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Perception of Montessori preschool teachers regarding literacy development through technology-supported play-based activities

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Background: As technology continues to evolve, educators and researchers are exploring innovative ways to harness the potential of technology to enhance literacy development for young learners. The Montessori approach to teaching and learning is an interactive approach that caters to diverse learning needs, as well as the individual learner's interests.

Objectives: The purpose of this study was to investigate the perceptions of Montessori preschool teachers regarding literacy development through technology-supported play-based activities.

Method: A case study of 10 teachers from four Montessori schools in Tshwane, South Africa, combined the Montessori theory, the Technological Pedagogical Content Knowledge (TPACK) framework and social constructivism to form the research lens, which guided the investigation. Data were collected using semi-structured interviews, a focus group discussion and non-participatory classroom observations.

Results: The findings showed that the participating teachers were not in favour of incorporating technology into the Montessori classroom. Those who incorporated technology did so with caution, keeping the original Montessori philosophy of hands-on learning. With technological advances increasing daily, some teachers in the study realised that technology is unavoidable.

Conclusion: Most Montessori preschool teachers in the study perceived literacy development through technology-supported play-based activities as misaligned with the Montessori approach, while a few teachers believed that it could foster literacy development in resource-constrained schools.

Contribution: The findings of this study contribute to the growing interest in integrating a technology-supported, play-based Montessori approach to foster literacy in the South African context, which has been relatively unexplored. The findings may provide a pathway in encouraging teachers to consider incorporating digital technologies that are consistent with the Montessori approach.

Keywords: Literacy development; Montessori approach; technology; reading and writing; play-based.

Introduction and background

Literacy development in the early years has been proven to benefit critical thinking, problem-solving, and skills in language and communication (Teane 2024). What is unique about the Montessori approach is that it recognises the sensitive periods during which the child gains some of these skills and sensitises teachers to be aware of these periods (Ozeremi & Kavaz 2013). The efficient education method, applied during the sensitive periods, optimises learning. These sensitive periods, for example the period of interest in the social aspects of life, also include the:

- Needed environment is set for the learner.
- Period when the environment is explored through touch, taste and language learning.
- Period in which the child learns to walk.
- Period in which the child develops curiosity and interest towards objects (Ozeremi & Kavaz 2013).

Note: The manuscript is a contribution to the topical collection titled 'Literacy learning across contexts: home - play - work', under the expert guidance of guest editor Dr Zelda Barends.

In recent years, the integration of technology into educational practices has become increasingly prevalent, revolutionising traditional teaching methodologies across various levels of education (Kawinkoonlasate 2020; Manire et al. 2023). In South Africa, the growing use of technology may lead to the exclusion of many learners in resource-constrained areas from the benefits of technological advancements, as schools in disadvantaged areas probably might not have resources and cannot afford technology-supported play-based activities (Chen 2015; Teane 2024). Furthermore, factors such as teachers' attitudes towards technology and their resistance to technological advancements may hinder the integration of technology in the classroom (Chisango & Marongwe 2018; Du Plessis & Webb 2012).

Maria Montessori (1912) considers children to be whole beings, capable of learning without adult assistance (Jones 2017). Under the Montessori paradigm, teaching and learning are learner-oriented rather than teacher-oriented (Jones 2017). The Montessori approach to literacy is beneficial as it emphasises hands-on learning that familiarises learners with words and their meanings, exploration and discovery through play, and collaboration with peers. Language development is done through conversations, storytelling, rhymes, and songs. Some studies have been conducted on the Montessori approach to teaching reading and writing in South Africa to discover how some of these methods can be adapted and made beneficial for resource-constrained schools.

This study aimed to explore the perceptions of preschool Montessori teachers regarding literacy development through technology-supported play-based activities. The following research question was formulated: What are the perceptions of teachers on the use of technology in the Montessori classroom?

Literacy development through the Montessori approach

Literacy development according to the Montessori approach is driven by the interest of the child, using phonics as its backbone (Jones 2024). Phonics enables a learner to recognise that certain letters correspond to specific sounds. This recognition can be explored in the classroom by playing sound games, or 'I spy' games (Jones 2024). When learners hear a sound, they should be able to associate that sound with a certain letter. Following the phonics games, letters made from sandpaper are introduced to the learners. These letters are colour-coded and contain a sandpaper inscription (Weasler 2024). Through feeling the sandpaper letters, a learner discovers the shape of each letter. Learners are then introduced to the moveable alphabet, which is a set of letters the learners use to form words (Bowman 2013). Finally, learners are taught how to write with sand trays, a chalkboard, or a pencil and paper. The Montessori method generally teaches learners first how to write and then how to read (Catherine, Javier & Francisco 2020).

Part of the Montessori way of teaching learners how to read and write is to use the Pink, Blue and Green letter series (Lnenickova 2015). This series is sequential in order of difficulty, with each colour consisting of a set of words to be presented to the child (Helper 2014; Jones 2024). Firstly, the Pink series is used, consisting of short vowel sounds, or three-letter phonetic sounds such as pig, hen, pen, and so on. Next in the series is the Blue, which introduces learners to consonant blends such as duck, kick, rock, et cetera (Lnenickova 2015). Words in the Blue series usually contain four to eight-letter words. Lastly, the Green series contains phonemes, digraphs, and hard, soft, and silent letters such as high, though, bead, cube, and so on. This method of teaching learners how to read from preschool age has been proven to have remarkable success (Jones 2024).

Technology in the classroom

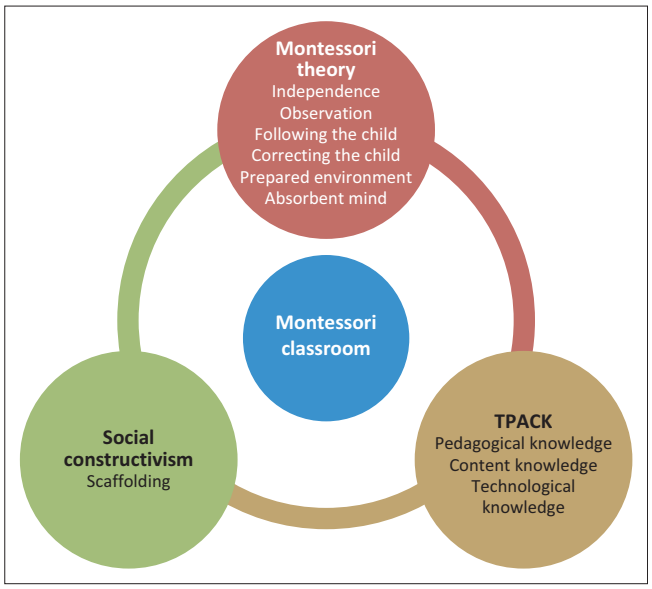
The use of technology in any school is widely evident (Haleem et al. 2022). Digital tools for learning include any programme, app or technology that can be accessed via the Internet connectivity but are not limited to it (Manire et al. 2023; Venketsamy & Hu 2022). Tools such as online libraries, educational websites, and digital and audiobooks help teach young children to read. These options, however, require a laptop or mobile device with Internet connectivity, referred to as high-tech options for teaching (Teane 2024). There are also low-tech options for learning, for example think-pair-share discussions, kinaesthetic learning, expeditionary learning, et cetera. Some teachers prefer low-tech options for learning as there are concerns over digitised methods, for example the fact that more screen time can be distracting for learners (Haleem et al. 2022). The current statement confirms that Montessorians have been apprehensive about the use of technology in the classroom (Simsek & Tugluk 2021). In the Montessori classroom, there is concern that the 'purity' of the philosophy or the method may be compromised by the introduction of technology into the traditional Montessori environment, which emphasises hands-on learning (Jones 2017; Manire et al. 2023; Simsek & Tugluk 2021).

Conceptual framework

Figure 1 illustrates the conceptual framework on which this study was based, which comprises the Montessori theory, social constructivism, and the Technological Pedagogical Content Knowledge (TPACK).

The Montessori theory

Emphasising independence, the Montessori theory of education allows learners to choose what they want to learn (Ozeremi & Kavaz 2013). The role of the teacher is to set the learning environment and organise materials from simple to complex; learners then choose which material they want to learn (Ozeremi & Kavaz 2013). The teacher observes and only intervenes when the learner requires assistance. Learners absorb information through experience with nature and in the classroom environment (Daily Montessori 2021). Learners should be allowed to make mistakes and correct



TPACK, Technological Pedagogical Content Knowledge.

FIGURE 1: The conceptual framework for the study (compiled by author S.A).

themselves. For the Montessori approach, how the environment is set for the learner is important, as the relationship in this environment is between the learner and the materials (Daily Montessori 2021). The teacher only guides the correct use of the material. Children from ages 2 to 6 years are in the same classroom – the older learners model behaviour for the younger learners; this is done through scaffolding. The Montessori curriculum overlaps with social constructivism in emphasising social support in classrooms with learners of diverse ages.

Social constructivism

Vygotsky's (1978) social constructivism proposes that learners acquire new knowledge through social interactions with other individuals in their world (Lantolf 2023). This phenomenon is viewed not only through formal teaching methods, but through methods of interaction such as classroom discussions, modelling, zone of proximal development, and scaffolding (Lantolf 2023). Scaffolding is a means by which a 'helper', such as a teacher or fellow pupil, provides support to a learner in acquiring new knowledge (Hariana 2021). The zone of proximal development is the space between what a learner already knows or can do (the actual level of development) and what the child will be able to master when provided with support from a knowledgeable peer or teacher (potential development) (Adam 2017). This is relevant to the study because in the Montessori classroom, learning takes place through social interactions among peers. A teacher or more knowledgeable peer guides learners to master a particular task.

The Technological Pedagogical Content Knowledge model

According to the TPACK model, teachers must have more than only a knowledge of their content area and a separate understanding of pedagogy; they must also be aware of how pedagogy can be implemented to support the teaching and learning of specific content knowledge (Ammade et al. 2020; Jones 2017). According to the model, teachers use technology most effectively when they can simultaneously consider the content, pedagogy, as well as functions and uses of various technologies (Ammade et al. 2020; Jones 2017). This theory is relevant to the study as the teachers' knowledge of pedagogical content and technology may influence their willingness to integrate technology in the classroom.

Research methodology and the selection of participants

This was a case study of four Montessori preschools in Tshwane and Gauteng (see Table 1). The researchers used a convenience sampling due to the school's location and limited resources; however, with one school in Mamelodi, snowball sampling was used, as a referral was made to visit a township school. After providing the principals and teachers at the school with consent letters, the researchers received permission from three preschools to participate in the study. At one of the preschools, the researchers were referred to School 4, a Montessori school in the township area of Mamelodi. Permission was granted by the school principal in Mamelodi to conduct the study at her school. Hence, four Montessori preschools formed part of the study, with 10 teachers in total. The method of data collection consisted of one focus group discussion, semi-structured interviews and classroom observations. At Sunshine preschool, the researchers conducted a focus group discussion with the preschool teachers, a semi-structured interview with the principal, and teaching methods used for literacy development were observed. However, the researchers only conducted semi-structured interviews at Panda Bear and Greenhill preschools, while at Lesedi preschool, an individual interview with the school principal and observations were conducted. Due to the unavailability of the other teachers and time constraints, focus group discussions could not be conducted. The researchers opined that the data obtained through individual interviews and observation was sufficient.

The focus group discussions and interviews were audio recorded and transcribed. The researchers also ensured the anonymity of the participating schools and teachers, as pseudonyms were used.

Data analysis

Data was analysed through thematic content analysis; the themes for the study were derived from the interview questions used during the semi-structured interviews and the discussion of the focus group (Aung 2021). After developing the main themes, subthemes also emerged under each theme as participants gave a wide range of responses. Interview recordings were transcribed verbatim, and transcriptions were then divided into three columns: in the

TABLE 1: Data collection methods for the study.

Name of preschool	Number of teachers	Method of data collection
Sunshine	5	Focus group discussion Semi-structured interview Observation
Panda Bear	2	Semi-structured interview
Green Hill	2	Semi-structured interview
Lesedi	1	Semi-structured interview Observation

third column, a label was assigned to a text that was significant to a relevant theme (Aung 2021). To ensure methodological rigour, credibility, transferability, dependability, confirmability, and trustworthiness, criteria were applied during the study.

Ethical considerations

Ethical approval for the study was obtained from the Ethics Committee at the Faculty of Education, University of Pretoria on 31 March 2023 with ethical clearance number UP18/03/01. The purpose of the study was disclosed to the participants. Participation was voluntary, and participants had the right to withdraw from the research process at any time without consequences or explanations. The data collected was treated with utmost confidentiality. The identity of participants and the schools were not revealed to anyone outside the research team. Pseudonyms were used in data transcription in reporting to conceal their identity. The raw data are securely stored at the Centre for Evaluation and Assessment at the University of Pretoria.

Results

Theme 1: The use of technological methods

Sub-theme 1.1: Teachers' perceptions on the use of technological methods for literacy development

In recent years, technology in the classroom has been incorporated into teaching and learning. However, views of teachers regarding the use of technology in the classroom differ, especially in Montessori preschools. Most teachers expressed that they do not support the incorporation of digitised methods into teaching and learning in their schools, especially in preschool, as this stage is critical for learners to develop sensory skills. The following feedback shows the views of some teachers:

> 'No, I am absolutely no, no to digitalisation at the moment. Because for me, um, for me, children need to work with their hands, touch, feel, hear, and you know everything that has to do with the senses.' (Linda, teacher, Sunshine preschool)

> 'I feel that technology should come in later, not at preschool level. Sensorial basis doesn't come through technology. Sensorial basis comes through touching, hearing, looking, but a lot of it is movement, and that you don't get with technology' (Marinda, teacher, Sunshine preschool)

Another participant agreed with Linda and added how technology creates learning difficulties in young children:

> 'If you look at children now, do you see a massive growth in ADHD, dyslexia and all of that? That's technology. That's what's happening. They're not learning how to play anymore.' (Laura, teacher, Panda Bear preschool)

Further agreement is evident with adding that the use of digital devices causes learners to not develop sensorial skills resulting in consulting an occupational therapist:

> 'Most children will end up in occupational therapy.' (Rose, teacher, Sunshine preschool)

> 'Montessori as a pedagogy as a whole would be slow to take up technology. Montessori is a space where children can move around freely and can physically manipulate their environment. You cannot physically manipulate what is on screen.' (Sarah, teacher, Green Hill preschool)

However, one participant had a distinct perspective and said:

> 'We use YouTube all the time. And then I use PowerPoint. And then, of course, we use the music, so we do use it. I mean, it's here. You can't run away from it. It's there. It's useful. I don't find anything wrong with it. But we don't give the children tablets.' (Boipelo, teacher, Lesedi preschool)

When learning about mammals, for example, Boipelo uses images in a PowerPoint presentation or a YouTube video.

At *Sunshine*, the researchers observed that the teachers were reluctant to implement technology in their teaching and learning, as they believed it would hinder the process of sensory development in the children. Children learn through their senses with everyday objects around them, and introducing technology would diminish the experience of hands-on learning. *Lesedi* had incorporated technology in the form of a Bluetooth speaker, which the teacher used for playing music at the beginning of the lesson.

Sub-theme 1.2: Technological methods teachers use in the Montessori classrooms for literacy development

The use of technology for literacy development is widely evident in teaching (Haleem et al. 2022). Digital methods of instruction include high-tech and low-tech options. High-tech options require a laptop or mobile device with Internet connectivity for teaching (Manire et al. 2023). Low-tech options come in the form of think-pair-share discussions, kinaesthetic learning, and expeditionary learning (Manire et al. 2023). Only one of the participating teachers in the study thought that the use of technology was unavoidable.

Teachers at *Sunshine* expressed that they prefer to use natural objects that children can see, feel and touch with their hands to instruct children. The school also expressed that they do not think of apparatus like scissors as low-tech but would rather classify them as materials they make use of. Therefore, *Sunshine* uses non-digitised methods to teach in their classrooms:

> 'That's what I'm showing you with the geography materials. But even there, we want it to be hands-on. Not just seeing what a lake is or an island but actually managing to pour water in and see where the water goes if it's a lake and where it will go if it's an island.' (Linda, teacher, Sunshine preschool)

Figure 2 illustrates natural objects that teachers use for vocabulary and sensory development. Here, the learner can see and feel the object and hear the sound of the first letter it starts with. For example, with scissors, the learner can see what a pair of scissors looks like and that the word *scissors* starts with an 's' sound.

Teachers at *Panda Bear* agreed with those from *Sunshine*, where there is a belief that digitised methods are not complementary to the Montessori paradigm. This is evident in the statement:

> 'We believe that they need to learn through work and play. So, it's more important than sitting on a computer and watching something, where they can rather learn through their senses and stuff like that.' (Laura, teacher, Panda Bear preschool)

> 'We will not bring technology into the school in the sense of replacing books with an iPad. It's not something that's pro-Montessori. We do have to change with the times. We just see that they learn more from being physically able to manipulate things.' (Sarah, teacher, Green Hill preschool)

Only one teacher mentioned that digital methods were incorporated in their everyday lessons. These digital methods included PowerPoint, television and YouTube as add-ons for lessons:

> 'I use it almost every week. We've got the knowledge and understanding area where you do it in CAPS, they call it themes. So, in Montessori, actually, you need to print those. Sometimes I don't have a colour printer, or I run out of ink, so what I do is I make PowerPoints. And then there is the TV. And then sometimes what is also nice is adding on to a lesson, we use YouTube.' (Boipelo, teacher, Lesedi preschool)

From observation, high-tech digitised methods were not used in the teaching and learning of the children at *Sunshine*.

Source: Original photo taken as part of the data collection by author, S.A.

FIGURE 2: Learners using objects in a box for vocabulary development at Sunshine preschool.

The teachers use everyday objects and materials purchased to teach children reading and writing. The children use low-tech methods in their learning, such as scissors. The teaching environment focuses on each child's development, and the teacher interacts with the child at their current level of development in terms of learning. Children also learn language development, such as the pronunciation of words, word recognition, and spelling words through play. The teachers engage in the facilitation of the learning process through play by guiding the children. When spelling and pronouncing, for example the word 'CAT', the teacher would ask what sound the word 'CAT' starts with, and the children would pronounce the 'C' as a phonic and continue to use the letters and try to spell the word, as seen in Figure 3.

At *Lesedi*, the teacher played a song on a Bluetooth speaker, and as soon as the song was played, the learners knew they had to line up to enter the classroom. The younger learners, aged two to three years, were separated from the older learners, aged four to six years. As the song played, the learners and teachers moved around in a circle. This took place at the beginning of each lesson to create a calm atmosphere before the lesson commenced.

Theme 2: Montessori methods for literacy development

Sub-theme 2.1: Methods used for reading

The Montessori approach teaches learners shapes of letters and associates those shapes with particular sounds. The participating teachers indicated that this is done in the Montessori way, which emphasises learner engagement, collaborative play, and vocabulary development. Each participating school also adheres to the Montessori method of teaching by reading the Pink, Blue, and Green series. One participant stated that it is important to make the material engaging:

Source: Original photo taken as part of the data collection by author, S.A.

FIGURE 3: Teacher and learners during a phonics activity at Sunshine preschool.

'It's all about concrete art. And we do it for the three of us. So, it's like we make it interesting, we make it engaging.' (Rose, teacher, Sunshine preschool)

The importance of vocabulary development in language learning was also highlighted:

'I think language is everywhere. You know, that is, we have a certain section for that, but whatever we do, whatever we say is part of our language development plan. We talk to the children, we chat, we engage them, we ask.' (Linda, teacher, Sunshine preschool)

'When they go through that sensitive period, the brain works like a sponge. So, yeah, that's why you've got the phonetic alphabet. So, when they go through that sensitive period, you will teach them the phonetic alphabet, and then you'll start reading.' (Laura, teacher, Panda Bear preschool)

From discussions it is evident that the Montessori paradigm starts with sounds, and as the teachers move through the Pink, Blue, and Green series to teach learners phonics, they guide them on how to read fluently. This is supported by the statements:

'There are different levels, and the material is colour-coded, and this is Montessori-specific.' (Sarah, teacher, Green Hill preschool)

'[*W*]e try to speak proper English all the time because if you don't speak properly, that's what they're going to hear. That's what they're going to imitate. So, we do lots of what we call the "I Spy Game".' (Boipelo, teacher, Lesedi preschool)

Lesedi preschool is in a township area, and unlike at the other three schools, English is not the learners' home language. Thus, teachers face additional challenges due to language when teaching phonics:

'My problem is because I have to start with the children, you know, at the other schools, their home language is already English.' (Boipelo, teacher, Lesedi preschool)

Sub-theme 2.2: Methods used for individualised learning

Individualised learning is the practice of allowing children to learn at their own pace and according to their preferred mode of learning. Each child has a specific learning need and progresses at a pace different from their peers. Montessori schools recognise this and adapt methods to follow the individual development of the child; this creates a sense of autonomy in the learner.

Discussions revealed that the Montessori system focuses on hands-on learning:

'So, I think the whole Montessori system is geared to hands-on learning, you know, and following the development of the child. So, [*I am*] not saying everybody in this class is three years old, therefore, they should all be doing letters.' (Linda, teacher, Sunshine preschool)

Furthermore, learners start to read at different ages and develop various interests:

'You don't put all of them together because some children will start reading at three and some children will learn at six. It depends on the child. You follow the child in their individual world.' (Laura, teacher, Panda Bear preschool)

'We don't really tell them what to do. Like you'll see if they're ready for something, then you follow them. If they're ready to do puzzles, that's when you go and do puzzles with them. If they can maybe start counting like one up to ten, that's when you see that maybe they're ready for maths.' (Tembi, teacher, Panda Bear preschool)

At *Green Hill*, learners are grouped according to age and then asked to work in pairs or groups on certain activities; then they are given individualised assistance according to their level of understanding.

Discussions at Lesedi revealed that one cannot just give a learner a worksheet and expect them to complete it on their own; they need to physically see and feel the object about which one is talking. The Curriculum Assessment Policy Statements (CAPS curriculum) is assessment-driven, and it was felt that learners need to make use of their tactile senses when learning:

'[*P*]resenting hot stuff and cold stuff, the child has gotta feel what you're talking about. Bring a hot water bottle or something. Bring some ice and let them feel the difference. This is hot. And this is cold.' (Boipelo, teacher, Lesedi preschool)

What the researchers observed at *Sunshine* was individualised teaching of the learners, with the teacher's guidance as well as peer learning. With individual learning, learners choose the activity and complete tasks on their own with minimal supervision. The activities that the learners chose included using their senses, such as pressing a peg, using scissors to cut paper, and smelling the scent of liquids to identify the smell. Figure 4 shows the teacher assisting the learner to arrange the pegs around a small basket; this is used for sensory development.

Source: Original photo taken as part of the data collection by author, S.A.

FIGURE 4: Teacher and learner at Sunshine preschool engaged with sensory development.

Theme 3: Montessori methods that can be adapted in resource-constrained contexts

Sub-theme 3.1: Methods and materials that teachers can adapt to township contexts

South Africa, a developing country, has communities with limited resources. Participating teachers at all four schools agreed that the Montessori methods can be applied to township contexts, even if resources are constrained. They gave practical ideas for adapting methods. This sub-theme presents some methods and materials that can be adapted by the teachers in township contexts or resource-constrained communities.

One example was to cut out materials, like pictures, to teach learners. Figure 5 shows the cut-out images of planets and their names, which can be adapted for any learning context:

> 'You know, Montessori herself started without any materials. She had to look after a group of children in a slum area. So, when she realised that children were interested in the sounds, she started cutting letters out of newspapers.' (Marinda, teacher, Sunshine preschool)

Sunshine also has a garden where learners planted vegetables and herbs. By doing this, learners experience the rewards of fresh produce and gain a first-hand connection with nature, by physically touching the soil and tasting the herbs, they planted themselves.

When it comes to the adaptation of the Montessori methods, the following were voiced:

> 'That's what it is about Montessori that's so lovely. A lot of the things you can make yourself, all the reading equipment, like the blocks and things, or sound things.' (Laura, teacher, Panda Bear)

Source: Original photo taken during data collection by author, S.A.

FIGURE 5: School display that illustrates the labelling of planets in the solar system at Sunshine preschool.

> 'But everything that's on the shelf, you can actually make yourself. So, it makes in terms of the use, very accessible. You just need to understand, basically, the system of how we teach it.' (Sarah, teacher, Panda Bear preschool)

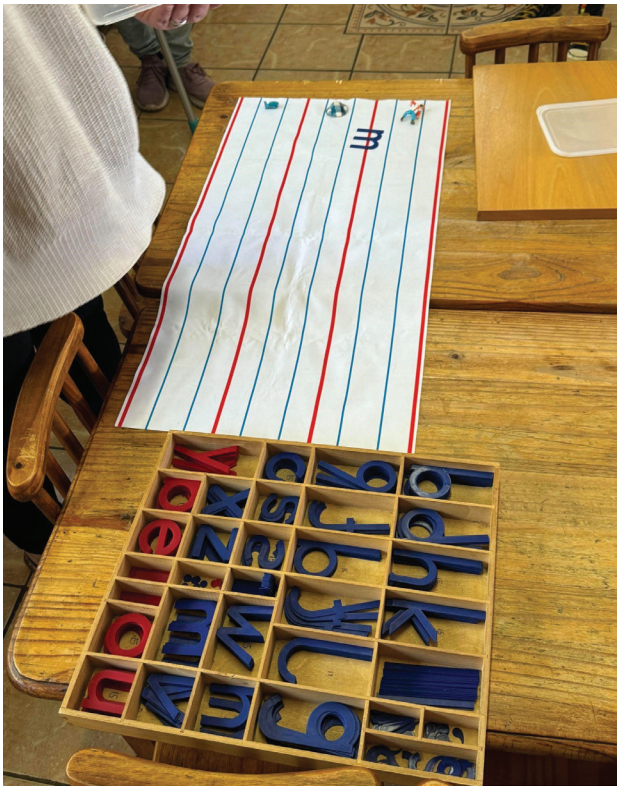
> 'I'm pretty sure that you could have these made or use cards.' (Sarah, teacher, Green Hill preschool)

As Sarah said, the lines on the mat can be drawn easily by using a black marker, and the letters can be cut out. This exercise is used to show learners the letter positioning, and the letters for the movable alphabet must be cut out, so that learners can recognise the shape of the letters.

Some advise for teachers in township contexts is to make use of the Department of Basic Education (DBE) books, from which one can cut out pictures or words for vocabulary development. One can also make use of self-adhesive rolls to preserve the items:

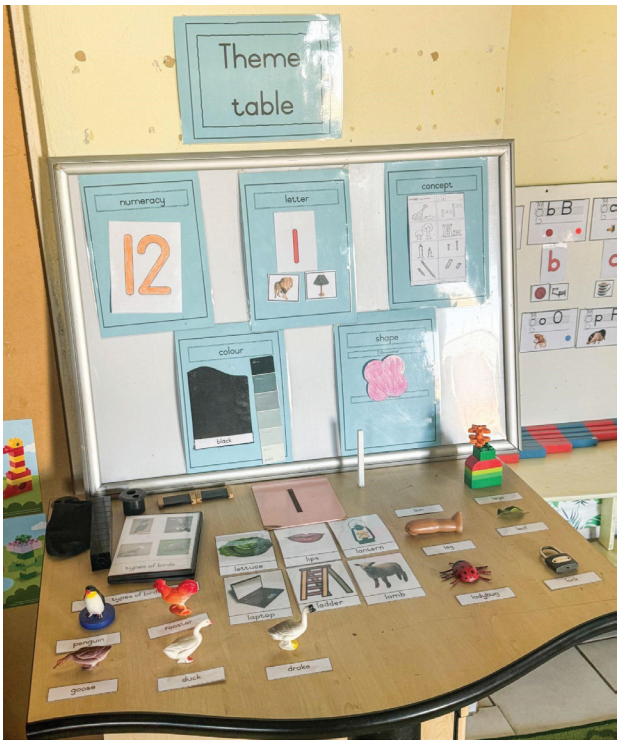
> 'They can just use those books that you get from the Department of Education. Yeah. Those books are quite fun if you take some of them, and they're colourful. Before we had a printer, I used to use some of those pictures from there. And instead of printing, I would just get those books and then cut out the pictures and then use those.' (Boipelo, teacher, Lesedi preschool)

Figure 6 and Figure 7 are examples of the themes; numeracy, letters, shapes, and concepts. This material can easily be accessed from the DBE books and laminated. Another suggestion was that sandpaper letters can be handmade with materials that are easily accessible, like sand and glue.



Source: Original photo taken as part of the data collection by author, S.A.

FIGURE 6: Moveable alphabet at Green Hill preschool.



Source: Original photo taken as part of the data collection by author, S.A.

FIGURE 7: Themes chart at Lesedi preschool.

Figure 8 shows how a teacher guides the learners through a numeracy exercise. The teacher physically showed learners how many scissors she had, and when three were taken away, learners had to count together how many were left. The same was done with blocks, stars, and markers. The teacher also used cutouts to teach learners the 'greater than' and 'less than' signs. The teacher used materials they had on hand, which can be adapted to township contexts.

Discussion

This study aimed to examine the perceptions of preschool teachers regarding the use of technology for literacy development through a technology-supported play-based Montessori approach. Despite the growing interest in literacy, development in South Africa has been relatively unexplored. This may be due to the small number of Montessori schools in the country.

The findings of this study indicate that most of the Montessori preschool teachers who participated in the study, believed that literacy development does not have to be dependent on technology. Literacy can be effectively developed by using the Montessori approach, which is play-based and aligned with the developmental stage of young learners. This result has been consistently detected in the literature, due to the valid concern that the 'purity' of the approach might be compromised through the integration of technology (Jones 2017). Moreover, the TPACK model was used within the study to conceptualise 'technology integration'. According to this model, the integration of technology is not merely about its isolated use as a tool but about leveraging it to enhance

Source: Photo taken during data collection by author, S.A.

FIGURE 8: Numeracy lesson at Lesedi preschool.

the learning experiences. Hence, the TPACK model was the lens through which we explored teachers' perceptions and beliefs on the integration of technology in Montessori schools to promote reading literacy and language development. The concerns of teachers regarding the integration of technology may be due to the limited research on technology-supported, play-based activities (American Montessori Society 2016). Therefore, the scarcity of empirical based evidence internationally and in South Africa may explain the slow receptiveness of digitised technology for literacy development in Montessori schools. According to the TPACK model, if teachers are not equipped with the knowledge and practical know-how to integrate technology with the Montessori approach for literacy development, they will be apprehensive about its use. It has also been argued in the literature that Maria Montessori embraced non-digitised technology prevalent in her time and utilised it to promote learning (Park & Murray 2023).

The results of the study are limited to preschools, which further explains the apparent rejection of the integration of technology. Montessori theory indicates that there are 'sensitive periods' in the development of learners – these periods are windows of opportunity for learning. According to this theory, preschool learners learn best through their senses. In this regard, the teachers in this study questioned the possibility of achieving sensorial development and social interaction through digitised technology and were thus opposed to it. However, the principal at a township Montessori school was more open to incorporating technology by means of YouTube videos. The reason might be that the school is in a resource-constrained environment where learners might not have the opportunity to see certain concrete objects, plants, and animals, or visit specific places like the zoo. In this regard, the teacher should incorporate technology to make up for the limited resources. The teacher also utilised YouTube and a Bluetooth speaker to engage the

learners in an activity before starting the numeracy lesson. This finding suggests that teachers should be more open to technology-supported play-based activities when they are knowledgeable about how they can be effectively incorporated without negating the Montessori approach.

The learning environment for reading literacy development in all the schools was structured to promote the key principles of the Montessori theory. Non-digitised methods and the use of concrete objects to promote reading literacy and language development were prevalent in the schools. The study further revealed that the Montessori approach to teaching and learning incorporates multiple classes and educates learners of different ages together. Individualised learning is also preferred, with the teacher as the facilitator (Capobianco 2021). These findings are in line with social constructivism, namely that learners actively play a role in the construction of their knowledge through social interactions, play, and experiences within their immediate environment (MacDonald 2016).

The Montessori principals and teachers in the study are proud to be Montessorians, and they recount several testimonies to the benefits of the approach to reading literacy and language development. Such benefits include aligning the engagement with the learners' developmental phase, which leads to an increased motivation to engage in literacy activities. The teachers believed they had found the key to effective learning. The teacher's perception was that their preschool learners were able to attain an elevated level of reading literacy proficiency and language development before proceeding to Grade 1. Notably, the approach was not as structured, and the content was not delivered as suggested by most Foundation Phase curricula. In addition, the teachers believed that CAPS curriculum promotes an undue reliance on worksheets and assessments, which do not effectively align with the child's development; hence the struggle to attain consistently positive academic results. It is therefore not surprising that all Montessori schools in South Africa are privately owned. This article indicates the urgency for the DBE and other stakeholders to give more attention to the Montessori approach as a viable approach with benefits already proven.

In the South African context, the reason for the small number of available Montessori schools could be a result of private ownership and the high fees charged, as there are currently no government-owned Montessori schools. The teachers in urban schools stated that most of the materials used in the classroom for literacy development are quite expensive to buy; however, they can be locally sourced and made. This practice was further observed in Lesedi School, where the teachers used locally manufactured and sourced materials for teaching and learning. Ene and Ngozi (2019) confirmed that the teaching and learning materials used in Montessori classrooms for literacy range from easily accessible and affordable ones, such as chalkboards, pictures, flashcards, counters, and worksheets, to more complicated and expensive materials.

However, the methodology used in this study presented some limitations. A qualitative methodology was used to gather data from four Montessori preschools. Although this methodology enabled the researchers to gather rich and in-depth data that can provide empirical evidence regarding the effectiveness of the Montessori-based approach in the 21st century, the findings cannot be generalised to all Montessori schools in South Africa, due to the small sample size. In addition, the study was limited to preschool teachers as the authors were unable to gain access to Montessori primary schools.

Conclusion

The findings of this study revealed that most of the teachers who participated in the research supported the development of literacy through play-based methods rather than technology-integrated methods. Montessori believed that learners must be given opportunities in the learning process to use their senses (American Montessori Society 2016). Most Montessori teachers believe that incorporating technology may conflict with the Montessori approach to reading literacy and language development, which may be due to the scarcity of research, particularly in the South African context, on effective ways to incorporate technology. However, the findings suggest that one of the teachers is open to embracing the use of technology to enhance literacy development. The findings of this study may stimulate Montessori teachers to reflect critically on their perceptions and practices in the use of digitised technology in their classrooms, for literacy development based on empirical evidence. This may provide a pathway to empower teachers on the use of digital technologies that are consistent with the Montessori approach.

Research studies on this issue in the Montessori community in South Africa are almost non-existent. Further research is necessary to ascertain the potential alignment of technology use with the Montessori approach. It is recommended that future research should examine this issue in primary and secondary Montessori schools, as the perceptions and use of technology may vary with the developmental stage of the learner. In addition, mixed-method studies are needed to better comprehend the possible benefits and drawbacks of integrating technology in Montessori schools for reading literacy and language development in South Africa. Furthermore, a longitudinal study could be conducted to assess the reading literacy and language development of learners who have attended Montessori preschools.

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Authors' contributions

M.F.O, S.P.S and E.I. contributed to the conceptualisation of the study. M.F.O, S.A, S.P.S and E.I. contributed to the methodology and conceptual framework. S.A., E.I. and S.P.S. wrote the original draft of the article. Additionally, S.A., S.P.S. and E.I. contributed to the collection and analysis of the data. S.A. and S.P.S. contributed to the introduction, literature review and findings. E.I. contributed to the discussion. M.F.O. reviewed, edited and supervised the article.

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Data availability

The data supporting the findings of this study are available at the Centre for Evaluation and Assessment on reasonable request from the corresponding author, M.F.O.

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