLUSIONS	75

Introduction	75
Summary	75
Conclusion	78
Limitations of the study	80
REFERENCES	82

CHAPTER ONE: INTRODUCTION

Introduction:

For a long time now, the Montessori education system has built a thriving reputation given its high success rate in churning out students who have occupied high-end offices in various places across the globe. Rising from the brainchild of a physician-cum education champion, this system boasts of a reputable yet much-coveted system that is inherently oriented towards moulding students into becoming critical thinkers, innovators, problem-solvers, and being self-reliant. Notably, one of the main characteristics of this instruction system is that it was indeed an embodiment of childcare (Isaacs, 2018). The Montessori childcare philosophy was founded on two fundamental principles: For starters, as a result of their interactions with their surroundings, children form their sense of "self." Second, each child follows a natural path toward healthy mental development. They can only reach a beneficial conclusion by following this extremely personal path to psychological development, and no two people's courses are the same (Montessori, 2004). Among the most emphasized foundations are inventiveness, exertion, information exchange, precision and accuracy, inquiry, environment manipulation, organization, consciousness, uniqueness, and individuality, to name a few (Montessori, 2004). Yet, the onset of the recent novel corona-virus disease shook the very foundations of this culture. The normative ways have been at the peril of being redundant when knowledge cannot be passed through technology. While this paper is particular on Montessori education, it is only fair to note that other institutions may have become casualties of the insurgent pandemic.

On March 11, 2019, the World Health Organization (WHO) declared a global pandemic called Corona Virus Disease- 2019 (COVID-19). COVID-19 is a deadly infectious disease that consists of fever, cough, nasal congestion, fatigue, and other signs of upper respiratory tract

infections (Velaran and Meyer, 2020). Due to the infectious characteristic of Covid-19, the province of British Columbia decided to switch to remote learning as a social intervention measure in March of 2020 (CBC news) to protect their students and school staff. Remote education is a form of learning where teachers and students are not physically present in the instructional place (Armstrong-Mensah et al., 2020) but where disruptive technologies are widely used in meeting the demands of learning while the instructor and learner are worlds apart. Therefore, the abrupt shifting from face to face learning to remote education was challenging for British Columbia (BC) (CBC News, 2020).

This insurgence of COVID-19 brought about a severe disruption of virtually every aspect of society. Notably, the education sector was adversely affected because it primarily depended on face to face interactions- which was highly discouraged. Several learning institutions were built on face to face learning, where hands-on learning took pre-eminence. For example, hands-on, project-based learning is emphasized in Montessori education, allowing pupils to self-correct and try again until they grasp the material. Students can cascade their education with tangible objects like thermic tiles, counting beads, and movable maps until they reach the point in each subject where they can work in cogitation (Hiles, 2018). A case in point is the Montessori education system, whose value proposition was strategically built around hands-on learning. With physical meetings being cancelled for fears of spreading the mysterious disease, the Montessori schools were greatly affected. Coupled with the fact that they were strict on applying the normative learning methods that highly discouraged the use of technology in learning, it was only a matter of time before they were entirely out of work. With the epidemic still being unpredictable, almost all schools have resorted to virtual and remote learning. This transition proved to be very difficult for both learners and teachers. This paper delves into this matter to

equip all the primary stakeholders: teachers, administrators, parents, and learners with the necessary skillset and exposure to continue teaching and learning while upholding the values and tenets of Montessori education through disruptive technologies.

This chapter provides a brief background about a potential workshop that could benefit Montessori teachers if there is another pandemic causing schools to adopt remote learning. First, I will outline the problem, followed by the research questions, aims, and objectives. Then a brief overview of the research methodology consisting of the research design, sampling process, and data collection is provided. Lastly, I will evaluate the study's trustworthiness, possible limitations, and ethical considerations.

Background and Problem Statement:

In Italy Bergamo in 1907, Maria Montessori founded Montessori education to help children with exceptionalities. The philosophy encompasses a way of teaching and learning that emphasizes the physical manipulation of concrete materials. According to Lillard (2012), this learning process includes manipulating hands-on learning materials to help children's learning and development. Children, for example, will suddenly embrace the idea of the subject matter. Besides that, when children learn what they are doing, they are much more inclined to participate in the learning process, and students' behavioural challenges are reduced. The Montessori philosophy regards the child's spirit as equally important for learning as their mind. A Montessori curriculum nurtures the whole child, mind, body, and spirit. The Montessori-educated child knows that each person can send ripples of peace throughout the world (Murray, 2011, pp. 22-33).

Being a Montessori teacher and having been trained to present lessons to students using hands-on manipulatives, the work done by a Montessori teacher has primarily been built around this proposition. While teaching theory, instructors at Montessori are strongly bent on leveraging the provided tools for cementing the theoretical underpinnings that have been laid as a way of ensuring that there is an excellent connection between the subjects that are taught and the real-time solutions within the society (Murray et al., 2021). Hands-on manipulatives are concrete teaching tools utilized in Montessori education. Children can keep moving around the classroom and participate in various activities in these institutions. They select a task to work on, introduce it to a table or mat, examine the materials, and make their findings. There are plenty of resources in the playgroup where the young kids first learn by touching and discovering with their hands. The vocabulary bins in the infant classes, for instance, are stuffed with items that infants examine with their hands and tongue. The next phase involves undertaking the conceptual process in the toddler and pre-schooler classes by matching the objects to picture cards.

This education system was modelled by Montessori about a hundred years ago (Ronen, 2021) to address the problems in learning among little children via psychologically ingrained methods of learning. Montessori was not an educator. She was a medical doctor. When she was assigned to one of the mental children's institutions in Italy, she cured the children using the hands-on learning manipulatives she created. The concrete materials that Montessori created developed the children's motor skills. For example, they improved their hand and eye coordination. Montessori continued to develop concrete materials for her patients until it became her passion, and she opened her Montessori school in Italy. The primary goal of Montessori education is to assist each child in acquiring the necessary skills that will allow them to

comprehend the creative learning process throughout life. It was about helping to develop the required skills for success in school and life (Murray et al., 2021, pp.1-29).

Montessori's philosophy of education was intended to have an outstanding perceived value. It would provide both teachers and students with opportunities to explore beyond the prescriptive ways to get the most out of education. Among the most emphasized foundations are self-independence, creativity, and discipline.

Teaching remotely during the COVID-19 pandemic was a real challenge for other teachers within the same teaching environment as me. However, similar to other instructors in our system of education, I believed that there was a lack of preparedness among the instructors because the better part of our teaching experience-which had now become an inherent part of our being, was embedded in the physical interactions that enabled us built a conducive environment for optimal learning. As a seasoned instructor, I was not prepared for remote learning because the time allotted for us was insufficient to learn the best way to rightly prepare for a virtual meeting with my team of learners for the different sessions. During the first encounter with my students and for a virtual class meeting, my teaching experience was tense because I was very nervous and uncomfortable. Part of my nervousness and a lack of comfort arose because everything seemed strange and awkward. The medium of communication, the environment, the conduct of the students, and my need to adjust to this new reality marred by my usual self from adequately interacting with my students as it happens in class during face to face learning.

Additionally, a myriad of unusual things compounded my woes during the maiden virtual course. Among such were tendencies like my students sending messages and emojis while the meeting was still on, the students' continuous complaints regarding my inaudibility and lack of clarity because of a weak Internet connection, among other notable things. The rather strange

happenings during that class prompted the innovative me to consider designing a workshop that would be of much benefit and importance to Montessori teachers-most of whom are not endowed with the necessary skillset to traverse this rather strange and uncharted grounds so that they could be ready and prepared in case there would be another phenomenon that would cause remote learning.

This paper uses the most recent happenings to evaluate remote learning inclined to Montessori education and create a workshop model for equipping Montessori teachers with the necessary skills suitable for transition. Remote learning is a current reality already being used to blend the normative teaching methodologies with the current ones to make learning wholesome and all-inclusive (Siddiqui, 2020).

Research Questions:

The above-stated discussion of the identified problem has led me to formulate my research question: What guidelines could be developed from a meta-analysis of the literature to assist teachers in teaching young children on an online platform according to the Montessori philosophy?

Sub-questions:

- What are the specific characteristics, similarities, and differences of Montessori teaching in relation to remote or digital learning?
- What difficulties did elementary teachers encounter while teaching students online during the COVID-19 pandemic? (Perceived and actual?)
- What difficulties do Montessori teachers experience when teaching young children on an online learning platform?

- What are possible ways students could be taught online according to the Montessori education of education?
- How could these ways be encapsulated in a workshop to train teachers?

Aims and Objectives

According to the Montessori philosophy, this study aims to present the guidelines developed from a meta-analysis of literature teaching young children on an online platform.

Main aim:

- To gather data from research in the recent past about the guidelines of online platforms teaching young children.

Sub-aim

- To gather data from research in the past about the characteristics of the Montessori Philosophy.
- To gather recent data about elementary teachers' difficulties while teaching young children online during the COVID-19 pandemic.
- To outline how Montessori teachers could adapt to teaching young children on an online platform following the Montessori education method.

Background and Literature

A review of current literature focused on Montessori education within the pandemic will form the primary data source of this study. With that in view, the literature review as used in this section of the paper is meant to serve two primary functions; painting a comprehensive picture of primary Montessori education (grades 1, 2, 3) amidst the pandemic and providing relevant data

to analyze which would culminate in the possible guidelines to create a comprehensive workshop according to the Montessori system of education.

In attempting to draw as much information as possible from the research on remote learning, Montessori education, this investigation highlights particular topics, including, among others, the perception of Montessori teachers towards remote learning, the availability of the necessary resources for making remote learning success, the level of support that comes from schools and administrators, students' conduct, and the teachers' skillset among other things.

This work draws from a plethora of literature from diverse sources in modelling the right mental picture of the adjustments that should be made at Montessori to fit in the current dispensation of developed schools when it comes to remote learning,

Theoretical Framework

The study utilizes ideas proposed by Lev Vygotsky on Semiotic Mediation (Vygotsky, 1934). Vygotsky defined semiotic mediation as the process by which humans employ intellectual adaptation tools - these learning tools (via various modalities) enable children to perform basic psychological operations more efficiently. These capabilities are purely cultural (for instance, memory mnemonics, mind maps). Vygotsky, like Piaget, thought that children are inquisitive and fully engaged in their education and the revelation and emergence of new concepts/schema (Vygotsky, 1934). The Digital revolution has demonstrated its utility in satisfying a wide range of educational requirements, including establishing the classroom design itself, where instruction and classwork are organized in the virtual realm; organizing teaching methods; organizing within the framework of digital activities or applications; and arranging online learning programs, accordingly within unique digital technology, and ancillary materials. As a result, I argue that it

is critical to develop a holistic approach investigating the learning task in digital spaces to obtain solutions to the issues about using digital technologies in the classroom.

In this paper, I opine that the issue of incorporating a semiotic approach into learning that can explain how digital technology impacts learning and its contribution to inefficaciously promoting education via digital spaces requires extensive research. An examination of how mediation occurs in a digital learning environment can thus be proposed to increase understanding of the impact of digital technologies in the classroom. Furthermore, an assessment of the educational value of digitalization in learning challenges Lev Vygotsky's (2015) theoretical foundation, which integrates expressive, friendly, and developmental processes in education.

As Lillard (2007) highlights, Montessori education's hands-on learning activities give the children the opportunity to construct new meaning from their experiences. Jones (2017) also states that "Montessori techniques and materials provide opportunities for students to interact and make meaning from their environment in multiple modes of interaction". These Montessori practices aligned consistently with Vygotsky's semiotic mediation theory.

Since Montessori shares much with the encompassing Renaissance ideology (Feez, 2007), it is easy to miss the obvious truth that educationalists and those who followed in their footprints have been some of the most prominent critics of Montessori's instructional strategies. Conversely, renewed widespread interest in Montessori's pedagogy in the mid-twentieth century resulted from waning faith in the outcomes of progressive education (Chisnall, 2011). The emergence of different constructionism remotely familiar to Piaget, Bruner, and Vygotsky and the emergence of Skinner's programmed learning, a reworking of behaviourism, accompanied the revival of Montessori schools (Feez, 2007).

As mentioned by Ahlquist and Gynther (2019), it is proper to note that progressive educators such as Vygotsky considered the Montessori education approach was rigid to the extent that it could not open up to change. This is evident in the opposition between these two philosophies of learning-with, with one being pro-change and the other resisting the increased advancements in technology that have increasingly been shaping modern-day education. However, this paper is highly interested in the propositions advanced by Vygotsky that inform an aspect of Montessori-the aspects of a hands-on approach to learning (Ahlquist and Gynther, 2019).

In Vygotsky's concepts, the interactive combination of words and deeds in the initial stages of a human child's upbringing introduces the prospects for overcoming biological constraints and acquiring a level of independence and liberation not accessible to certain other species, precisely the sort of liberty highly prized in the Montessori heritage, into the way of human acclimation (Mulderrig et al., 2019). The combination of words and deeds is designed as a single dynamic unit of activity in a Vygotskian schema. Reverting to the culture from which Montessori pedagogy emerged, particularly Séguin's psycho-physiological method and its emphasis on the relationships between training, intelligence, and will, allows for a more in-depth investigation of the nature of this activity (Ahlquist and Gynther, 2019). While the Vygotskian schema vouches for digitization in learning, the normative Montessori approach was tilted towards conventional techniques (Mulderrig et al., 2019). At its core, this paper looks forward to developing the idea of embracing the Vygotskian concept of digitization to blend it with the hands-on approach for optimal output. The new Montessori outlook will be a hybrid of progressive and normative ideologies. This approach informs the workshop's scope- equipping

the teachers with the most relevant skills and techniques for remote teaching in a manner that does not compromise the Montessori culture.

Overview of Research Methodology

Research Design

By addressing the research questions, a review of the literature is conducted utilizing qualitative, as defined by Mertens (2020), and meta-analysis, as described by Boslaugh (2019) on data guided by the two functions of the literature: providing a comprehensive picture of primary Montessori education amidst the pandemic and, providing data to analyze the possible guidelines of teaching young children according to the Montessori education of education. These will give information for and thereby culminate in the workshop's design, which will, in effect, be the product of the study.

This paper's primary methodological approach is design-based research (DBR) (Scott et al., 2020; Lo et al., 2021). Professional development (Pro-D) is regarded as a combination of techniques, materials, and training sessions used by educators to enhance the efficacy of their instruction (Zohar, 2012). These resources assist instructors in broadening their content knowledge while also offering direction and possibilities to develop new teaching techniques (Hunzicker, 2011). Workshops and leadership seminars help participants learn and improve specific technical, mathematical, and analytical skills. Professional development for instructors encompasses fine-tuning and tweaking their abilities to meet better their students' needs (Hunzicker, 2011). While utilizing DBR as the primary methodological technique, this paper acknowledges some of the listed shortcomings of the approach, such as unpredictability, incorrect understanding, and the uncertainty of the various components of the process. This

paper also delves into the planning of a DBR process, the features, the practicability of its usage, and how it can be utilized to help Montessori teachers get more equipped for confronting the challenges brought about by the new mode of teaching.

Sampling/Participants

The sampling of the study is purposive. The study uses purposive sampling because the study will only focus on gathering literature on the guidelines of the online platform for teaching young children and the characteristics of the Montessori teaching philosophy. Purposive sampling is used to collect data for this study, which is supposedly based on the techniques used by Etikan et al. (2016) and Campbell et al. (2020) in their review of the literature. The Trinity Western University (TWU) library, Journal of Montessori Research and more extensive search engines such as Google Scholar are used to collect data. Each data set's selection process encompasses extremely relevant literature on Montessori education, cover information on the guidelines of online platform teaching young children and the characteristic of the Montessori education method, remote learning, and professional development workshops for teachers in using technology for virtual learning, recent articles that have a publication for the last ten years, preferably, but not limited to, literature published in Canada and the United States, Campbell et al. (2020) state that "Purposive sampling strategies move away from any random form of sampling and are strategies to ensure that specific kinds of cases of those that could be included are part of the final sample in the research study."

Data Processing & Analysis

The process of processing and analysing data has to be carefully and meticulously done. In this case, data processing takes the form of stages. The same foundational process was used for the catalogued data sets during the review process. The first step involved locating primary online sources from the various databases. The references are marked and set aside for scrutiny and consideration upon discovery. Secondly, the net phase entailed data mining-specific literature from databases and reliable web sources by employing descriptive terms and keywords. This second step was rigorously undertaken using the already set parameters that informed the search domain. The rationale, in this case, was to maintain a high level of consistency and objectivity such that at the end of the mining, only the most relevant and appropriate literary sources would have been sampled for consideration. After this step, the next one involved scrutinizing and carefully considering each study and report, following the already defined framework for searching the papers. Upon scrutiny, the documents that may not meet the specified search domains are discarded. At the same time, those that would have fallen out of the net but are considered very important in modelling the paper are added. Consequently, the next step entails searching all identified studies' reference sections for additional qualifying materials for record purposes. Next, the references are recorded because it is standard practice to document them for cross-checking when the work is eventually done for ease of referencing and keeping track of the various findings of the work concerning the others. Lastly, this process is finalized by maintaining a well-organized record of all the bibliographic information and notes on virtually every literary source chosen for consideration. It is proper to mention that while these steps are organized into phases, there is a possibility that some of the steps are likely going to overlap with others. These steps provide a guiding

framework for how the data mining and analysis will occur without implying that the process is cast in stone. For ease of replicating the study, it is expedient to note the point of overlapping activities within the same framework.

Intended Workshop

The main objective of this paper is to plan, model, and organize a workshop that addresses the main issue that has been put as the subject of discussion. The workshop's thematic concern is transitioning into the digital learning space while incorporating hands-on learning. The workshop is intended to span two days with a more relaxed schedule to provide room for the active engagement of the participants. The team leading the preparations majorly comprises the administrators at Montessori. The audience is intended to constitute the key stakeholders: parents and teachers at Montessori because they play the most pivotal role in their kids' learning, especially in the lower classes. Within the two days, the workshop will take a collaborative approach of engaging the primary players in presentations, demonstrations, and assessments to ascertain the degree of empowerment that would have taken place. At the end of the workshop, attendees will be awarded certificates of attendance and completion of the training that would have ensued.

Trustworthiness

The utmost intent of this study is to present data sources that represent pieces of evidence. For instance, selected articles cite credible and accurate citations. The articles' credibility was examined using criteria (Lincoln 2009). In addition, there is careful documentation of how the research was conducted, the associated data analysis and

interpretation processes, and the thinking processes of the research (Mertens 2020)—referencing and guiding the reader on all the steps taken throughout the study to ensure that this research is valid and reputable.

Ethical Considerations

The author declares that all sources used in this study are acknowledged, and there is no conflict of interest and no clear ethical considerations. Ethical considerations are critical for intellectual integrity, sentient freedom and respect, and science-society cooperation. Such ideals ensure that study subjects' participation in this study is adequately informed and safe. In this case, the primary ethical considerations come about using other people's works and ideologies. This paper has ensured that the work produced is clear of plagiarism and that every foreign idea, thought, and material utilized in this paper has been acknowledged in line with the set principles of the school.

First and foremost, before beginning the study, I made sure that my research proposal had been submitted for institutional review. This move gave my supervisor more time and space to assess whether my research objectives and design were ethically acceptable and adhered to the institution's code of conduct. Furthermore, it provided space for determining whether the proposed research materials and procedures are code compliant. Following approval, I began the work by collecting data according to the approved guidelines. As part of ethical considerations, I have ensured that possible deviations from the initial agreement with my institution are not implemented until such variations have been communicated and approved.

Study Organization

This paper is organized into five main chapters. This first chapter serves as an introduction. The chapter gives an overview, context, and theory on which this study is based. It focuses on the problem statement, the research questions, objectives, and thematic concerns. Chapter Two delves into Montessori education-exhausting every tiny detail of this system. It highlights instructors in the wake of remote learning instigated by the abrupt insurgence of COVID-19. Chapter 3 is particular about a Professional Development Workshop. Among many things, it gives the fine details into what it entails, the process of planning and making one a reality, and most importantly, the methodology (design-based research) that is to be used in this paper as the most viable approach in approaching the subject matter in this paper. Chapter 4 is about the Professional Development Workshop (modelled for the Montessori teachers). It provides a vivid insight into the whole process, from the planning phase to its tail end. This chapter contains the primary intervention measure to address the problem highlighted in the first chapter. It makes use of rich sources of data. Finally, Chapter 5 gives a summary of the initial four chapters.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter delves into Montessori education-exhausting much of this system. Moreover, it highlights the plights of the instructors in the wake of remote learning that was instigated by the abrupt insurgence of COVID-19.

Montessori - A glimpse into her life

Maria Montessori was the founder of Montessori education. She was born on August 31, 1870, and the daughter of Alessandro Montessori and Renilde Stoppani. Kramer (1988) describes Alessandro Montessori as an "old-fashioned gentleman of conservative temper and military habits" (p. 22). The mother of Dr. Montessori, Renilde Stoppani, was an intelligent woman who came from a landed family (Kramer, 1988). Growing up as a kid, Dr. Montessori experienced the rough treatment of women over men. As a result, she became a strong advocate fighting for women's rights. There she decided to become an engineer and later become a doctor. However, she knew that the path she had chosen was not easy. Dr. Montessori knew by heart that she would encounter hardships and struggles due to the unequal rights of men and women in her country.

Interestingly, even her government tried everything to pull her down, but she passed those challenges. Finally, in 1896, she became the first female Italian doctor. Soon after her graduation, she was assigned to work in a mental institution for mentally disabled children. There she saw how these children were severely maltreated. For example, they threw their food at them. While the children were picking up the food crumbs from the floor, Dr. Montessori observed that they were not staved for food but starved for knowledge (Lillard, 2007). This

phenomenon motivated Montessori to study the work of Eduard Seguin. Seguin was a French-born American psychiatrist who developed sensory stimuli to educate severely disabled children (Encyclopedia Britannica, 2022).

Montessori incorporated the work of Seguin in her work and created her hands-on learning materials to educate the mentally disabled children in her care. These children responded well to Montessori's learning method. In 1901, Dr. Montessori decided to join these mentally disabled children in the Italian state educational test designed for normal children. The children passed the test, which attracted reporters worldwide, making Dr. Montessori very famous. The test result made Dr. Montessori turn around and have a different perspective. She wondered why children did not do well in the state exam. As a curious physician, Montessori went back to school to become an educator. She had the opportunity to observe children in traditional classrooms. She realized that regular children were not appropriately educated because they were not engaged in hands-on, concrete learning materials which involved manipulatives. As a result, the children were bored and unmotivated to learn. Montessori saw this as a big problem in educating children. She then started developing her own hands-on, manipulative wooden learning materials and used these to teach young children. The young children learned well with Montessori's teaching method, and later, she named this method Montessori education.

Through this life-changing experience that Montessori experienced in her formative years of practice as a physician, she ended up dedicating the better part of her adult life to the education of young people. Maria Montessori spent most of her time developing a guiding philosophy aimed at bettering the education of young children. It's an intriguing approach to education with far-reaching ramifications in the classroom.

The Montessori Education

Based on the short history share before Montessori founded Montessori education in 1907. Montessori education is a philosophy involving the physical manipulation of concrete materials to support students' learning and development. Lillard (2007) describes this learning process as incorporating manipulating hands-on learning materials to empower the children's cognitive development. For example, young kids will quickly grasp the subject's concept. Additionally, when children know what they are doing, they participate joyously in learning, which eliminates students' behavioural challenges. According to the Montessori philosophy, kids' ethos is just as important as their psyche. Therefore, a Montessori curriculum nurtures the entire child.

Along with academic skills, children develop an appreciation for diversity and the ability to tolerate individual differences. Realistic Life's element of kindness and human decency is used to help educate peaceful conduct. The Montessori-educated child knows that each person can spread ripples of peace throughout the world (Murray, 2011, pp. 22-33).

The Montessori method's emphasis on learning through direct contact, experience, and action is one of the characteristics that sets it apart from more conventional learning environments. In quintessential learning environments, students sit at desks and pay heed to a teacher. On the other hand, Montessori students are strongly encouraged to roam the classroom and engage in the numerous activities available. They choose an action to complete, transport it to a desk or rug, explore the components, and make their findings. Much of learning in the Montessori method is done by manipulating concrete objects to enhance coordination among the children's various motoric and sensory systems (Montessori Elementary Classroom Experience,

2022). The *raison d'être* of this approach has everything to do with the wholesome acquisition of knowledge.

The purpose of the hands-on, manipulative learning materials of Montessori education is to encourage children to use their five senses while learning the concept of the lesson. For example, children will have the opportunity to touch the material. This part of the lesson activity will allow the child to use their sense of touch and discover the material. The child will now learn a new knowledge that the material is stiff, soft, and smooth. Once a child knows that he has acquired a new understanding, they will feel confident, and if the child has this confidence, it has the potential to develop into independence. Once children are independent, they acquire a solid learning foundation (Murray et al., 2021, pp.1-29). Montessori believed that children who have freedom feel confident to explore (Montessori, 1989b). Therefore, Montessori education starts early in preschool with a focus on independence.

The practical life curriculum of Montessori education teaches young children to independently put on their shoes, jacket, and coat when they go outside. When they work with Montessori materials, young children are trained to clean their learning spot and put the materials back on the shelves where they belong. This provision allows the material to be available to the next learner.

While aiming at modelling a more robust and disruptive approach to educating young people, Montessori came up with an educational philosophy that was, in essence, a proper improvement of the status quo (the progressive education that focussed more on the theoretical work). The Montessori Teaching philosophy challenges conventional teacher-student engagement. It approached education with the assertion that children are inherently curious and that a 'one size fits all' approach does not adequately address the needs of all learners. Instead of

viewing the instructor as the 'holder of understanding' and the child as a vessel to be loaded with knowledge, children's inherent uniqueness and curiosity are favoured. Due to the traditional approach's uniformity and lack of hedonistic nuance, the Montessori method seeks to give children a greater sense of control to promote greater comprehension (Murray et al., 2021, pp.1-29).

An essential aspect of this approach to education, as noted by Isaacs (2018), is that it also was an extension of the Montessori idea of child-care. The Montessori childcare ideology was founded on two primary areas; To begin, develop a sense of "individuality" through their experiences and interactions. Students are taught to participate in activities instead of sitting in a classroom and being instructed, perform with a range of accessories, visit a variety of regions, experiment with various things, and determine what works best for them individually. Secondly, each child is born with an inherent capacity for healthy psychological development. They can reach a beneficial conclusion by following this extremely personal path of psychological development, which is unique to each individual.

Montessori's philosophy of education (Montessori, 2004) was intended to have a superior value proposition to cultivate the critical, analytical, and logical thinking of children. It would afford both the learners and the teachers a chance to explore beyond the normative to get the best out of education, for example help children to develop their concentration. Some of the most stressed underpinnings include creativity, effort, communication, precision and accuracy, investigation, environment manipulation, organization, awareness, novelty, and identity, among others strongly vouched for principles (Ahlquist and Gynther, 2019). According to the philosophy, education should be designed around these principles to enable the best healthy psychological growth- ideally, intending to foster independence in all of the areas stated because

these tendencies are 'universal,' it is reasonable to anticipate that education systems founded on a healthy respect for them will find it easier to develop a framework or foundation upon which to build more individualistic 'ad hoc' instructions.

Teaching in a Montessori-focussed context

This section will briefly focus on the educative environment – thus, the ideal spaces for Montessori teaching and what is needed as equipment and teaching tools in this approach. Therefore, I will discuss the classroom, instructional tools and materials, ideal classroom grouping, foster collaborative work with peers, and the focus of learning activities. Montessori education has a well-organized classroom (Hiles, 2018). Materials are displayed based on the Montessori curriculum. Montessori education has five curricula. These are practical Life, sensorial, language, mathematics, and culture. The materials display from the most accessible lesson to the most challenging task in each curriculum. The purpose is to gain the child's self-confidence so that they are not upset or frustrated when they work on the difficult part of the curriculum. Materials that have already been presented to students are still displayed for students' lesson concept mastery. The well-organized feature of the Montessori classroom fosters the welcoming environment of Montessori education. Lillard (2007) highlights that the welcoming atmosphere of the Montessori environment invites the children to engage deeply to explore their knowledge in discovering new things around their learning environment (Lillard 2007).

The well-maintained, painstakingly selected instructional materials are a common feature of Montessori classrooms. Hands-on, project-based learning is emphasized in Montessori education, allowing pupils to self-correct and try again until they grasp the material. Students can

cascade their education with tangible objects like thermic tiles, counting beads, and movable maps until they reach the point in each subject where they can work in cogitation (Hiles, 2018). Different Montessori tools, for example, guide learners through a classic progression of bolstering their grip strength and agility, tracing letter and number patterns, and ultimately writing the alphabet and numbers independently. When a student is capable of writing letters and numbers without using their hands, they have advanced to conceptual writing. Of course, other skills (like reading and comprehension) are also improving simultaneously. These physical, emotional, and psychological priorities are woven into a complete, hands-on Montessori curriculum.

Montessori education has a three-year-age grouping class. For instance, preschool one, preschool two, and kindergarten are joined together. Grades 1, 2, and 3 are primary classes, and grades 4, 5, and 6 are the intermediate program. The multi-age grouping of the Montessori education provides the opportunity for the older children to develop their exemplary leadership skills. Additionally, these cross groups of children ranging in age from 6 to 9 and 9 to 12 also provide a diverse mix of children with whom to collaborate and interact. These cross-generational bonds benefit the respective communities in a wholesome manner (Hiles, 2018; Edwards, 2003). Experts highlight that it is vital to develop good leadership skills at a young age (Redmond and Dolan, 2016; Karagianni and Montgomery, 2018). The multi-aged grouping of the Montessori program also teaches the younger children to respect the older children (Murray, 2011, pp. 22-33). When there is respect among the children, they are in a team. For example, everyone is included. Teamwork among students also promotes positive interaction.

In Montessori schools, learners work at tables or on mats on the floor in a Montessori Elementary classroom, either independently or in small groups. Natural light, soft colours, and

uncluttered spaces create an environment conducive to focused and relaxing activities. Learning resources are organized by curricular area on easily accessible shelves, encouraging students' freedom while they work. Everything is in its proper place, exuding a sense of calm and order that both soothes and inspires. The classroom is a joyful environment. Inside these classrooms, learners enjoy a high level of focus.

Moreover, it is proper to note, as per the reports, that these learners enjoy what they do. They innovate, investigate, discuss, construct, make snacks, and wrap up with books; they may even reflect in a quiet, tranquil place. Meanwhile, teachers move around the classroom, observing pupils and taking notes on their progress, always ready to offer assistance or present new content (Montessori Elementary Classroom Experience, 2022).

Multi-age grouping in Montessori schools, being one of the most prominent features, defines the organization and the DNA of this schooling system (Alwi et al., 2021). The mixture of learners, per age, among other properly defined parameters, creates a perfect atmosphere for the learners of different ages and from diverse backgrounds to thrive in. Given that the slightly older learners are perceived as being role models to the younger ones, their role in helping the younger ones cannot be over-emphasized. While in school, the older children are highly encouraged to play a role in the development of the younger ones by socializing with them, supporting them with new tasks, or teaching them skills they have learned. On the other hand, the younger students are oriented towards following; the older students lead and have classmates with whom to engage in parts of the curriculum where they are more advanced. This multi-generational community allows everyone to learn from one another while also providing opportunities to lead, share, and serve as role models. It also fosters an understanding of differences.

Collaboration between students is a way children's social skills are essential in their learning process, as is the case at Montessori (Debs and Brown, 2017; Hiles, 2018; Elkin and Bers, 2014). Research also claims that children will have a meaningful learning experience if they know how to work with their peers (Allen and Kelly, 2015). For example, last year, I had a child with ASD, and one of his challenging behaviours is that he constantly argues and fights with his peers, which frustrates other parents in my class. However, the cooperative lessons of the Montessori education, such as solving mathematical problems, helped him learn how to work cooperatively and respectfully with his peers. Thus, my Montessori trainer says that the concrete materials of Montessori education promote collaboration with children and help them develop their social skills. As Vygotsky (1934) defined in his semiotic mediation theory, the use of tools, symbols, and signs fosters individuals' interaction to engage in their community freely.

Jones (2017) highlights that the hands-on learning activities of Montessori education develop the child's fine motor skills; for instance, when a child works on the Montessori Knob Cylinders, the materials will help build the child's pencil grip. My Montessori training taught me the Montessori Knob Cylinders' other purpose: it develops the child's concentration, hand-eye coordination, and visual perception of dimension. Lillard (2007) also indicates that manipulating concrete materials improves children's critical, logical, analytical, and problem-solving thinking skills. For example, children use their logical, analytical, and problem-solving skills to solve Montessori maps and animal puzzle games.

These unique characteristics of Montessori education are essential for developing the child's solid foundation. Children with a solid foundation will know how to face the challenges that come in their lives. For example, if a building has a solid foundation, that building does not easily fall or be destroyed by a strong storm.

Remote learning

COVID-19's resurgence, combined with rapid technological advancement, has disrupted and redefined numerous aspects of life—education being one of them. Remote learning, by definition, is a method of instruction in which the learner and the instructor, or source of knowledge, are not present physically, in contrast to the traditional interactive educational instructional approach (Hodges et al., 2020). Information is supported and communicated through technology, such as discussion boards, video conferencing, and online examinations. Remote learning can be simultaneous, involving genuine peer-to-peer collaboration and interaction, or async, involving self-paced educational activities that do not require the presence of an instructor (Saichaie, 2020)

Unlike its close relative, learning, which is a more founded and official mode of online learning, remote learning involves instructors and students unfamiliar with the various online learning methods (Saichaie, 2020). It is typically used when unusual events occur in a society that disrupts the regular learning routine, such as scheduling conflicts, illnesses or as is the case today, natural disasters. As a result, both instructors and students may find remote learning challenging due to its novelty. Distant learning is generally organized as follows: the instructor creates a virtual connection with their students via a feasible virtual learning environment such as Google Classroom, Zoom, Webex, or even Khan Academy. The teacher uses this space to carry out various modes of teaching, including publishing assignments, allocating reading, collecting student work, and providing feedback. On their end, students log into the virtual home base daily for a specified amount of time to complete homework, listen to lectures, or participate in activities (Carter Jr et al., 2020). The success of distance learning depends on having a virtual home base.

As per the UNESCO report, more than 350 million school-going children were affected by the disruptions in their education caused by the novel COVID-19 (UNESCO, 2021). This disruption happened in virtually every part of the world and caused a great migration for most educators and students from in-person teaching and learning to a remote model. Something that many educators and students found exceptionally difficult to pivot to in the short space of time afforded to them to change. At its best, remote learning should be something educational authorities can transform on and off as considered necessary; regrettably, the potency of the transition to virtual learning is contingent upon preparedness, innovative methods, and a comprehensive student aid facility (Carter et al., 2020). It is distinct from online classrooms and virtual classroom programs, which frequently abide by an official framework for establishing an education system, incorporating an online syllabus, and instituting a devoted organization to maintain enrolled students. eLearning is a term that refers to a method of accessing educational content outside of the traditional classroom setting via electronic technologies (Marshall et al., 2020).

Through remote learning, learners and staff can retain access and be involved with the study area while continuing to work from their residences. Prospects for remote education are commonly related to crises that jeopardize student safety. Making the transition to remote education can help students stay on track so that when they return to traditional school settings, they won't have to do as much catch-up work to be ready for any scheduled tests. Many of the same standards that apply in traditional classrooms will use in remote learning environments to adhere to as many state and municipal regulations as feasible (Marshall et al., 2020). Notably, in remote learning environments, as opposed to virtual learning environments, the learner and

teacher aren't used to being separated during class. This fact may provide a problem for both the teacher and the student, but it can be overcome with the help of specific support systems.

There exist quite a several differences between remote learning and in-class learning. Online and face to face learning are similar in their core mandate that primarily entails passing down knowledge to learners (Hodges et al., 2020). However, in their similarity, many differences are traceable in their strategy, organization, means, and instruction, among other pertinent components. Notably, the learning environment is the main overriding difference between these two learning modes. Unlike their on-campus counterparts, e-learning is primarily non-simultaneous, which means that students (and instructors) decide when they will engage and take part in their online classes. For instance, in traditional in-class learning, lesson instructors (teachers) always plan their teaching schedules and structure them according to the timetables. With well-planned teaching schedules, both the student and the instructors become more disciplined and object-oriented in their approach to learning ((Hodges et al., 2020). The in-class lesson also occurs in a group setting where the students may spit out helpful discussions, resulting in more involvement and interactions among the learners and the teachers.

Planning an online lesson, on the contrary, is somewhat more spontaneous when compared to in-class learning. In an online setting, learners may decide whether or not to attend a particular class session given the leeway on their side given that they learn on an online platform (Tho and Yeung, 2016). In this case, there is no physical appearance as in the face to face learning environment. In addition, learners may opt to attend the course on their own time in cases where such an arrangement is a part of the learning schedule. One may describe it as attending a course whenever curiosity strikes; otherwise, a learner may decide to sleep and skip a morning course. In some instances, the instructor posts the content online where learners can

access them at their volition, this kind of setting results in laziness from both the teachers and the students (Victoria, 2020).

Another critical difference between online and face to face learning is the type of learning content used. Face to face learning often employs the usage of traditional textbooks, traditional modes of demonstrations and illustrations, and lecture notes. The use of these instructional materials is contingent on much research that has been done that ascertained their importance and usefulness in achieving high learning rates and performance. Before a course begins, learners are instructed on the hard copy materials. Upon acquisition (through purchase or renting), the instructors actively engage the learners in using the hard copy reference materials in learning the various topics. Remote learning, on the hand, encourages the use of digital modes, including e-books, digital discussion forums, virtual announcements, and others, in a manner that fosters interaction between instructors and learners. With traditional in-class learning, instructors set the pace of learning while the students, on the other hand, learn passively. As a result, the students either have limited or no opportunity to relearn some concepts that might not have been clear during the in-class teaching. The best they have is extra hours to consult teaching assistants to inquire about some ideas and instructions that may not have been adequately captured (Stafford, 2020). In both strategies, the objective is to ensure significant value addition in learning. While face to face leverages the power of interactive time, remote learning, on the other hand, capitalizes on advanced technology to bridge the gap and work out a way to ensure that there is a near-perfect state of interaction and learning throughout the entire period.

Additionally, in-class learning allows the instructors to provide assessment tests based on the amount of content that has been delivered to the learners. The assessments are primarily found in class and closely monitored by the instructor to ensure competencies and honesty.

Reviews in online learning, on the contrary, can be said to be somewhat flexible because they do feature frequent knowledge checks and shorts assessments to gauge the learners. In addition, sequentially timed examinations, most examinations have flexible timelines and are not as strictly supervised (Stafford, 2020). Moreover, for face to face learning, the assessments are easy to administer because instructors can easily trace any anomaly in the undertaking of an exam- something that can only be achieved to a limited extent when learning remotely. Sometimes, learning remotely can be encapsulated by writing exams remotely, under some strict examination guidelines. However, there are cases when students may be required to register for examinations from a central place to ensure excellent ease of supervision and following up.

Numerous learning exercises and teaching materials in distance education require a range of communication skill sets, including reading the written text, consuming sound and video material, and communicating with others via various communication techniques. This necessity for good communication, as realized through multiple communication modes, distinguishes remote learning from its face to face counterpart, which emphasizes classroom teaching and conversation learning exercises. Therefore, it is necessary to note that the advantage of keeping variously conveyed core curricula is that students can read, perceive, and review course materials consistently. As a result, students' performance on classwork and learning aims improves.

Students enrolled in a face to face course can typically anticipate receiving thoughts and input about their effective learning daily. Students rely more on their instructor's enablement, assignment explanation, and feedback in adaptive online courses that are not undertaken face to face. There are numerous time-saving strategies for providing frequent and relevant feedback utilizing documented and interactive media techniques (Brown, 2019).

For both teachers and students, remote learning demands digital literacy and netiquette. To administer an online course, one wouldn't need to be an expert in computer programming languages or coding. On the other hand, educators should be relaxed with a learning system and essential computing software such as electronic mail, Apps, and publisher software (such as Word) and try to diagnose fundamental design problems with students. This knowledge and skill are essential in maneuvering the digital platforms to ensure construction work is going on in learning the various concepts. However, face to face learning does not necessarily require tutors to be thoroughly furnished on technology matters. In virtually every institution, there always is a laid-out support system that ensures that instructors and students, given the need, have much ease in traversing the online portal for anything that needs to be done and accomplished.

One of the main differences between the normative learning approach, for example, face to face and remote learning, is the level of real-time interaction between the instructor and learners. Remarkably, this difference is also a limitation because, at the various levels of learning, there is always a great need for interaction when hands-on learning is required, especially at the lower level of learning and science students. When remote learning was adopted in the thick of COVID-19, a number of instructors who taught their students in the field plunged into an uncharted territory-facing an unprecedented challenge. Most instructors accustomed to instructing their students on hands-on skills such as environmental studies, surgery, engineering, and others opted to go into recess until it was practically possible to resume the classes (McQuate, 2020). This pointed to the difficulty in integrating experiential learning into the remote learning approach. However, some instructors readjusted to face a new reality. Some opted to make tutorials, while others used the allotted time for designing demonstrations for their lessons, among other things. In as much as some instructors tried fitting hands-on learning into

the remote learning approach, the concerted effort has been one of the most significant hurdles to overcome in the new learning landscape (McQuate, 2020).

Challenges during remote learning.

The effects of the novel coronavirus of 2019 (COVID-19) have permeated various strata of society, one of which is education. The World Health Organization (WHO) declared COVID-19 a global pandemic on March 11, 2020, according to (Armstrong-Mensah et al., 2020, p. 1). Chang et al. (2021) describe COVID-19 as a "highly infectious disease that has a great impact not only on health but also violates economics and social activities global wide" (p. 2)

Armstrong-Mensah et al. (2020) define online learning as a "form of education where there is a physical separation of teachers from students during the instruction and learning process" (p. 2). This learning model is mainly conducted by applying communication technologies and internet service (Samat et al., 2020, p. 221). However, research indicates that shifting from face-to-face learning to online learning was challenging for some educators, students, parents, caregivers, and especially Montessori teachers who teach young children (Murray et al., 2021).

Research highlights that insufficient administration support for technology use is one of the significant problems Montessori teachers experienced teaching young children online during the COVID-19 pandemic. Murray et al. (2021) support this claim stating that "teachers were primarily responsible for designing the distance-learning arrangements for their students, with most teachers relying on live videoconference experiences without substantial support from school administration" (p. 6). In my opinion, this motivates Montessori teachers to have different views on teaching young children online. For example, Jones (2017) indicates that Montessori teachers who are not inclined with technology use in the Montessori curriculum believe that

technology negatively impacts the children's learning process. Thus, MacDonald (2015) highlights that "Montessori education ignores anything with a screen or a keyboard" (p. 101). Furthermore, Murray et al. (2021) reveal that Montessori teachers believe online learning created obstacles to Montessori education; for instance, online learning focuses more on communicating with parents than academic collaboration. Unfortunately, research clearly states that it is hard to change teachers' beliefs and practices, which sometimes is the cause of the interruption of the children's learning development (Murray, 2011). I think that if teachers are willing to accept change in their practices and beliefs every obstacle in their career, they will know how to face them. Research shows that people who are eager to make a change in their lives are always flexible to work with their peers. I also think that accepting change (in this case, integrating remote learning into Montessori's normative philosophy) in people's lives benefits the society they belong to. Montessori teachers are more conservative in adopting technology as part of their instructional approach. Courtesy of their training, these teachers have their school culture heavily built on interactive learning. Moreover, the syllabus used to instruct the young students in Montessori does not incorporate EdTech. Despite having a lot of issues such as a sheer lack of training, among other things, the main factor in forming the beliefs and practises in the case of Montessori teachers is the raison detre of the system-aimed primarily at churning out students with a more pragmatic and yet robust approach to solving societal issues (Ryu, 2020). There is a limited chance for technology to be incorporated from a pragmatic perspective, yet it is almost impossible to eschew technological advancements in the current learning paradigm. This conservative nature of these teachers has become a serious policy concern because any change- however small, can only be effected better through these teachers (who play an essential role in imparting knowledge) (Debbs et al. 2017). Thus, this attitude and mentality are to be moulded

into an adaptive one for ease of addressing the main gap of the Montessori education- using technology with the already established learning and teaching systems.

Another major problem Montessori teachers encountered teaching young children online is the lack of digital devices and internet service (Khalil et al., 2020). In addition, Mensah et al. (2020) note that an insufficient supply of technology devices and internet access is observed among minority populations (p. 2). For example, the socioeconomic status of people in the minority group caused their children not to attend their online classes because they couldn't afford to buy digital devices and internet services (Zain et al. (, 2021). Furthermore, (MacDonald and Hill, 2021) highlight that some students and their parents develop stress and anxiety when children can't attend their online classes. Additionally, Zain et al. (2021) imply that teachers were also in a stressful and anxious mode when their students missed their online learning.

Another distinct challenging situation that Montessori teachers face teaching younger children online is that children are easily distracted and less motivated (Khalil et al., 2020). As a result, teachers spend more time de-escalating students' behaviour than discussing their lessons (Zain et al., 2021). In addition, research shows that young children just want to socialize with their peers online; for instance, they want to talk and chat with their friends, which is a usual routine that they always do when they are in the classroom. Thus, online background noises, such as family conversations or pet noise, distract younger children when studying online (Zain et al., 2021). As a result, Murray et al. (2021) declared that Montessori teachers, during the online classes that happened when COVID-19 was insurgent, asked their students' parents to stay with them during their online learning, making the other teachers uncomfortable. While being odd and unlike the Montessori educational approach, going virtual in education was highly precipitated by the challenging and punitive pieces of legislation enacted across different

provinces that discouraged face-to-face learning. During this maiden term, where learning was done remotely, teachers highly utilized parents as the primary resource people in helping make learning a success. In this case, the role of teaching assistants and resource teachers was assumed by parents who, among other things, created a conducive environment for learning, ensured that there was proper logging into the platform where classes took place, helped their young kids in responding appropriately to the teachers, played a part in fostering high levels of concentration throughout the lesson.

The lack of teachers' knowledge in the digital world is one of the most formidable challenges Montessorians faced teaching young children online during the COVID-19 pandemic (Lorenza and Carter, 2021). Thus, Murray et al. (2021) claim that the insufficient knowledge of Montessori teachers in technology creates their unwillingness to teach children on an online platform. Jomezai et al. (2021) support this claim, stating that the teachers' uncomfortable online behaviour influences their attitude (p. 3). For instance, teachers will lose their confidence if they don't know what to do, resulting in their unmotivated behaviour to promote the importance of online learning (Zain et al., 2021). Kaur (2020) contends, however, that "providing necessary support and training can assist teachers in developing technologically advanced instructional methods for improving their likelihood of teaching online" (p. 27). Thus, Murray et al. (2021) suggest that school administration should be the teachers' backbone when teaching children online—for instance, conducting training and workshops on online practices that will enhance their teachers' skills. In addition, Kaur (2020) claims that teachers' knowledge is an essential aspect of children's education (p. 27).

Research also indicates that insufficient teachers' skills in technology hinder the students' learning process. For instance, there is always a lesson disruption if the teacher doesn't know

what to navigate while teaching online. Lorenza and Carter (2021) highlight that the lack of online teaching experience resulted in repetitive, dull classes. Thus, Ling and Nasri (2019) suggest that teachers should be equipped with ample knowledge and skills to keep their students engaged. As Dr. Montessori declared, when children are motivated in what they do, they keep working and working as if nobody is there (Lillard, 2007).

Jones (2017) firmly advocates for Montessori teachers to build their virtual Montessori materials to overcome the challenges of teaching young children on an online platform. MacDonald (2015) supports this claim by stating that digital devices are tools that promote safe-paced learning, just like the Montessori materials. I agree with these authors that Montessori education should develop virtual Montessori materials and allow digital devices in their curriculum to support the learning process of their students. However, I think that Montessorians can successfully build their virtual Montessori materials if they are willing to accept change in the Montessori curriculum and consistently attend technical training. As Kaur (2020) strongly suggests, "ongoing professional development provides opportunities for practical experiences of digital devices and access to the latest technology that helps teachers learn how to choose and integrate technology in their online study effectively." In addition, Homes (2013) highlights that professional development enriches teachers' skills to accurately develop and organize their online lessons, promoting an authentic curriculum that enhances students' motivation, concentration, and participation in online learning. In connection with the Montessori method of education, a teacher will also enjoy training in the Montessori practices before teaching in a Montessori environment (Lillard, 2005). Dr. Montessori believed that a fully prepared teacher with the curriculum pedagogy would have the full potential on how the program works (Montessori, 1972).

Another way that Montessori education could adapt to teach young children online is to facilitate the lesson in a metacognitive way (Herrington, 2011). Metacognitive is a teaching strategy that allows the learners to be in charge of their learning, and the teacher serves as a facilitator (Li, 2017, p. 3797). This learning theory is also practiced in Montessori education, where students have total control of their learning process. The Montessori teacher is an 'adult' that guides the learners (Montessori, 1989b). For instance, students set clear targets to meet their learning expectations, and the teachers set boundaries for the students to succeed. If this practice also happens in the online learning world, I'm confident teaching young children online is not an inconvenience.

Herrington et al. (2011) also suggest that developing a quality unit approach will ease the challenges of teaching young children online. According to these authors, "quality unit is activity-based rather than content-based, and the activities reflect real-life tasks" (p. 6). Thus, for example, students will have the opportunity to work collaboratively on products rather than individually. In addition, research reveals that activities that engage the children's collaboration develop their creativity, imagination, and concentration. This finding is also highlighted in Montessori education that manipulating concrete materials improves the child's attention, imagination, innovation, and the cooperative lessons of Montessori education, such as map puzzles, enhance children's collaboration (Lillard, 2007). For example, children work together to brainstorm ideas on how they solve the Montessori puzzle activities.

Montessorians have long opposed technology in teaching and learning, which has become increasingly common in traditional schools in recent decades. Though there hasn't been much research on Montessori instructors' attitudes toward technology, research indicates a restricted acceptance of digital learning, especially for young children. When the COVID-19

pandemic struck in the spring of 2020, several instructors had no recourse but to rely on electronic resources to keep instructing pupils while schools closed their doors and transitioned to remote learning. As per a recent survey by Murray et al. (2021, pp. 1-29), over seventy-five percent of Montessorians noted that their schools issued electronic gadgets to families for use in remote learning, while other seventy-one percent reported that they distributed packets and physical materials. Other digital tools and resources, such as FlipGrid and Khan Academy and the much older and more familiar phone call technology, were used to promote learning. Murray et al. (2021, pp. 1-29) say that the children's time was roughly split between screen-based activities like Zoom meetings and online activities and hands-on activities like practical life exercises. Almost half of the survey participants said they supplied digital versions of Montessori products for children to manipulate via apps or websites, and roughly a third said they used electronic resources like Natural Geographic movies to help children connect with nature because the pandemic brought with it a limitation in terms of physical interactions. These limitations could also result from any occasion that may not warrant physical interaction in the near future—as such, utilizing the digital technology and such spaces will become expedient if learning is to be optimally done. Technology was also employed to aid remote observation; 40% saw students working through videoconference, while 65% relied on parent-reported data, including narrative and images.

The resurgence of COVID-19 prompted Montessori educators to re-evaluate their use of technology with their students. With little insight from school administration, Montessori teachers devised remote learning provisions that adjusted digital as well as hands-on activities for students (Murray et al., 2021, pp. 1-29). At both the childhood education and primary school levels, most Montessori teachers used live teleconferencing with their students as part of their

distance-learning strategies. The early childhood team depended heavily on support from parents, which included providing educational materials instead of Montessori hands-on learning methods, making preparations for classes, and getting ready for teleconferencing contact with peers, provided that The Montessori logic design of learning outlines the resources required for Montessori education, the suitable efforts of kids in Montessori classrooms, and the intended results. Notably, parental and care provider involvement was limited but remained substantial at the elementary level while providing teaching aids instead of Montessori hands-on instructional strategies and lesson planning remained prevalent. Offering technological tools was a lot more critical at the primary school level.

Challenges with teaching Montessori online: a rethinking of learning in relationship

Montessori education is renowned for its comprehensive and integrated approach to education; children develop a sense of skill as they socialize with artifacts and progress through the Montessori syllabus. The transition to remote learning (facilitated by technology) was significantly constricting in scope. Montessori educators, who have historically favoured a hands-on approach and sparing use of technology (MacDonald, 2016), must devise new strategies for engaging children in e-Learning.

Some of the challenges highlighted by Scott and Myers (2021) as having been experienced among teachers in instructing their students who were learning remotely included: a lack of accountability among students. According to the Montessori teachers, student frustration stemmed from students failing to turn in their work or engaging in activities such as playing video games during class breaks (when they should be completing independent assignments). According to the authors, teachers said it was often obvious when children received support at

home to help them with personal accountability. Generally, remote learning lessened the students' ability to develop a sheer sense of personal accountability (an integral part of Montessori education). As observed in the various manners in which students responded or even failed to, this predicament revealed the challenge arising from the use of remote learning to maintain the Montessori education's status quo.

Additionally, Scott and Myers (2021) emphasize the detrimental effect of the students' surroundings on their learning. Instructors in an online education system have no control over what is seen on camera. Because students' home lives and school days were inextricably linked, their educational regulations and concepts were also. Families must juggle work, family life, and their children's education simultaneously. Teachers stated that they attempted to remain aware of the situation to determine the most effective method of communication with the students. Among other things, the instructors discussed the difficulties and issues associated with supporting children that would be acknowledged separately in an in-class set - up. For example, teachers expressed concern about acknowledging frustration in all pupils in a virtual setting; it was difficult to tell when children were upset on the computer. Additionally, the interruptions children face at home, such as computer video games throughout recess, posed additional challenges for teachers as they tried to engage students in their work. Ultimately, more time was required to help parents with educational, interpersonal, and psychological issues than would typically be required in a classroom setting. Finally, teachers encountered a slew of difficulties as they transitioned to remote learning amid COVID-19 as the new normal. These obstacles posed a slew of action points that would undoubtedly reframe the Montessori educational DNA. This chapter puts much effort into labouring to give an intuitive background to Montessori education. The chapter has presented this education system's inception, development, and

fundamentals. Moreover, more details have been divulged on the focussed context of this system and the challenges that Montessori teachers recently encountered in the wake of COVID-19. The challenges were much about the transition to the virtual learning platforms and the intricacies of such systems. With this in view, the next chapter presents the proposed approach to addressing this problem faced by these teachers. Finally, chapter 3 presents the designed-based research methodology as a viable approach to addressing this strategic inflection.

CHAPTER 3: METHODOLOGY

Introduction

This chapter describes the methodological application used to model the professional development workshop (Pro-D Workshop). The model employed in this research is the Design-Based Research (DBR).

Definitions and background

Inside the overarching framework of design-based research (Scott et al., 2020; Lo et al., 2021), this chapter will elaborate on a research project that focused on evaluating the possibility of incorporating hands-on learning among Montessori teachers for the remote learning program: The previous chapter showed evidence from current research that Montessori teachers feel ill-equipped to teach young children online in the Montessori method (Marshall et al., 2020). Given the rapid changes occurring in society and coupled with the insights gained during the COVID-19 insurgence that significantly shifted the learning paradigm, this chapter will focus on the design of a professional development workshop is designed to provide Montessori teachers with the best competencies and insight into how to best teach online (while combining normative and newly acquired remote (wholesome) learning techniques).

Professional development implies a set of instruments, infrastructure, and pieces of training that instructors use to improve their teaching quality (Zohar, 2012). These resources assist instructors in broadening their content knowledge while also providing direction and prospects to experiment with new teaching techniques (Hunzicker, 2011). Workshops and leadership pieces of training assist participants in developing and honing specific skills such as specialized numerical methods and analytic abilities. Professional development for instructors

entails honing and refining their abilities to meet better their students' needs (Hunzicker, 2011). Professional development methods are case studies analysis, consultation and coaching, mentorship, and technical support. According to Antley (2020), professional development is intended to allow professionals to acquire and apply new skills that will benefit them in their jobs and enhance their skills.

Professional development is all about perfecting one's craft and broadening one's knowledge base in one's chosen field. Co-operation and assessment occur here for instructors to improve the outcomes of their students. A properly modelled professional development (PD) program helps teachers expand and perfect their content knowledge and teaching skills (Hunzicker, 2011; Dede, 2006). This paper employs a design-based research methodology to address the problem statement in this research paper, given its ability to leverage its iterative designs to develop knowledge for adaptive learning in the online teaching landscapes. DBR could thus provide the ideal vehicle to design a workshop that could be implemented in the future. However, before the workshop can be developed, I would first like to discuss DBR research in general and then show which part of the DBR "cycle" this study followed in its methodology.

Design-based Research

A thorough process involving design-based research is used to model a Professional development workshop. As such, it is necessary for this chapter to consider the conceptual model of design-based research to gain a better idea of what it takes to develop a viable framework. Design-based research (DBR) is a methodological approach that aligns with engineering or applied physics research methodologies that focus on product development for specific purposes.

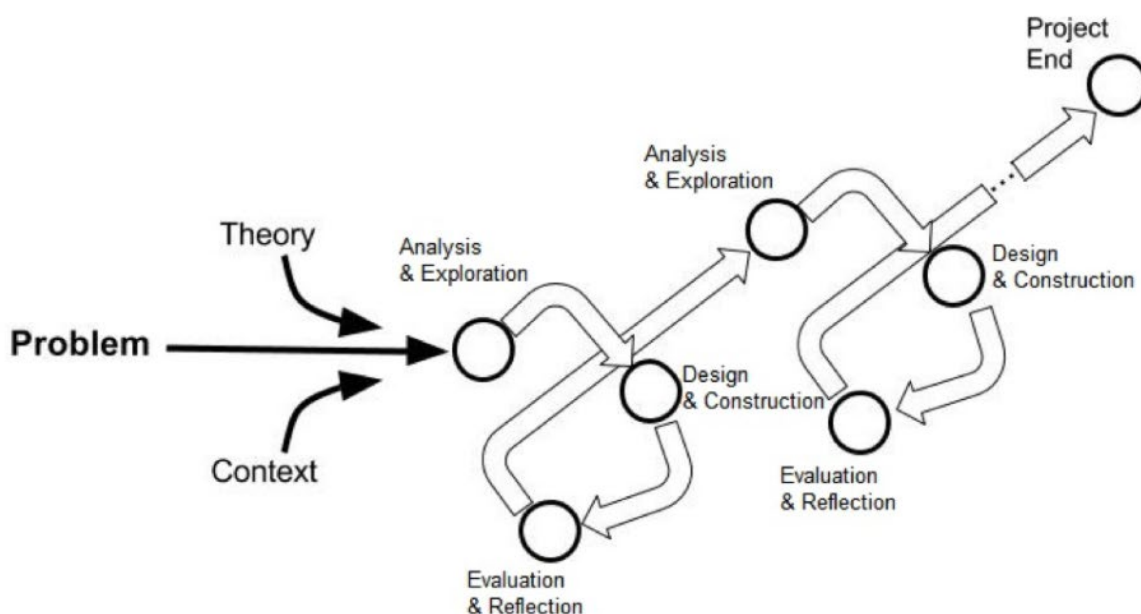
However, more recently, DBR has been the preferred design for educational research because it resolved the need created by the sudden realization that academic research has historically failed to improve classroom practices. (2011) (Reimann). Design-based researchers approach the educational inquiry in the same way that engineers do when developing a new product: The researchers begin by identifying a problem that needs to be solved, such as a specific learning issue that students face (in this case, using Montessori methods to teach younger children via remote learning); then, as in the case of Reiser et al., (2001), they build a potential "solution" to the problem in the form of teaching material that utilizes reasoning processes that the specific theory and previous research indicate will address the issue. This study aims to design a workshop that could be used to train teachers on how to use the Montessori method for remote learning with young children.

The next step involves researchers putting the educational tools to the test in a real-world context like the classroom (learning environment) to evaluate their impact on whether or not the intervention improves student learning (this will be a "next step" of the research proposal, but not implemented in this study. According to Collins et al. (2004), as testing proceeds, authors investigate instructional resources based on new information about their efficacy (or lack thereof) and make necessary real-time revisions. Finally, the researchers analyze the experiment's results, noting which aspects of the educational materials helped overcome the initial learning problem, revising those that were not, and establishing how the investigation informed the experiment's theory.

This step leads to a new research cycle of designing, testing, assessing, and reflecting on instructional materials to improve student learning. Figure 1 depicts the iterative process, which

has been modelled following Sandoval's (2014) proposed design. Although the processes in the various phases are described as being independent, there is often overlapping in the processes.

Figure 1 A diagram depicting the Design-based Research process (Scott et al., 2020)



DBR relies heavily on analysis, which must be applied throughout the cycle. Therefore, it is vital to recognize and determine which issue will be tackled at the outset of a DBR initiative.

Researchers aim to comprehend all facets of a topic in partnership with stakeholders. As per Msonde and Van Aalst (2017), they also look for and gain from the manner in which others have approached and solved comparable situations." This analysis aids in determining the context in which treatment should be carried out. In this study, much focus has been on analyzing (from the current research) what is needed to support teachers to teach Montessori remotely. The study thus addresses the first "cycle" of the analysis process up to the workshop's design. As this is a knowledge translation project only, implementation of the workshop will be reserved for future

research, which would then pick up on another cycle of analysis based on feedback from workshop attendees.

Personal experience has proved that theories cannot account for the variables that are present in any learning setting, and further investigation is required. When putting together an intervention, DBR researchers can use a variety of disciplines and approaches. The setting and objective of this research should guide the methodology selection process, which I followed when I investigated current literature on the topic, as exemplified in chapter two of this study. At the formative stages of the DBR process, the developers usually consider the project's audience, topic, and scope. The audience identifies the intended stakeholders, such as learners and others, including the respective parents or the community, as I have done for the Montessori teachers instructing young children. The team specifies the exact person engaged actively in the designing of the product in addition to spelling out the reasons for such a person(s) involvement in the designing work. The subject defines the primary issue that the product should resolve and how it arose. The scope defines the project's constraints and scale. These concerns are typically addressed in a concept design. The next stage entails understanding all the components of the entire process. There is a thorough study of the subjects (like the selected Montessori teachers), the various contexts, and the most viable solutions during this phase. The designer (in this case, me) focuses on the issue using scientific evidence and secondary sources at this stage of the process and reconstructs that understanding to be easily replicated later in the process. Strategies such as observation, conducting interviews, questionnaires, and data analytics, among other things, are typical examples of the empirical methods that get utilized in work. A secondary source review provides an overview of previous studies that help recognize the issue, like learning models and contextual factors, understanding existing solutions to comparable

problems, and identifying the design guidelines. Techniques such as theme identification, building graphical representations, and developing learner monikers are utilized in constructing empirical data and research literature (Easterday, 2014).

The next phase entails defining two essential aspects of the model design: the objectives that have been set in addition to the analysis criteria. Definition, in this case, entails transforming an undefined issue without a remedy into a determinate one with a viable solution Puntambekar (2018).

DBR entails conceptual design, modelling, and testing (to validate). Conception entails sketching out a solution. Developers have a range of tools for planning, sketching, and modelling designs. These tools enable them to compare their designs to their comprehension and concept, identifying issues and proposing improved solutions before dedicating to implementation in a particular medium, which can be difficult, expensive, or time-consuming. Whenever a concept has been conceived, it can be implemented in a usable form by the developer. This execution can be of lower or higher adherence contingent upon that project's stage, and the concern that the designer wants to test, which could be about a specific aspect of the educational intervention like, in this case incorporating hands-on learning by Montessori teachers to remote learning just in case they need to switch into remote learning arises (as was prompted by COVID-19) (Sandoval, 2014).

During the last stages of an adequately organized DBR, designers assess the solution's effectiveness during the testing phase. Iterative usability evaluation entails putting the design through successive (often parallel) iterations with increasing accuracy. Evaluating the initiatives taken during the conception stage is typically focused on their significance and predictability, followed by their expected pragmatism, which is verified through expert reviews and tutorials.

Later testing on prototypes constructed during the build phase concentrates on their exact practicability and potency through one-on-one, small group, field trials, and their varieties (Tessmer, 2013). From a more objective position, this paper does not perform this last phase of the DBR model that will be designed because it is only meant to mirror an exact DBR in design and scope but not on the eventuality.

As per Anderson and Shattuck (2012), there are no explicit constraints for the shape instructional tools must take or how they must be evaluated in design-based research. Instead, the design-based research has "epistemic commitments" that inform the fundamental goals of a design-based research project as well as how it is performed, according to Sandoval (2014). Design-based research should be founded on learning theories like constructivism, expertise, and conceptual development that guide and assist in implementing instructional aids. DBR advocates say educational research is frequently divorced from practice (Armstrong and Welsh, 2020). At least two issues develop due to this detachment: Firstly, these advocates maintain that researchers' work does not provide aid to practitioners, and secondly, study findings may be erroneous since they do not account for context (Armstrong and Welsh, 2020). The last and yet critical phase of DBR is the assessment bit. Scholars can assess their designs both before and after they are implemented. Each iteration of the cyclical process is evaluated carefully and continuously to improve. While exams and quizzes are standard methods of assessing educational achievement, interviews and observations are also important since they provide a more profound knowledge of how teachers and students perceive the learning situation. This paper considers the five phases of DBR without necessarily going into the experimentation bit of it. These phases include analysis and exploration in addition to design and construction. It stresses more the design than the evaluation and reflection that involves human subjects.

The planning phase of a Professional- Development Program

A professional development program based on design-based research outlines every detail of the workshop's planning. This level of planning prepares both the trainers and trainees psychologically so that the developed expectations can easily fit into the jigsaw of the more significant concern; thus, everyone develops via learning. Productive workshops that appear to flow naturally result from considerable planning by leaders. Everyone involved has a clear grasp of the program and its objectives and realistic planning for how long session activities will take (Tessmer, 2013).

Practicality in DBR in Education

It should be emphasized that teaching experience is not the same as knowledge. Teaching acts must be reflective in order to gain knowledge. An experience creates knowledge through reflected action. Dewey emphasized that experience encompasses the entirety of human potential and that the world as we perceive it is the actual reality (Miettinen, 2000). For example, a "self-educated" unqualified instructor and a science education researcher would almost certainly characterize and justify their teaching differently (UNESCO, 2021). Their teaching and learning experiences, on the other hand, are as genuine. Different rationales are explained by differences in their backgrounds, perspectives, or intentions. Prudence is a philosophical paradigm that was developed to address the thought problem: how can our ethereal mind gain knowledge of the physical realm? Peirce, James, and Dewey were classical pragmatists who challenged the correspondence theory of truth and the conception of knowledge as representation; particularly, Dewey focused on knowledge and its acquisition within the concept of action (Miettinen, 2000).

Dewey distinguished various patterns of awareness that give reality to all aspects of human behaviour (Sense, 2008). Cognitive (understanding), practical, ethical, artistic, and religious experiences are examples of these experiences. The cognitive model of experience encourages action, and knowledge enables a teacher to better manage his or her activities, resulting in more understandable instruction. As a result, science education research aims to assist instructors, like in this case, Montessori teachers, in acting more clearly in the science classroom. The physical manipulation of artifacts actuates this action.

On the other hand, the pragmatic viewpoint does not presume that there is just one real universe that can be discovered by scientific investigation. Pragmatists criticize the correspondence theory of truth. Every parallelism of a belief to reality may only be the reality under a specific description, which is neither ontologically nor philosophically privileged. This idea means that the veracity of researchers' claims is strongly contingent on the environment in which they are made. The concept of comprehension helps pragmatism avoid the traps of solipsism, subjectivity, and relativistic truth. In the shared universe, humans have comparable experiences. A science teacher produces knowledge about scientific education on an individual level, then co-reconstructs it in social practices with the help of other teachers and researchers (Ryu, 2020; De Villiers and Harpur, 2013).

Features of DBR

This section outlines three characteristics of design-based research: Firstly, a DBR process is iterative. Secondly, it aims to create an artifact that will assist teachers and learners in acting more intelligibly (in a way that leads to learning); thirdly, DBR generates novel knowledge about science teaching and learning. As such, DBR is an embodiment of these three

characteristics. A design-based research project in the field of science education begins with the recognition of a problem (for example, educational policy decisions to be adopted or research findings recommend changes in science teaching and learning): In such situations, neither researchers nor teachers are sure what to do (Ørngreen, 2015). Within the context of the professional development workshop that I look forward to building for the Montessori teachers, these three features embody the exact technique that I intend to use. These features form the fundamental framework upon which the solution to the Montessori teachers' problem will be handled.

The first step is to look for answers in the research. Theoretical problem analysis is the name for this stage of design-based research. Nonetheless, it is sometimes impossible to explain models of learners' conceptions and learn or communicate teachers' worlds of teaching and learning. Without new research, designers only have a rudimentary strategy for dealing with the challenge at first. Use creative problem-solving methods to generate these tentative strategies, such as positive and nonjudgmental reviews and recognition of all ideologies, the authority to ask productive concerns about a notion, and the ability to combine and redefine ideas in such a way that the tenuous approach is a mixture of several ideas (Ørngreen, 2015).

The most crucial point to remember is that before planning, designers must accept that the approach is uncertain and that they must be willing to change it completely. This point emphasizes the importance of iterative design and testing phases in achieving dynamic equilibrium. The design process principles assist a designer in developing their unique design approach. To assist teachers in teaching more cogently, the invention should be (figuratively speaking) in the zone of proximal development of teachers' learning strategies. Design is based on designers' preliminary understanding of the situation and assessment study results. Designers

seek to manage discovered demands and determine objectives to refine the piece after testing during these testing phases. The critical point is how the evaluation is structured (Easterday, 2014; Benavides and Van Landeghem, 2015).

As a result, the design-based research process is abductive and employs practical reasoning. A researcher and a teacher are both aware of situation A. The reflection focuses on "guessing" what action B in environment C caused situation A. Suppose instructors' (and researchers') objective was to design a condition A. After reflection (and after data analysis and literature review), they genuinely think that intervention B will create scenario P'. In that case, the design team will implement modifications C to the artifact that they believe will help them achieve action B. People have an "instinct for the truth: the human mind is akin to the truth because it will light upon the correct hypothesis in a finite number of guesses," according to Peirce (Juuti et al., 2021).

Modelling a DBR involves coming up with an artifact that becomes the subject of the research design. From a practical standpoint, the designed artifact's role is to assist a teacher in acting more intelligently. This necessitates the teacher's cognitively active role. The learning environment is ultimately created by the teacher's actions in the classroom. As a result, every designed artifact has intrinsic immaterial and undetermined aspects that constitute a classroom action and can be addressed only through the teacher's thinking. Every teaching aid is 'personalized' by the teacher. To use it successfully, a teacher must understand and agree with the artifact on some level (Fahd et al., 2021).

The presence and nature of an artifact distinguish design-based research from other types of research, such as action research. Practitioners develop their actions in action research, and the study results in a new approach. The goal is not that artifact but that others would adopt a novel

method of acting. One of the essential criteria of design-based research is creating a widely usable artifact (Alghamdi and Li, 2013). Furthermore, it is impossible to construct a "flawless" or "totally correct" artifact because targeted recipients do not share the same competence and intention in a topic as designers. The position is that the artifact should be appropriate for teachers' current ability, ideologies, aspirations, and perceptions toward the concepts given by the artifact. At the same time, an artifact should assist teachers in teaching more intelligently. It is a big task for scholars to construct an artifact in the proximal development zone of teachers' instructional strategies.

According to the pragmatist, knowledge can be gained through action, and without knowledge, actions are guided by habits. Context helps to make actions understandable. The challenge is to abstract teachers' experiences gained from actions so that fellow DBR scholars and teachers outside of the project can understand and share the designed world (Ryu, 2020).

Using a DBR to guide the design of a workshop for Montessori teachers

Inside the overarching framework of design-based research (Scott et al., 2020; Lo et al., 2021), this section elaborates on a research project that focused on evaluating the possibility of incorporating hands-on learning among Montessori teachers for the remote learning program: Given the rapid changes occurring in society and coupled with the insights gained during the COVID-19 insurgence that significantly shifted the learning paradigm. This Professional Development workshop is designed to provide Montessori teachers with the best competencies and insight into how to teach best online (while combining normative and newly acquired remote (wholesome) learning techniques). The following two steps outline the formative design steps of this customized DBR for the Pro-D workshop for Montessori teachers.

The focus of the workshop

This workshop is meant for Montessori teachers who have been confronted by new situations that have disrupted conventional teaching methodologies. These teachers are the primary target of the upcoming Pro-D workshop largely because of the important position they hold in the Montessori education's DNA. The DBR is also meant for two other key stakeholders (learners and parents). From an objective position, these three primary stakeholders are to be actively involved in remote learning, which requires a multi-dimensional approach to ensuring a smooth transition into learning. This workshop's main topic of the workshop will be Integrating Hands-on learning into remote learning in the Montessori education system. to reiterate the problem of having hands-on learning artifacts that came about during the insurgence of COVID-19. Since its establishment, the Montessori education system has thrived in its wholesome approach to imparting knowledge. With this being a pivotal aspect of this system, the disruption caused by COVID-19 threatened this very important aspect of this system. At its best, the newly embraced remote learning provided room only for a theoretical bit of learning. As such, the Montessori system of education was under a threat of losing its identity, which was woven into hands-on learning. This potential damage has to be mitigated well if the system maintains its status quo.

At the end of the workshop, it is expected that the teachers, learners, as well as respective parents should be adequately empowered to swiftly transition into the remote learning environment with proper integration of all the traditionally established paradigms that include hands-on learning. All the necessary tools for incorporating hand-on learning will be

exhaustively discussed through and through to ensure that whatever is viable is adopted and incorporated into the system.

Understanding the problem and contextualizing solutions

Through the majority of studies, Brinson (2015) reports that student learning result achievement is equal to or higher in Non-traditional learning (NTL), which incorporates remote learning versus traditional learning (TL) comprising of the normative face-face learning across all learning outcome categories (comprehension, reasoning skills, technical knowledge, interpretation, reasoning abilities, and scientific and social interaction). Moreover, Anderson and Hira (2020) investigated the manner in which elementary school teachers responded to the new situation brought about by COVID-19. The target audience was those teachers who were used to traditional learning techniques. The authors conducted interviews with about seven primary school teachers and used the information to create iterative centred standards to help comprehend the manner in which the teachers coped with the challenges of integrating technology into the classroom (remote learning), the types of resources that they needed, and how they considered their roles as well as their perception and opinions on the new students' learning environment. Educators are facing the challenge of replacing brick-and-mortar schools by generating new assignments and engaging with learners as well as parents via different platforms. They're learning how to leverage techniques to develop relevant, socially distant learning experiences, blurring their work-life boundaries in the process.

Because important components of the normative approach were not readily convertible to this new and hurriedly developed format, the shift to remote learning induced by COVID-19 in the spring of 2020 was highly problematic for Montessori educators and students. When children

learned from home, it was challenging to replicate hands-on learning using Montessori materials and learn in a community and rigorous teacher supervision (Murray et al., 2021). According to these authors, Montessori distance-learning arrangements combined live teleconference experiences for children with offline hands-on activities while also relying on the engagement of parents and caregivers. Teachers said they generally planned active learning independently, with little help or direction from administrators. Nonetheless, teachers claimed they could only uphold Montessori principles to a minor degree under the conditions. Admittedly, there still exists a trade-off between Montessori principles and remote learning in a way that exists a conflict in trying to transition while keeping these principles in view. The big question that arises thus is, can we leverage the best available materials to come up with the best system of optimally passing knowledge while maintaining the status quo?

Tho and Yeung (2016) investigated how students can learn science in a more technologically improved way through a remote lab. The study employed a blended methodological approach that comprised a survey questionnaire, open-ended questions, and interviews that were primarily devised expressly to gather information on students' opinions, perspectives, and implementation challenges linked to the use of the remote learning system. From the findings, it is proper to note that the participants were reported to express a belief that the different educational qualities of the remote learning system and the methods for conducting such unique tests were acceptable.

The model in this study is highly centred on the study findings on transitioning to remote learning. Through the workshop, I intend to demonstrate that one does not have to be in the same room as the teacher to participate in hands-on learning. It is very much possible for instructors to prepare the learners to "play along" with the activity from the comfort of their homes. Students

can, for instance, acquire hands-on experience with science by collecting rock or soil samples. They can show these samples to the class via webcam and discuss how rocks and soils are classified. In a virtual world, thinking hands-on requires only a small shift in mindset because hands-on does not have to mean face-to-face! For instance, in Earth Science 5th grade, we are working on desert studies, which is a significant lab assignment. Desertification is the study of the impact of sand dunes intruding on a settlement and the various remedial actions that can be taken to assist in avoiding the destruction. In addition, we investigate the consequences of removing plants and trees in our own backyards and what happens to erosion. Signing up for different variables or even being data collectors on the board allows students to participate in many aspects of the experiment. Learners construct a clay city with specific measurement specifications and then sign up to perform various protection strategies such as fences, plant hurdles, and even an oil spray (such as PAM) to discover which works best. We also put the control technique – no protection – to the test. A hairdryer generates the wind while their school donates the clay and sand. Students then take turns displaying their protection strategy (the variable) on the webcam, with another student serving as our official timer to ensure that everything runs well.

Moreover, it also is proper to note that parents might handle things and replicate what the teacher is doing on the camera to keep their children engaged. Parents can also print presentations, such as those used to build 3-D forms and cut them out or colour them so that their children understand how to compute surface area.

Summarily, the world is moving at a very fast-paced courtesy of technology. Technology has disrupted virtually every aspect of society. As one of the primary tenets of society, education has also been seriously disrupted. Education schools whose philosophical underpinning has been

hinged on face-to-face learning may find it hard to cope or even get crowded out of the competitive and disruptive learning landscape. When transitioning to remote learning, all the stakeholders, especially learners and parents, can ensure that a home learning room is adequately organized with bins for supplies and resources. Whenever a science lab is approaching, preparing a box with the necessities ahead of time is proper.

Chapter three has presented the approach for mitigating the challenge faced by Montessori teachers who are intentionally instructing young children. The chapter has presented a design-based approach as the most viable for informing the professional development workshop for Montessori teachers. All the necessary phases of the entire planning process have been discussed and in addition to the potential challenges. Having laid the foundation for the much-hyped professional development workshop, the next chapter will now actuate the theories and plans into an actual workshop. In chapter 4, I design the professional workshop intended for the Montessori teachers teaching young children. The workshop is discussed comprehensively.

CHAPTER 4: THE PRO-D WORKSHOP

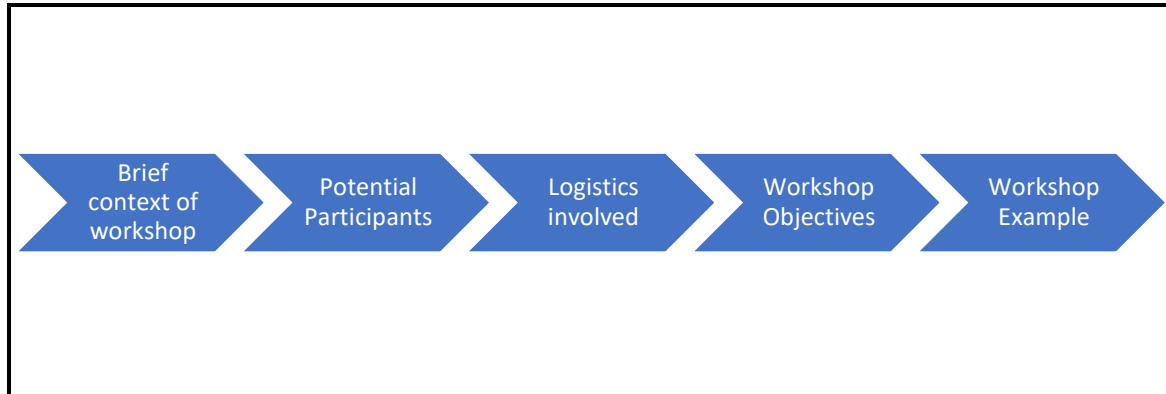
Introduction

Based on the DBR methodology discussed in the previous chapter and the subsequent use of DBR principles in the workshop's design, this chapter will focus on the outline and background discussion of the presentation content of the workshop. The discussion in the chapter will first focus on a possible outline, logistical planning, and anticipated audience, and what an agenda for such a workshop would look like. The most viable content for such a workshop will be presented in the final part of the chapter.

For further context, this chapter provides a detailed exposition of the workshop's contents that has been modelled using DBR. The workshop is meant to insightfully instruct Montessori teachers, educational assistants, resource teachers, and school administrators on how best to leverage disruptive technology's available tools and power in learning while maintaining the core principles and values of Montessori education. All the steps mentioned earlier are to be incorporated into every step of the workshop to maintain focus and objectivity. At the end of the workshop, the goal is to have a properly developed, well-informed work that can be presented to a group of Montessori teachers, educational assistants, resource teachers, and school administrators.

This chapter presents and explains the workshop that I designed as a specific step in the DBR process (Reimann, 2011), I present in Figure 4.1 below an outline of the progression of the chapter, which will show the process involved in developing the workshop.

Figure 4.1 Progression of Workshop Planning



Brief context of the workshop

This Professional Development Workshop that is being developed is purposely meant for Montessori teachers instructing young children. Typically, these teachers are used to one-on-one interaction with young pupils. Through that interaction, it has been easier for these teachers to impart knowledge to the young ones through the use of artifacts that they manipulate as they are taught. Notably, the insurgence of COVID-19 rendered face-to-face learning impossible. In May of the 2020 school year, the BC health authorities halted face-to-face learning to mitigate the punitive spread of the virus (Archer-Kuhn et al., 2020). As such, most educators switched to remote learning to cope with the new reality. However, this new reality almost came as a curse to Montessori teachers. The Montessori system has not traditionally embodied the incorporation of disruptive technology - especially remote learning (MacDonald, 2016). The face to face to online changes left the teachers (especially those who instruct young students) almost in limbo because they did not know of any other way other than the hands-on approach to instruct them. The tidal wave of incorporating technology into learning has grown irresistible among learning institutions in Canada and the world at large, as evidenced by its widespread use in various institutions. Moreover, virtually every system in society today is embedded with technology (Muller, 2017).

As such, institutions have, over time, strived to incorporate technology as much as possible to their strategic fit for various reasons such as relevance, consistent movement with the world, among other reasons.

This planned workshop seeks to address the primary challenges faced by instructors at Montessori in transitioning and adapting to remote learning. While it is true that the culture of the Montessori education system is rich, this workshop is aimed at making it openly evident that technology and as well remote learning typifies an inflection point in learning.

Potential Participants

Montessori Teachers

Primarily, the teachers being included in this workshop are the ones who teach the lower/younger classes within the Montessori education. This cadre of teachers has been entrusted with the sole mandate of instructing the youngest members of the Montessori education system (preschool one, preschool two, kindergarten, Grades 1, 2, and 3 are primary classes). Montessori education focuses on hands-on, project-based learning, enabling students to self-correct and retry until they master the topic (Hiles, 2018).. However, due to the cancellation of actual face to face meetings, these Montessori school teachers struggled to teach their students via the newly adopted remote learning system. As a result, the gap in their skill set for remote learning became significant, necessitating the creation of a workshop to assist bridge it. By attending the workshop, these teachers will have their concerns addressed in addition to acquiring the relevant skills for use in the remote learning setup.

Educational Assistants

At Montessori schools, educational assistants work hand in hand with the lead teachers by offering assistance in establishing and maintaining a harmonious classroom. Educational Assistant teachers, also called EAs, collaborate with the Lead Montessori Teachers to create and sustain an organized, appealing, and friendly atmosphere as part of their role. The EA adds another set of alert, perceptive eyes and ears to the classroom. Additionally, EAs play a critical role in demonstrating polite and respectful conduct and adding to the friendly, encouraging, and tranquil ambiance that defines a genuine Montessori setting (Culclasure et al., 2018). The above exposition makes these assistants fundamental in the learning environment. The main reason why they are involved in the workshop is certainly because of their pivotal role in ensuring that the learning environment is adequately furnished with all the required enablers. Given the transition from face-to-face to remote learning, they should also be appropriately instructed to quickly and smoothly extrapolate their work into the new learning space. As such, EA needs the new skills that will help them advise students, parents, and the lead teachers appropriately on matters of the learning environment both from a materials' perspective and the room at large.

Resource Teachers

Within the Montessori approach, resource teachers are responsible for developing curriculum support systems for children, teachers, and administrators (Peled et al., 2011). Additionally, resource teachers help the class teacher and give additional support to students with mild learning challenges. When migrating to a remote learning program, these teachers are critical because substantial obstacles have been demonstrated or are expected to be encountered by both class teachers and students when doing particular tasks. This is the point at which

resource teachers are invited to participate in the workshop as participants. The majority of these teachers have been trained to provide services exclusively within physical classrooms. Today's shift is mainly reliant on technology. In addition to the regular issues experienced by teachers and students in class, additional ones are likely to arise. This reality underscores the importance of considering these resource teachers, as they will be available to assist students in a way that makes learning enjoyable, intriguing, engaging, and productive. Their participation in the session will allow them to learn about adaptive strategies and the most effective ways to solve various difficulties.

School Administrators

At Montessori, school administrators serve as the organization's apex. By definition, their job requires anticipating practically every school activity that affects academic and non-academic workers. These administrators are crucial in establishing academic programs, evaluating student success, training, encouraging teachers and other personnel, overseeing career counselling, and other student services. Given their active role in ensuring that learning occurs, it is critical and vital for school administrators to attend this training to gain insight into how to manage the school in light of the newly implemented reforms. In addition, their supervision roles in the learning process should take these modifications into account. According to Peled et al. (2011), school administrators have a considerable impact on instructors. This suggests that when adequately informed about current events, such an influence is highly likely to be beneficial. However, in the case of ignorance, these administrators may have a detrimental effect on the teachers' approach and method of operation. As a result, they must participate fully in the session.

Logistics Involved in the workshop development and presentation

This is a full-day workshop and may take different forms where, at some point, the participants will be required to take notes and use their personal computers for demonstration. As such, the participants are expected to carry along writing materials, including pens, notebooks, and personal computers, for use in the demonstration. Wingate (2018) asserts that bringing along materials for use in a workshop is a good way of fostering a collaborative approach to the learning process. The materials that these participants will bring along will enable learning-as to be professionally provided. In addition to the materials mentioned that should be brought along, these participants should bring easels, newsprint, and markers for recording ideas, questions, comments, or for documenting what goes on in small groups.

The schedule of the workshop is meticulously organized in such a way that every session (with the intention to have six sessions) will take an hour with 30-minute breaks for break monotony and also for bio-breaks. The approach to effectively managing time during this workshop follows the suppositions by Dobrigkeit et al. (2018), which states that planning enough time for each activity with deliberately planned breaks fosters increased learning and productivity. During this workshop, the intention is to use a typical classroom learning approach of optimally utilizing the allotted time to dispense the best knowledge and skills. The programs will begin at 8 am in the morning and end at 5 pm in the evening. The six sessions are to be divided into three main phases in such a way that the first phase tackles the Montessori philosophy of teaching, the next one focuses on remote learning, and the final emphasizes relatable ways of integrating the Montessori education model into the remote learning environment.

In the final phase of the workshop, an evaluation will be done. For this evaluation, we shall utilize evaluation forms that participants will be expected to fill out quickly at the end of the workshop on the specific areas of interest such as skills acquired, the level of interactions, and the degree of success of the workshop, among other things. In addition, the World Health Organization (2019) asserts that it is prudent to assess the logistics and planning of the event at which the modules were represented and the participant's perceptions of the workshop. Were they pleased? Was the information offered pertinent to their job? This type of input will be important to the organizing team to improve future events.

Workshop Objectives

Since the emergence of COVID-19, , the Montessori Education system has been planning and executing online dialogues and workshops for its teachers at all levels of education, administrators, and other educators. Over the years, varying stakeholders who utilize the Montessori approach have used online discussions to supplement and expand in-person institutes and graduate courses and provide online seminars on a variety of themes, engaging hundreds of educators. Persons with decision-making commitments for syllabus, professional development, regulatory regime, financial planning, assessment, technology implementation, and/or technology facilities at the school, district, and state levels, as well as individuals learning to perform their online professional development, have all been among our audience members. As in all cases, this current workshop was designed with the following three goals in mind

First and foremost, to guide teachers in identifying the difficulties they face with doing Montessori classes online. The Montessori education approach was overtly strict in applying the normative methods of learning that highly discouraged the use of technology in learning. Being a Montessori teacher and having been trained to present lessons to students using hands-on

manipulatives, the work done by a Montessori teacher has primarily been centred on this practical approach. While teaching theory, instructors at Montessori are strongly bent on leveraging the provided tools for cementing the theoretical underpinnings that have been laid as a way of ensuring that there is an excellent connection between the subjects that are taught and the real-time solutions within the society (Murray et al., 2021). This approach proved to be a serious hurdle for the instructors with the online classes. As such, one of the primary objectives of the workshop is to pinpoint the genesis of the problem to address it comprehensively.

My other (and second) fundamental objective is to connect the dots for teachers regarding the possible opportunities they can look out for while doing Montessori teaching online. Most teachers were not prepared for remote learning because their time was insufficient to learn the best way to correctly prepare for a virtual meeting with my team of learners for the different sessions. The idea behind addressing the gaps that brought asymmetries in the manner of teaching as well as exploring the opportunities that await these teachers hinges on the premise that remote learning is a current reality already being used as a way of blending the normative teaching methodologies with the current ones to make learning wholesome and all-inclusive (Siddiqui, 2020). This workshop intends to bring these teachers to speed with the recent developments in disruptive technology in an educational context. Through this lens, the teachers should be able to see a myriad of opportunities to exploit for a better experience in teaching.

My third goal is to give the teachers a real-time experience of the lesson that they can easily teach remotely and how best such a class can be. While being pragmatic in the approach, the workshop presentations have been designed so that the sessions will help make a strong connection between the activities of each workshop and the participants' ongoing professional practice. Workshops for teachers, for example, involve activities in which participants create

technology-enhanced lesson plans for their personal use and share them with other workshop participants. There shall also be activities that cascade judgment calls and response processes intentionally meant for administrators. The Montessori approach is highly engaging, action-oriented, and discussion-based and thus exemplifies the types of classroom practices that I recommend instructors to employ when incorporating technology.

Actual Workshop

The progression of the workshop and the deliberation behind actions and tasks are discussed in this section. Please refer to the PowerPoint presentation (see Appendix slide 16) for the actual slides and content referred to in the discussions below.

Focus 1: Opening & Introduction (slides 1 – 2)

The workshop will be opened with an introduction. During this phase of the day-long workshop, the goal is to create a perfect atmosphere and a safe space where the participants can confidently share their experiences and learn without compulsion or under any duress (Cebesoy, 2019). Therefore, the introductory part begins with teachers, then educational assistant teachers, then the resource teachers, and finally the administrators.

Focus 2: Montessori Method (slides 3 – 7)

This second part of the workshop focuses primarily on Montessori education in its inception, philosophy, and the things that define it and make it unique from the rest. Notably, Lillard (2007) describes this learning process as one that incorporates manipulating hands-on learning materials to empower the children's cognitive development. For example, young children will quickly grasp the subject's concept. Additionally, when children know what they

are doing, they participate joyously in learning, eliminating students' behavioural challenges. According to the Montessori philosophy, a kid's ethos is just as important as his or her psyche. A Montessori curriculum nurtures the entire child literally.

Along with academic skills, children develop an appreciation for diversity and the ability to tolerate individual differences. Realistic Life's element of kindness and human decency is used to help educate peaceful conduct. The Montessori-educated kid knows that each person can spread ripples of peace throughout the world (Murray, 2011, pp. 22-33).

Some of the most stressed underpinnings include creativity, effort, communication, precision and accuracy, investigation, environment manipulation, organization, awareness, novelty, and identity. Interestingly, this educational philosophy is averse to the technological advancements that have been evident in the world today. While being holistic in nature and diverse in approach, Montessori education is one in which the young students learn to find solutions to problems through their active involvement (Culclasure et al., 2018). The manipulated artifacts typify the various enablers in the real world that form an integral part in getting solutions to problems.

During this phase, the participants (especially teachers and the other assistants) are engaged in active participation to gauge their attitudes towards Montessori. The intention for gauging the participants is to have a clear view of what makes Montessori teachers incapable of perfectly gliding into the new system.

Focus 3: Remote learning (slides 7-11)

Next, the workshop considers the issue of remote learning. It is essential to bring it up because it forms a central part of the discussion in the workshop. It is imperative to lay a proper

foundation of what remote learning is about to be able to model an appropriate way of discussing it in the context of Montessori education.

Remote learning, by definition, is a method of instruction in which the learner and the instructor, or source of knowledge, are not present physically, in contrast to the traditional interactive educational instructional approach (Hodges et al., 2020). Instead, technology supports and communicates information through discussion boards, video conferencing, and online examinations. Remote learning can be simultaneous, involving genuine peer-to-peer collaboration and interaction, or async, involving self-paced educational activities that do not require the presence of an instructor (Saichaie, 2020).

A remote learning lesson could be organized as follows: the teacher makes a virtual connection with their students via a viable online learning platform such as Google Classroom, Zoom, Webex, or even Khan Academy. On the other end, the student's role is to ensure that they follow through with the activities as stipulated, respond when necessary, and actively participate during the class sessions by answering questions and raising concerns, among other things. At this point, it is interesting to note that remote learning and Montessori education are, in essence, opposed. Murray et al. (2021) reveal that Montessori teachers believe online learning created obstacles to Montessori education; for instance, online learning focuses more on communicating with parents than academic collaboration. The Montessori philosophy is based on the concept that children learn best by touching, manipulating, and "doing." One of the most frequent concepts associated with the Montessori technique is hands-on learning, which is a non-negotiable cornerstone of the system (Ahlquist & Gynther, 2019). So, how does tactile learning fit into the world of distance learning? At first look, this appears to be the most significant barrier to converting Montessori to an online setting. However, it's a common fallacy that online

training can't help with this type of learning. When thinking about online learning, one might picture a student sitting in front of a computer screen, passively absorbing information. Online learning may reflect some unsuccessful teaching strategies frequently reported (Schwerdt & Wuppermann, 2011) in lecture-style classroom situations. This is the polar opposite of what one might expect to find in a Montessori setting. This position thus gives us a reason to consider the linkage between Montessori education and remote learning.

Focus 4: Remote learning and Montessori education (slides 11 – 15)

While it is true that remote learning and normative Montessori education seem to be opposed in their scope, the reason for considering both of these in the same context is the fact that Montessori education is supposed to be superimposed on Remote learning in a manner that Montessori education becomes the enabler of remote learning in a different context.

According to Murray et al. (2021), the limited administration support for technology use is one of the critical issues Montessori teachers had in educating young children online during the COVID-19 pandemic. The author further confirms this assertion by noting that "teachers were primarily responsible for developing the distance-learning arrangements for their students, with most teachers relying on live videoconference sessions without substantial input from school administration" (p. 6). (p. 6). In my perspective, this inspires Montessori teachers to have diverse viewpoints in teaching young children online. For example, Jones (2017) suggests that Montessori teachers who are not inclined with technology use in the Montessori curriculum believe that technology negatively affects the children's learning process. Thus, MacDonald (2015) stresses that "Montessori education excludes anything with a screen or a keyboard" (p. 101).

Furthermore, Murray et al. (2021) suggest that Montessori teachers believed online learning caused impediments to Montessori education; for instance, online learning focuses more on connecting with parents than academic collaboration. Unfortunately, research reveals that it is hard to modify teachers' attitudes and practices, which sometimes is the reason for halting the children's learning progress. I think that if instructors are willing to accept change in their methods and beliefs every hurdle in their profession, they will know how to face them.

The changing educational landscape has become more than necessary to go digital and support it with the already existing structure. Fundamentally, the current system of education has virtually all its roots in the ancient one. As of today, the system of instructing students (especially young ones) in the vast majority of schools and systems is one which prides itself in increased touch with the fourth industrial revolution from which students learn how to approach the existing problems and solve them intuitively (Menon & Castrillón, 2019). To remain relevant, the current Montessori system (diametrically opposed to the conventional schooling system) has to embrace change-through adopting technology. While embracing this change, the modern system has to be embedded into the already existing rich learning system in a way that incorporates all the tenets of the old into the new in the developed space and landscape—for instance, stressing on hands-on approach in the remote learning environment in cases where physical meetings cannot be sustained.

Many Montessori programs include technology in the curriculum since some acquaintance with technology is necessary for success in life. However, unlike most public programs, the employment of technology is approached differently (Chisnall, 2011). Technology is carefully and thoughtfully integrated into the Montessori classroom. Students are not taught with smartphones, but they do have restricted access to them as extra learning aids. In a

Montessori classroom, technology is a tool, not a core component of the curriculum (Elkin and Bers, 2014).

While the Montessori education approach has for a long-time eschewed technology-enhanced learning, there were myriad challenges reported by the teachers and parents. These challenges showed that remote learning is, to a great extent, a going concern that has to be addressed. The Montessori teachers need to be trained, instructed, and thoroughly equipped for effective practice.

Focus 5: Practical Teacher activities with the students during remote learning (slides 16 - 20)

The last focus of this workshop is on strategic intervention measures. More particularly, this area focuses on the real-time ways in which the teachers can make the things advocated in this workshop a reality. Some of the real-time activities that teachers can engage in to make remote learning exciting and enriching in a manner that still upholds the colloquialism DNA of Montessori, stressing the use of manipulatives to enhance learning, include the following: In language arts, students can create a story box. After creating such a story, these students can be guided into collecting things that are important to them inside their house or in their backyard and creating a story about the things they collected. That way, these students identify with what they do in real-time. Then, when presenting their findings during a remote class, they will share experiences informed by the things they touched.

Another example could also be during an Earth Science class; Students participate in many aspects of the exercise by signing up to be variables or even data collectors on the board. The students are made to construct their clay city using particular measurement specifications

and then sign up to test several safety methods to see which one works best. As a part of their reporting in a remote learning class, they then take turns to showcase their results on camera to the teacher one upon the other till all of them are done.

Conclusion

Although the discussed online professional development (OPD) is still in its early stages, the model demonstrates that online workshops can provide a valuable means of professional development, complementing and extending—but not completely replacing—other elements of comprehensive professional development programs. An online workshop's pacing and routine are suitable for several teachers, provide opportunities to tap into the knowledge and experience of coworkers and experts who would not be accessible for local events, and allow workshop events to inform and reflect participants' ongoing practice.

Transitioning from face-to-face learning to some aspects of virtual learning is not an easy task. It may be even harder for the Montessori system that has been built on practical manipulation of things. However, the main task lies with the instructors and administrators. It becomes easy and interesting work when teachers are appropriately trained and equipped with the relevant skills required for this modern age. The ability to pass knowledge and skills to students is dependent on how best the teachers are equipped. Integrating hands-on activities into online learning only seems a mountain until all the stakeholders have learned the art of properly teaching away from the classroom. Then, with the help of relevant materials, it is easy to incorporate all the proper ideas and insights that make it a success.

Moreover, it is proper to mention that professional development workshops like this one are very important in modelling a superior value proposition for teachers' strategic fit. Education

is one of the most fundamental things in society. Therefore, any approach towards imparting knowledge and skills must be considered with great care.

CHAPTER 5: SUMMARY AND CONCLUSIONS

Introduction

This chapter discusses the summary and conclusion based on the first four chapters of this paper.

Summary

In Chapter One, the foundation for this paper has been laid. The chapter introduces Montessori education from its inception, development, ideologies, and the challenges it has faced since the insurgence of COVID-19. It is proper to note from this chapter that before the insurgence of COVID-19, Montessori education has been particularly criticized for not embracing Vygotsky's digitization in its mode of instruction. The primary modus operandi entailed interactive learning, where the hands-on experience was greatly emphasized. The entire teaching fraternity was thoroughly furnished regarding the Montessori way but seriously detached from the digitization aspect of teaching. This asymmetry in skill, mentality, and exposure becomes an Achilles heel when COVID-19 disrupts the usual learning method in virtually every corner of the world. This chapter lays plain the fact that it utilizes the propositions of Vygotsky, who propounded that young children are curious and actively involved in their learning and the discovery and development of new understandings (Vygotsky, 1934). Notably, one of the main underpinnings of this chapter is the digital revolution that has demonstrated its utility in satisfying a wide range of educational requirements.

These requirements include establishing the classroom design itself, where instruction and classwork are organized in a virtual realm; organizing teaching methods; organizing within

the framework of digital activities or applications; and arranging online learning programs within individual digital technology and ancillary materials. As a result, the main argument advanced in Chapter One is that it is critical to develop a holistic approach to analyzing the learning task in digital spaces to obtain solutions to the issues about using digital technologies in the classroom. This argument is the basis of the research and, by extension, the first chapter because of the main challenge the Montessori teachers face at the point of transition into the virtual learning space. Basically, the entire chapter is about laying the ground for virtually everything the paper entails, including the ideas expounded in the other chapters.

In Chapter Two, the study advances an in-depth review of the selected literature. The background of the pioneer of Montessori education: Maria Montessori -is laid to contextualize the philosophy of this education technique. Having experienced the uneven treatment of women over men, Montessori grew to become a strong advocate fighting for women's rights. She practices in a mental institution for mentally disabled children despite training as a doctor and engineer. This experience and exposure drive her to mitigate the mistreatment those children underwent. She studied and incorporated the work of Seguin in her work and created her hands-on learning materials to educate the mentally disabled children in her care, thus giving birth to the Montessori education. The chapter continues by defining the philosophy of Montessori education. It is important to note that The Montessori philosophy considers the child's spirit to be just as essential as their mind. The whole child is nurtured in a Montessori curriculum.

Along with academic skills, children learn to respect cultures other than their own and tolerate individual differences. Grace and courtesy, a component of Practical Life, teach peaceful behaviour. The other important subject that is discussed in the second chapter is remote learning, including the place it occupies in the world today. Essentially, this chapter delves into modelling

a picture of what Montessori education philosophy is about and remote learning. This discussion forms the paper's backbone because the central theme revolves around the two.

Chapter Three is about the methodological approach in the paper. In this case, the methodology is essential in defining the critical technique employed in addressing the main challenge: the sheer lack of the right skills to properly utilize the virtual space to instruct learners, especially the younger learners in the first grades. This chapter introduces the design-based approach utilized in modelling the solution to the challenge. This DBR will be utilized in a Professional Development (Pro-D) workshop. This Professional Development workshop is designed to provide Montessori teachers with the best competencies and insight into how to best teach online (while combining normative and newly acquired remote (wholesome) learning techniques). Notably, the chapter notes the potential limitations (four of them) of using this approach to address this challenge faced by the Montessori teachers. It then expounds on what a DBR entails and how it is going to be utilized in the workshop that is being planned for the teachers. As part of the third chapter, the planning phase, meant to prepare both the trainers and trainees psychologically so that the developed expectations can easily fit into the jigsaw of the more significant concern, is also discussed. The other aspects of DBR discussed in the chapter include the notable features, the pragmatic nature of this design, and the exact manner in which it shall be utilized to instruct and empower the Montessori teachers and parents on how best to get the better out of the virtual learning space.

Chapter 4 presents the Professional Development Workshop in verity. The chapter describes in detail the workshop contents that were patterned using DBR. The workshop aims to train and educate teachers, teaching assistants, resource teachers, and the Montessori administrators on how to best leverage appropriate resources and the power of disruptive

technology in learning while adhering to their fundamental beliefs and ideals. Furthermore, it contains a thorough scheme for a workshop for Montessori teachers to be held in Uplands Elementary Montessori School and participated by various players, including educators and administrators from the school. Among the fundamental tenets of the chapter include the planning phase. This phase entails information such as the context of the workshop, the potential participants, the involved logistics, and the workshop objectives. The workshop was meticulously planned, as shown in the chapter. The exact workshop focuses on five main areas: opening and introduction, the history and facts on the Montessori method, much about remote learning, the connection between the Montessori method and remote learning, and finally, the practical things that these teachers can do with their students during remote learning to make learning productive and enjoyable. The main take-home points were the skills and competencies required of the participants to make remote learning smooth and practical, the involvement of parents in virtual learning, and the need for continual development in learning.

Conclusion

Summarily, this paper forms a basis for confronting the challenges of transitioning into remote learning. It is also important to note that it addresses the main obstacles to progressive learning, which is adaptive. While Montessori education may seem conservative in embracing change, empirical evidence supports the notion that it has been one of the most holistic and coveted instructional approaches for a long time. However, the insurgence of COVID-19 just revealed a loophole within this system and philosophy-that in any typical society, there are specific changes that one cannot forgo if at all they are to remain relevant and competitive. The aforementioned need for relevance owes to the fact that crowding out and redundancy is a reality when it comes to technology. Sooner or later, the Montessori system, devoid of thoughtfully and

meticulously incorporated technological systems, may find its unique philosophy no longer appealing in a world where technology takes center stage (Brown and Duguid, 2017). The need to remain competitive is essential given the sheer decline of a hands-on approach to solving school problems in an era where vast amounts of information with several teachers focus more on the theoretical aspects of learning (Tondeur et al. 2017). Nevertheless, Montessori education remains one of the best approaches to instructing young students. It, therefore, needs to stay competitive in maintaining the status quo through concerted efforts and thorough leadership of the teachers (thoroughly trained and properly equipped to get the best out of the students). That way, there is a reasonable degree of certainty that the blend between the pragmatic approach and the constructivist one will yield a hybrid system that is considered a superior value proposition in learning in this 21st century.

Interestingly, the Montessori system of instructing young students is a pragmatic approach, while the technological paradigm that is vouched for in this work is more of a constructivist system. These two systems may seem to be achieving almost similar goals, but their approaches are inherently different. In this case, technology is considered not merely as an autonomous paradigm but as an enabler within the more significant scope of learning within the Montessori education's strategic fit. The main reason why Montessori education should remain relevant is because of the place that it occupies in the world education system. Given its formative ideal, this education system need not be faced out by ensuring that all the necessary support is accorded to the entire fraternity to maintain its place in the world.

The instructor's most significant advancement has been a considerable boost in wireless data speed and reliability. Although increasing connectivity has made it much easier for teachers to use streaming video in the classroom, it has also enabled far more innovative teaching than

simply presenting attractive YouTube videos. Students may now access learning content and communicate with educators and fellow students from practically anywhere, at any time, thanks to increased bandwidth and worldwide connectivity (Rollag and Billsberry, 2012). Furthermore, open platform and gadget autonomy imply that learners and tutors can access learning materials using a range of operating systems, browsers, and devices without the technological eccentricities and incompatibilities that have previously caused so much aggravation (Rollag and Billsberry, 2012). For any Montessori teacher, the incorporation of technology should be considered more of a blessing than a curse because of the overwhelming potential benefits that have been demonstrated through tried and tested scientific evidence. In this case, the hands-on approach (the DNA of Montessori) was almost being faded out because Montessori did not embrace disruptive technology and embed it to be a part of its system. The Montessori ideals and philosophy have been adversely challenged to better the system for teaching and learning in the 21 century?

Limitations of the study

One of the limitations of this study is its nature. Given that this is just a side study in design and the first phase of the design, it does not run in the subsequent design phase. As a result, there is a possibility of running into issues that I have not thought about in the first phases of the design. However, this shortcoming can be mitigated in the next phase in the DBR process, which entails evaluating three designs.

Additionally, this study does not provide the finest of details to the Montessori teachers on how best to practically tackle all the challenges that arise during remote learning, such as accidents (when using manipulatives), the quality of a presentation, in case something happens that was not intended for the young students, among others. Instead, this study focuses on the

principles and leaves room for the application phase for each Montessori teacher to be informed by the environment and the circumstances. This limitation allows further research into how best the Montessori teachers can be trained to be adequately equipped to discharge their mandate with much ease and comfort.

Such a study should consider implementing all the necessary phases of a design-based research method. That way, it becomes wholesome, and the feedback got from the participants' forms an integral part of the whole process because the input makes room for actualizing the action points.

For record purposes, the next steps of the DBR process will entail approaching the relevant stakeholders within the districts (for example, the Montessori Association of BC) and working collaboratively to implement the modelled workshop, as it has been discussed in chapter 4. In addition, the process will involve getting the required feedback from the participants. Finally, the last phase entails assessing how best the strategies modelled through the design are working (in terms of the results from the various class tests).

The other prominent limitation especially touching on the actualizing bit of the workshop, is that it never materialized as planned because of COVID-19. The punitive restrictions given, coupled with the terrible effects of the virus, made it virtually impossible for the workshop to be actualized.

References

- Ahlquist, E. M. T., & Gynther, P. (2019). Variation theory and Montessori education. *Journal of Montessori Research & Education, 2*(1).
- Albrahim, F. A. (2020). Online teaching skills and competencies. *Turkish Online Journal of Educational Technology-TOJET, 19*(1), 9-20.
- Alghamdi, A. H., & Li, L. (2013). Adapting design-based research as a research methodology in educational settings. *International Journal of Education and Research, 1*(10), 1-12.
- Allen, L., & Kelly, B. B. (2015). Child Development and Early Learning: A Foundation for Professional Knowledge and Competencies. *The National Academies of Sciences, Engineering, and Medicine*.
- Almazova, N., Krylova, E., Rubtsova, A., & Odinkaya, M. (2020). Challenges and opportunities for Russian higher education amid COVID-19: Teachers' perspective. *Education Sciences, 10*(12), 368.
- Alwi, S. K. K., Zaman, Z., Ghaffar, R. B., Tabasum, S., & Hasan, S. W. (2021). Multi-Age Grouping In A Montessori Classroom Effects Positively On A Child's Social And Emotional Development. *Multicultural Education, 7*(4).
- Anderson, E., & Hira, A. (2020). Loss of brick-and-mortar schooling: How elementary educators respond. *Information and Learning Sciences*.
- Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research?. *Educational researcher, 41*(1), 16-25.
- Antley, T. (2020). *WebCE Blog | News*. WebCE. Retrieved 9 February 2022, from <https://www.webce.com/news/2020/07/16/professional-development>.
- Armstrong-Mensah, E., Ramsey-White, K., Yankey, B., & Self-Brown, S. (2020). COVID-19 and distance learning: Effects on Georgia State University school of public health students. *Frontiers in Public Health, 547*.
- Benavides, M. B., & Van Landeghem, H. (2015). Implementation of S-DBR in four manufacturing SMEs: a research case study. *Production Planning & Control, 26*(13), 1110-1127.

- Brinson, J. R. (2015). Learning outcome achievement in non-traditional (virtual and remote) versus traditional (hands-on) laboratories: A review of the empirical research. *Computers & Education*, 87, 218-237.
- Brown, J. S., & Duguid, P. (2017). *The social life of information: Updated, with a new preface*. Harvard Business Review Press.
- Brown, R. (2019). *13 Differences Between Online and Face to Face Courses*. Miamioh.edu. Retrieved 7 February 2022, from <https://miamioh.edu/regionals/eccoe/news/2019/01/differences-between-f2f-and-online.html>.
- Burggraff, A. (2015). Developing discipleship curriculum: Applying the systems approach model for designing instruction by Dick, Carey, and Carey to the construction of church discipleship courses. *Christian Education Journal*, 12(2), 397-414.
- Campbell, P. C. (2014). Modifying ADDIE: Incorporating new technologies in library instruction. *Public Services Quarterly*, 10(2), 138-149.
- Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., ... & Walker, K. (2020). Purposive sampling: complex or simple? Research case examples. *Journal of Research in Nursing*, 25(8), 652-661.
- Carter Jr, R. A., Rice, M., Yang, S., & Jackson, H. A. (2020). Self-regulated learning in online learning environments: strategies for remote learning. *Information and Learning Sciences*.
- Cebesoy, Ü. B. (2019). Pre-service teachers' opinions about a two-day climate change education workshop. *International Research in Geographical and Environmental Education*, 28(3), 211-227.
- Chisnall, N. (2011). *Montessori education in Aotearoa-New Zealand: A framework for peace and social justice* (Doctoral dissertation, Auckland University of Technology).
- Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design research: Theoretical and methodological issues. *The Journal of the learning sciences*, 13(1), 15-42.
- Creswell, J. W., & Tashakkori, A. (2007). Differing perspectives on mixed methods research. *Journal of mixed methods research*, 1(4), 303-308.

- Culclasure, B. T., Longest, K. C., & Terry, T. M. (2019). Project-based learning (Pjbl) in three southeastern public schools: Academic, behavioral, and social-emotional outcomes. *Interdisciplinary Journal of Problem-Based Learning*, 13(2), 5.
- Culclasure, B., Fleming, D. J., Riga, G., & Sprogis, A. (2018). An evaluation of Montessori education in South Carolina's public schools. *The Riley Institute at Furman University, Greenville, SC*.
- De Villiers, M. R., & Harpur, P. A. (2013, October). Design-based research-the educational technology variant of design research: illustrated by the design of an m-learning environment. In *proceedings of the South African institute for computer scientists and information technologists conference* (pp. 252-261).
- Debs, M. C., & Brown, K. E. (2017). Students of Color and Public Montessori Schools: A Review of the Literature. *Journal of Montessori Research*, 3(1), 1-15.
- Dede, C. (2006). *Online professional development for teachers: Emerging models and methods*. Harvard Education Press. 8 Story Street First Floor, Cambridge, MA 02138.
- Dobrigkeit, F., Paula, D. D., & Uflacker, M. (2018). Breaks with a Purpose. In *Design Thinking Research* (pp. 59-76). Springer, Cham.
- Dorer, M. (2022). Montessori Characteristics - Montessori Children's House. Montessori Children's House. Retrieved 29 March 2022, from <https://www.montessorichildrenshouse.org/why-montessori/montessori-characteristics/>.
- Easterday, M. W., Lewis, D. R., & Gerber, E. M. (2014). Design-based research process: Problems, phases, and applications. Boulder, CO: International Society of the Learning Sciences.
- Edwards, C. P. (2003). " Fine Designs" from Italy: Montessori Education and the Reggio Approach.
- Elkin, M., Sullivan, A., & Bers, M. U. (2014). Implementing a robotics curriculum in an early childhood Montessori classroom. *Journal of Information Technology Education: Innovations in Practice*, 13(01), 2014.
- Enrique Hinostroza, J. (2018). New challenges for ICT in education policies in developing countries: The need to account for the widespread use of ICT for teaching and learning outside the school. In *ICT-Supported innovations in small countries and developing regions* (pp. 99-119). Springer, Cham.

- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, 5(1), 1-4.
- Fahd, K., Miah, S. J., Ahmed, K., Venkatraman, S., & Miao, Y. (2021). Integrating design science research and design based research frameworks for developing education support systems. *Education and Information Technologies*, 26(4), 4027-4048.
- Feez, S. M. (2007). Montessori's mediation of meaning: a social semiotic perspective.
- Glancy, F. H., & Isenberg, S. K. (2011). A conceptual learner-centered e-learning framework.
- Hayati, R., Fauzan, A., Iswari, M., & Khaidir, A. (2017). The Validity of Holistic Mathematics Education Model Based Among System in the Low Grade Elementary School.
- Hiles, E. (2018). Parents' reasons for sending their child to Montessori schools. *Journal of Montessori Research*, 4(1), 1-13.
- Hodges, C. B., Moore, S., Lockee, B. B., Trust, T., & Bond, M. A. (2020). The difference between emergency remote teaching and online learning.
- Hunzicker, J. (2011). Effective professional development for teachers: A checklist. *Professional development in education*, 37(2), 177-179.
- Isaacs, B. (2018). *Understanding the Montessori approach: Early years education in practice*. Routledge.
- Jena, P. K. (2020). Challenges and Opportunities created by Covid-19 for ODL: A case study of IGNOU. *International Journal for Innovative Research in Multidisciplinary Field (IJIRMF)*, 6.
- Jones, S. J. (2017). Technology in the Montessori Classroom: Teachers' Beliefs and Technology Use. *Journal of Montessori Research*, 3(1), 16-29.
- Joynes, C., & James, Z. (2018). An overview of ICT for education of refugees and IDPs.
- Juuti, K., & Lavonen, J. (2006). Design-based research in science education: One step towards methodology. *Nordic studies in science education*, 2(2), 54-68.
- Juuti, K., Lavonen, J., Salonen, V., Salmela-Aro, K., Schneider, B., & Krajcik, J. (2021). A teacher-researcher partnership for professional learning: co-designing project-based

- learning units to increase student engagement in science classes. *Journal of Science Teacher Education*, 32(6), 625-641.
- Karagianni, D., & Jude Montgomery, A. (2018). Developing leadership skills among adolescents and young adults: a review of leadership programmes. *International Journal of Adolescence and Youth*, 23(1), 86-98.
- Katsarou, E., & Chatzipanagiotou, P. (2021). A Critical Review of Selected Literature on Learner-centered Interactions in Online Learning. *Electronic Journal of e-Learning*, 19(5), pp349-362.
- Kimani, S. W. (2015). Exploring quality of learning and teaching experiences in higher education using the theory of constraints: Kenya and New Zealand.
- Lillard, A. S. (2012). Preschool children's development in classic Montessori, supplemented Montessori, and conventional programs. *Journal of school psychology*, 50(3), 379-401.
- Lo, C. K., & Hew, K. F. (2021). Developing a flipped learning approach to support student engagement: A design-based research of secondary school mathematics teaching. *Journal of Computer Assisted Learning*, 37(1), 142-157.
- M. H. Abdous (2011), "A Process-Oriented Framework for Acquiring Online Teaching Competencies," *Journal of Computing in Higher Education*, 23(1), p. 65
- MacDonald, G. (2016). Technology in the Montessori Classroom: Benefits, Hazards and Preparation for Life. *NAMTA Journal*, 41(2), 99-107.
- Marshall, A., & Wagner, S. (2019). A Way Through... Troublesome Knowledge: Student Research as Threshold Concept Practice. *portal: Libraries and the Academy*, 19(3), 393-406.
- Marshall, D. T., Shannon, D. M., & Love, S. M. (2020). How teachers experienced the COVID-19 transition to remote instruction. *Phi Delta Kappan*, 102(3), 46-50.
- Mathew, I. R. (2020). Learner centered e-interactions: An exploration of context and practicality that influences e-learning experience. *International Journal on E-Learning*, 19(3), 229-241.
- Mayer, R. E. (2019). Thirty years of research on online learning. *Applied Cognitive Psychology*, 33(2), 152-159.

- McKenney, S., & Reeves, T. C. (2018). *Conducting educational design research*. Routledge.
- McQuate, S. (2020). 'Hands-on' classes online? How some instructors are adapting to a new teaching environment. UW News. Retrieved 4 February 2022, from <https://www.washington.edu/news/2020/04/16/how-to-move-hands-on-classes-online/>.
- Menon, K., & Castrillón, G. (2019). Reimagining curricula for the Fourth Industrial Revolution. *The independent journal of teaching and learning*, 14(2), 6-19.
- Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International journal of lifelong education*, 19(1), 54-72.
- Ministry of Education. (2022). *Policy/Program Memorandum 164*. Ontario.ca. Retrieved 17 February 2022, from <https://www.ontario.ca/document/education-ontario-policy-and-program-direction/policyprogram-memorandum-164>.
- Molnar, A., Miron, G., Elgeberi, N., Barbour, M. K., Huerta, L., Shafer, S. R., & Rice, J. K. (2019). Virtual Schools in the US 2019. *National Education Policy Center*.
- Montessori Elementary Classroom Experience*. Amshq.org. (2022). Retrieved 7 February 2022, from <https://amshq.org/About-Montessori/Inside-the-Montessori-Classroom/Elementary>.
- Montessori, M. (2004). *The discovery of the child*. Aakar books.
- Montessori, M. (2004). *The Montessori method: the origins of an educational innovation: including an abridged and annotated edition of Maria Montessori's The Montessori method*. Rowman & Littlefield.
- Msonde, S. E., & Van Aalst, J. (2017). Designing for interaction, thinking and academic achievement in a Tanzanian undergraduate chemistry course. *Educational Technology Research and Development*, 65(5), 1389-1413.
- Mukherjee, D., & Hasan, K. K. (2020). Challenges in Learning Continuity during the COVID-19 Pandemic: A Methodological and Thematic Review. *South Asian Journal of Management*, 27(3).
- Mulderrig, J., Montessori, N. M., & Farrelly, M. (2019). Introducing critical policy discourse analysis. In *Critical policy discourse analysis*. Edward Elgar Publishing.
- Muller, H. A. (2017). The rise of intelligent cyber-physical systems.

- Murray, A. (2011). Montessori elementary philosophy. *Montessori Life*, 23(1), 22-33.
- Murray, A. K., Brown, K. E., & Barton, P. (2021). Montessori Education at a Distance, Part 1: A Survey of Montessori Educators' Response to a Global Pandemic. *Journal of Montessori Research*, 7(1), 1-29.
- Murray, A. K., Brown, K. E., & Barton, P. (2021). Montessori Education at a Distance, Part 1: A Survey of Montessori Educators' Response to a Global Pandemic. *Journal of Montessori Research*, 7(1), 1-29.
- Nicolaides, A., & Eschenbacher, S. (2022). The Many Turns of Transformation Creating New Vocabularies for Transformative Learning. In *The Palgrave Handbook of Learning for Transformation* (pp. 1-22). Palgrave Macmillan, Cham.
- Norton, P., Rooij, S. W. V., Jerome, M. K., Clark, K., Behrmann, M., & Bannan-Ritland, B. (2009). Linking theory and practice through design: An instructional technology program. In *Educational media and technology yearbook* (pp. 47-59). Springer, Boston, MA.
- Ørngreen, R. (2015, June). Reflections on design-based research. In *IFIP working conference on human work interaction design* (pp. 20-38). Springer, Cham.
- Peled, Y., Kali, Y., & Dori, Y. J. (2011). School principals' influence on science teachers' technology implementation: A retrospective analysis. *International Journal of leadership in Education*, 14(2), 229-245.
- Puntambekar, S. (2018). Design-based research (DBR). *International handbook of the learning sciences*, 383-392.
- Redmond, S., & Dolan, P. (2016). Towards a conceptual model of youth leadership development. *Child & Family Social Work*, 21(3), 261-271.
- Reimann, P. (2011). Design-based research. In *Methodological choice and design* (pp. 37-50). Springer, Dordrecht.
- Reiser, B. J., Krajcik, J., Moje, E., & Marx, R. (2003, March). Design strategies for developing science instructional materials. In *Annual Meeting of the National Association of Research in Science Teaching, Philadelphia, PA*.

- Ripoll-Núñez, K. J., Mojica-Ospina, I. E., Torres-Riveros, A. C., & Castellanos-Tous, M. S. (2018). Teachers' and students' perceptions of excellence in teaching in Colombia. *New Directions for Teaching and Learning*, 2018(156), 57-65.
- Rollag, K., & Billsberry, J. (2012). Technology as the enabler of a new wave of active learning. *Journal of Management Education*, 36(6), 743-752.
- Ronen, S. (2021). Montessori Approach in Public Schools.
- Ronen, S. (2021). Montessori Approach in Public Schools.
- Ryu, S. (2020). The role of mixed methods in conducting design-based research. *Educational Psychologist*, 55(4), 232-243.
- Saichaie, K. (2020). Blended, Flipped, and Hybrid Learning: Definitions, Developments, and Directions. *New Directions for Teaching and Learning*, 2020(164), 95-104.
- Sandoval, W. (2014). Conjecture mapping: An approach to systematic educational design research. *Journal of the learning sciences*, 23(1), 18-36.
- Schwerdt, G., & Wuppermann, A. C. (2011). Sage on the stage: Is lecturing really all that bad?. *Education Next*, 11(3), 62-67.
- Scott, C. M., & Myers, B. (2021). Montessori Education: Teacher Perceptions of Challenges in Transitioning to Virtual Instruction. *Journal of Montessori Research*, 7(2).
- Scott, E. E., Wenderoth, M. P., & Doherty, J. H. (2020). Design-based research: a methodology to extend and enrich biology education research. *CBE—Life Sciences Education*, 19(2), es11.
- Sense, A. J. (2008). Conceptions of learning and managing the flow of knowledge in the project-based environment. *International Journal of Managing Projects in Business*.
- Siddiqui, S., Thomas, M., & Soomro, N. N. (2020). Technology integration in education: source of intrinsic motivation, self-efficacy and performance. *Journal of e-Learning and Knowledge Society*, 16(1), 11-22.
- Stafford. (2020). *Online Learning vs Classroom Learning. Read 5 differences..* Stafford Global. Retrieved 4 February 2022, from <https://www.staffordglobal.org/articles-and->

[blogs/general-articles-and-blogs/5-differences-between-online-learning-vs-classroom-learning/](#).

Tauson, M., & Stannard, L. (2018). *EdTech for learning in emergencies and displaced settings: A rigorous review and narrative synthesis*. Save the Children.

Tessmer, M. (2013). *Planning and conducting formative evaluations*. Routledge.

Tho, S. W., & Yeung, Y. Y. (2016). Technology-enhanced science learning through remote laboratory: System design and pilot implementation in tertiary education. *Australasian Journal of Educational Technology*, 32(3).

Tondeur, J., Van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: a systematic review of qualitative evidence. *Educational technology research and development*, 65(3), 555-575.

TWINOMUGISHA, A. (2019). *The promise and the challenges of virtual schools*. World Bank Blogs. Retrieved 17 February 2022, from <https://blogs.worldbank.org/edutech/promise-and-challenges-virtual-schools>.

Unesco. (2002). *Open and distance learning: Trends, policy and strategy considerations*. Unesco.

UNESCO. (2021). Education: From disruption to recovery. UNESCO. Retrieved 4 February 2022, from https://en.unesco.org/themes/education-emergencies/coronavirus-school-closures?fbclid=IwAR34xtgjsaJtaDBGstsWRUHAn9RnPJshWAKa_8YCMj5S51hBy700rDtcQ2M.

UNESCO. (2022). *COVID-19: Schools for more than 168 million children globally have been completely closed for almost a full year, says UNICEF*. Unicef.org. Retrieved 17 February 2022, from <https://www.unicef.org/press-releases/schools-more-168-million-children-globally-have-been-completely-closed>.

Victoria, E. (2020). *Online learning vs. in-person classes – what's better? - EF United States*. EF United States. Retrieved 4 February 2022, from <https://www.ef.edu/blog/language/online-learning-vs-in-person-classes-whats-better/>.

- Windeler, J. B., & Harrison, A. (2018). Rethinking media synchronicity theory: Examining the cooperative assumption. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, 49(4), 15-29.
- Wingate, U. (2018). Academic literacy across the curriculum: Towards a collaborative instructional approach. *Language Teaching*, 51(3), 349-364.
- World Health Organization. (2019). *Appendix 2: model of workshop evaluation form* (No. WHO/CED/PHE/EPE/19.12. 04). World Health Organization.
- Zohar, A. (2012). Explicit teaching of metastrategic knowledge: Definitions, students' learning, and teachers' professional development. In *Metacognition in science education* (pp. 197-223). Springer, Dordrecht.